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U.S. DEPARTMENT OF COMMERCE
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PREFACE

Under the 1994 amendments to the Marine Mammal Protection Act (MMPA), the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) are required to publish Stock Assessment Reports for all stocks of marine mammals within U.S. waters, to review new information every year for strategic stocks and every three years for non-strategic stocks, and to update the stock assessment reports when significant new information becomes available.

Pacific region stock assessments include those studied by the Southwest Fisheries Science Center (SWFSC, La Jolla, CA), the Pacific Islands Fisheries Science Center (PIFSC, Honolulu, HI), the National Marine Mammal Laboratory (NMML, Seattle, WA), and the Northwest Fisheries Science Center (NWFSC, Seattle, WA). The 2016 Pacific marine mammal stock assessments include revised reports for 23 Pacific marine mammal stocks under NMFS jurisdiction, including eight “strategic” stocks: Hawaiian monk seal, Guadalupe fur seal, Southern Resident killer whale, California/Oregon/Washington humpback whale, California/Oregon/Washington fin whale, Eastern North Pacific sei whale, Main Hawaiian Islands Insular false killer whale, and Hawaii Pelagic false killer whale. New abundance estimates are available for 16 U.S. west coast stocks: Guadalupe fur seal, Washington Inland Waters harbor porpoise, California/Oregon/Washington stocks of Dall’s porpoise, Pacific white-sided dolphin, Risso’s dolphin, coastal and offshore stocks of common bottlenose dolphin, striped dolphin, short- and long-beaked common dolphin, northern right whale dolphin, short-finned pilot whale, pygmy sperm whale, fin whale, Eastern North Pacific sei whale and Southern Resident killer whales. New information on fishery-related serious injury and mortality has been updated for those stocks where possible. Updated estimates of stock abundance are also available for the Hawaiian monk seal.

New abundance estimates for several species along the U.S. west coast are considerably higher than previous estimates (Barlow 2016). This is attributed to two factors: 1) estimates of the trackline detection probability, *g(0)* are lower than in previous surveys, because new Beaufort sea state-specific estimates of *g(0)* have been calculated that better reflect differing probabilities of detection with increasing wind and swell (Barlow 2015); and 2) warm-temperate species such as short-beaked common dolphin, long-beaked common dolphin, and striped dolphin were encountered more frequently during a 2014 line-transect survey compared to previous years, due to anomalous warm-water conditions in the California Current (Barlow 2016, Cavole *et al*. 2016).

Human-caused mortality and injury documentation is often based on stranding data, where raw counts are negatively-biased because only a fraction of carcasses are detected (Williams *et al*. 2011), even for extremely coastal species (Wells *et al*. 2015). Carretta *et al*. (2016a) estimated that only 25% of California coastal bottlenose dolphin carcasses are recovered / documented, and given the extremely coastal habits of the population, Carretta *et al*. (2016a) argue that carcass recovery rates for this population represent a maximum rate, compared to more pelagic dolphin and porpoise species in the region. Therefore, for U.S. west coast stock assessment reports involving dolphins and porpoises, human-related deaths and injuries counted from mainland beach strandings are multiplied by a factor of 4 to account for the non-detection of most carcasses. Species / stocks for which the stranding correction factor has been applied include: California coastal bottlenose dolphin, Washington Inland waters harbor porpoise, Risso’s dolphin, striped dolphin, and short-beaked and long-beaked common dolphin. This carcass recovery correction factor has not been applied to large whale serious injuries and mortalities, because the method of detection for most large whale entanglement and vessel strike cases are opportunistic offshore sightings, and it is currently unknown what fraction of injured or dead large whales are detected at sea or ashore.

New estimates of human-caused mortality and serious injury are included for U.S. west coast stocks that interact with the California swordfish drift gillnet fishery (Carretta *et al*. 2016b). Estimates are model-based and are based on inclusion of 25 years of bycatch data, in contrast to previous ratio estimates of bycatch that relied on within-year data only (Carretta *et al*. 2014). The main effects of implementing model-based bycatch estimation are that resulting estimates are less volatile inter-annually, have better precision, and are less prone to biases associated with rare bycatch events and low observer coverage (Carretta and Moore 2014). Model-based estimates also result in positive estimates of bycatch even in years when no bycatch of a particular species is recorded by fishery observers.

This is a working document and individual stock assessment reports will be updated as new information on marine mammal stocks and fisheries becomes available. Background information and guidelines for preparing stock assessment reports are reviewed in Wade and Angliss (1997). The authors solicit any new information or comments which would improve future stock assessment reports.

Draft versions of the 2016 stock assessment reports were reviewed by the Pacific Scientific Review Group at the February 2016 meeting.

These Stock Assessment Reports summarize information from a wide range of original data sources and an extensive bibliography of all sources is given in each report. We recommend users of this

document refer to and cite *original* literature sources cited within the stock assessment reports rather than citing this report or previous Stock Assessment Reports.

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PINNIPEDS

CETACEANS - U.S. WEST COAST

CETACEANS – HAWAII & WESTERN PACIFIC

APPENDICES

Revised 6/30/2015

CALIFORNIA SEA LION (*Zalophus californianus*): U.S. Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The breeding areas of the California sea lion are on islands located in southern California, western Baja California, and the Gulf of California (Figure 1). Mitochondrial DNA analysis identified five genetically distinct geographic populations: (1) Pacific Temperate, (2) Pacific Subtropical, (3) Southern Gulf of California, (4) Central Gulf of California and (5) Northern Gulf of California (Schramm *et al*. 2009). In that study, the Pacific Temperate population included rookeries within U.S. waters and the Coronados Islands just south of U.S./Mexico border. Animals from the Pacific Temperate population range into Canadian waters, and movement of animals between U.S. waters and Baja California waters occurs. Males from western Baja California rookeries may spend most of the year in the United States.

There are no international agreements between the U.S., Mexico, and Canada for joint management of California sea lions, and the number of sea lions at the Coronado Islands is not regularly monitored. Consequently, this stock assessment report considers only the U.S. Stock, i.e. sea lions at rookeries within the U.S. Pup production at the Coronado Islands is minimal (between 12 and 82 pups annually; Lowry and Maravilla-Chavez 2005) and does not represent a significant contribution to the overall size of the Pacific Temperate population.

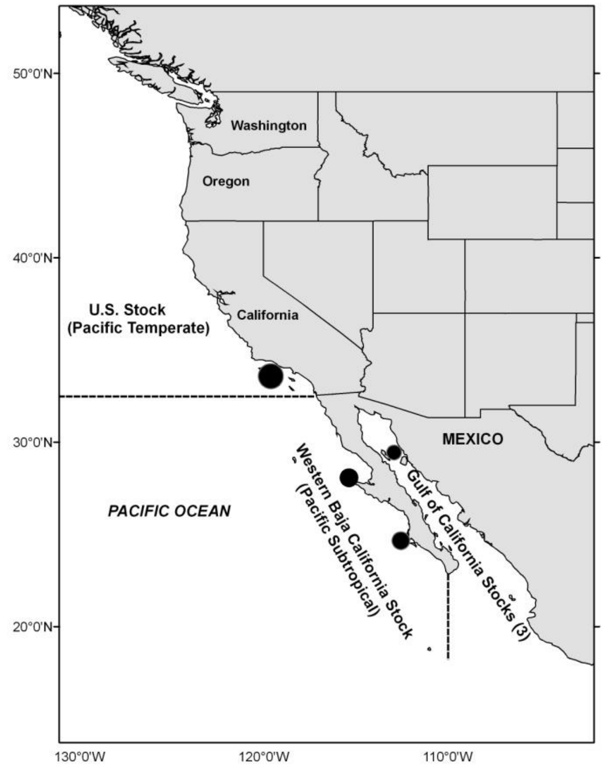

Figure 1. Geographic range of California sea lions showing stock boundaries and locations of major rookeries. The U.S. stock also ranges north into Canadian waters.

POPULATION SIZE

The entire population cannot be counted because all age and sex classes are not ashore at the same time. In lieu of counting all sea lions, pups are counted during the breeding season (because this is the only age class that is ashore in its entirety), and the number of births is estimated from the pup count. Population size is then estimated from the number of births and the proportion of pups in the population. Surveys are conducted in July after all pups have been born. To estimate the number of pups born, the pup count for rookeries in southern California in 2008 (59,774) was adjusted for an estimated 15% pre-census mortality (Boveng 1988; Lowry *et al*. 1992), giving an estimated 68,740 live births in the population. The fraction of newborn pups in the population (23.2%) was estimated from a life table derived for the northern fur seal (*Callorhinus ursinus*) (Boveng 1988, Lowry *et al*. 1992) which was modified to account for the growth rate of this California sea lion population (5.4% yr^{-1}, see below). Multiplying the number of pups born by the inverse of this fraction (4.317) results in a population estimate of 296,750. More recent pup counts made in 2011 totaled 61,943 animals, the highest recorded to date (Figure 2). Estimates of total population size based on these counts are currently being developed, along with new estimates of the fraction of newborn pups in the population.

Minimum Population Estimate

The minimum population size was determined from counts of all age and sex classes that were ashore at all the major rookeries and haulout sites in southern and central California during the 2007 breeding season. The minimum population size of the U.S. stock is 153,337 (NMFS unpubl. data). It includes all California sea lions counted during the July 2007 census at the Channel Islands in southern California and at haulout sites located between Point Conception and Point Reyes, California. An additional unknown number of California sea lions are at sea or hauled out at locations that were not surveyed.

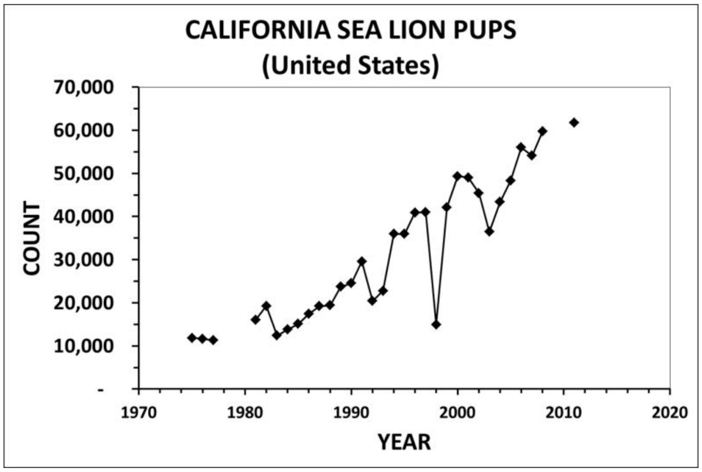

Figure 2. U.S. pup count index for California sea lions (1975-2011). Trends in pup counts from 1975 through 2011 are shown for four rookeries in southern California and for haulouts in central and northern California.

Current Population Trend

Trends in pup counts from 1975 through 2011 are shown in Figure 2 for four rookeries in southern California and for haulouts in central and northern California. The number of pups at rookeries that were not counted were estimated using multiple regression analyses derived from counts of two neighboring rookeries using data from 1975-2000 (Lowry and Maravilla 2005): (1) 1980 at Santa Barbara Is.; (2) 1978-1980 at San Clemente Is.; and (3) 1978 and 1979 at San Nicolas Is. The mean was used when more than one count was available for a given rookery. A regression of the natural logarithm of the pup counts by year indicates that pup counts increased at an annual rate of 5.4% between 1975 and 2008, when pup counts for El Niño years (1983, 1984, 1992, 1993, 1998, and 2003) were removed from the 1975-2005 time series. Using 1975-2008 non-El Niño year data, the coefficient of variation for this average annual growth rate (CV=0.04) was computed via bootstrap sampling of the count data. The 1975-2008 time series of pup counts shows the effect of four El Niño events on the sea lion population (Figure 2). Pup production decreased by 35% in 1983, 27% in 1992, 64% in 1998, and 20% in 2003. After the 1992-93, 1997-98 and 2003 El Niños, pup production rebounded to pre-El Niño levels within two years. In contrast, however, the 1983-1984 El Niño affected adult female survivorship (DeLong *et al.* 1991), which prevented an immediate rebound in pup production because there were fewer adult females available in the population to produce pups (it took five years for pup production to return to the 1982 level). Other characteristics of El Niños are higher pup and juvenile mortality rates (DeLong *et al.* 1991, Lowry and Maravilla-Chavez, 2005) which affect future recruitment into the adult population for the affected cohorts. The 2002 and 2003 decline can be attributed to (1) reduced number of reproductive adult females being incorporated into the population as a result of the 1992-93 and 1997-98 El Niños, (2) domoic acid poisoning (Scholin *et al.* 2000, Lefebvre *et al.* 2000), (3) lower survivorship of pups due to hookworm infestations (Lyons *et al.* 2001), and (4) the 2003 El Niño. Large numbers of emaciated sea lion pups stranded in early 2013 in California and pup weight indices at the San Miguel Island rookery were significantly lower in 2012 compared with previous years (Wells *et al.* 2013). As a result of the large numbers of sea lion strandings in 2013, NOAA declared an unusual mortality event (UME)[1]. Although the exact causes of this UME are unknown, two hypotheses meriting further study include nutritional stress of pups resulting from a lack of forage fish available to lactating mothers and unknown disease agents during that time period.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

We use the default maximum net productivity rate for pinnipeds (12% per year) (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (153,337) times one half the default maximum net growth rate for pinnipeds (½ of 12%) times a recovery factor of

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[1] http://www.nmfs.noaa.gov/pr/health/mmume/californiasealions2013.htm

1.0 (for a stock of unknown status that is growing, Wade and Angliss 1997); resulting in a PBR of 9,200 sea lions per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Serious Injury Guidelines

NMFS uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to distinguish serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*".

Historical Depletion

Historic exploitation of California sea lions include harvest for food by native Californians in the Channel Islands 4,000-5,000 years ago (Stewart *et al.* 1993) and for oil and hides in the mid-1800s (Scammon 1874). More recent exploitation of sea lions for pet food, target practice, bounty, trimmings, hides, reduction of fishery depredation, and sport are reviewed in Helling (1984), Cass (1985), Seagers *et al.* (1985), and Howorth (1993). There are few historical records to document the effects of such exploitation on sea lion abundance (Lowry *et al.* 1992).

Fisheries Information

California sea lions are killed in a variety of trawl, purse seine, and gillnet fisheries along the U.S. west coast (Barlow *et al.* 1994, Carretta and Barlow 2011, Carretta *et al.* 2013, Julian and Beeson 1998, Jannot *et al.* 2011, Stewart and Yochem 1987). Those for which recent observations or estimates of bycatch mortality exist are summarized in Table 1. In addition to bycatch estimates from fishery observer programs, information on fishery-related sea lion deaths and serious injuries comes largely from stranding data (Carretta *et al.* 2013). Stranding data represent a minimum number of animals killed or injured, as many entanglements are likely unreported or undetected.

California sea lions are also incidentally killed and injured by hooks from recreational and commercial fisheries. Sea lion deaths due to hook-and-line fisheries are often the result of complications resulting from ingestion of hooks, perforation of body cavities leading to infections, or the inability of the animal to feed. Many of the animals die post-stranding during rehabilitation or are euthanized as a result of their injuries. Between 2008 and 2012, there were 124 California sea lion deaths / serious injuries attributed to hook and line fisheries, or an annual average of 25 animals (Carretta *et al.* 2014b). One sea lion death was reported in a tribal salmon gillnet in 2009 along the U.S. west coast.

Table 1. Summary of available information on the mortality and serious injury of California sea lions in commercial fisheries that might take this species (Carretta *et al.* 2014a. 2009, 2010, 2012a, 2012b; Heery *et al.* 2010; Jannot *et al.* 2011; Appendix 1). Mean annual takes are based on 2008-2012 data unless noted otherwise.

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed Mortality	Estimated Mortality (CV in parentheses)	Mean Annual Takes (CV in parentheses)
CA/OR thresher shark/swordfish large mesh drift gillnet fishery	2008 2009 2010 2011 2012	observer	13.5% 13.3% 11.9% 19.5% 18.6%	7 5 0 18 6	51 (0.52) 37 (0.83) 0 (n/a) 92 (0.79) 32 (0.60)	42 (0.50)
CA halibut and white seabass set gillnet fishery	2008 2009 2010 2011 2012	observer	0% 0% 12.5% 8.0% 5.5%	n/a n/a 25 6 18	n/a n/a 199 (0.30) 74 (0.39) 326 (0.33)	200 (0.21)
CA small-mesh drift gillnet fishery for white seabass, yellowtail, barracuda, and tuna	2010 2011 2012	observer	0.7% 3.3% 4.6%	0 0 0	0 (n/a) 0 (n/a) 0 (n/a)	0 (n/a)
CA anchovy, mackerel, sardine, and tuna purse- seine fishery	2004-2008	observer	~5%	2	n/a	≥2 (n/a)

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed Mortality	Estimated Mortality (CV in parentheses)	Mean Annual Takes (CV in parentheses)
WA, OR, CA domestic groundfish trawl fishery (includes at-sea hake and other limited-entry groundfish sectors)	2005 2006 2007 2008 2009	observer	98% to 100% of tows in at-sea hake fishery Generally less than 30% of landings observed in other groundfish sectors	14 21 8 7 4	21 (n/a) 95 (n/a) 31 (n/a) 13 (n/a) 10 (n/a)	34 (n/a)
Unknown entangling net fishery	2008-2012	stranding	n/a		n/a	≥ 53 (n/a)
Unknown trawl fishery and bait barge net entanglement	2008-2012	stranding	n/a	2		≥ 2 (n/a)
Minimum total annual takes						≥ 331 (0.14)

Other Mortality

Live strandings and dead beach-cast California sea lions are regularly observed with gunshot wounds in California (Lowry and Folk 1987, Goldstein *et al.* 1999, Carretta *et al.* 2013). A summary of stranding records for 2008 to 2012 from California, Oregon, and Washington shows the following non-fishery related human-caused mortality and serious injuries: boat collisions (13), car collisions (3), entrainment in power plants (59), shootings (151), marine debris entanglement or ingestion (37), research-related (18), and other sources, including dog attacks, harassment, seal bombs, stabbings, and, blunt force trauma (10). Stranding records are a gross under-estimate of mortality and serious injury because many animals and carcasses are never recovered. The minimum number of non-fishery related deaths and serious injuries during 2008-2012 was 291 sea lions, or an annual average of 58 animals.

Under authorization of MMPA Section 120, individually identifiable California sea lions have been killed or relocated since 2008 in response to their predation on endangered salmon and steelhead stocks in the Columbia River. Relocated animals were transferred to aquaria and/or zoos. Between 2009 and 2013, a total of 47 California sea lions were removed from this stock (40 lethal removals and 7 relocations to aquaria and/or zoos). The average annual mortality due to direct removals for the 2009-2013 period is 9.4 animals per year (relocations to aquaria/zoos are treated the same as mortality because animals are effectively removed from the stock).

Between 2008 and 2012, 18 California sea lions were incidentally killed, 2 seriously injured, and 8 non-serious injuries along the U.S. west coast during scientific trawl and longline operations conducted by NMFS (Carretta *et al.*, 2014b). The average annual research-related mortality and serious injury of California sea lions from 2008 to 2012 is 4.0 animals.

Habitat Concerns

Sea lion mortality linked to the algal-produced neurotoxin domoic acid has been documented sporadically since 1998 (Scholin *et al.* 2000, Brodie *et al.* 2006, Ramsdell and Zabka 2008). Future mortality may be expected to occur, due to the repeated occurrence of such harmful algal blooms.

Exposure to anthropogenic sound may impact individual sea lions. Experimental exposure of captive California sea lions to simulated mid-frequency sonar (Houser *et al.* 2013) and acoustic pingers (Bowles and Anderson 2012) resulted in a wide variety of behavioral responses, including increases in respiration, refusal to participate in tasks involving food rewards, evasive hauling out, and prolonged submergence. Despite exposure to sources of anthropogenic sound in the wild, the California sea lion population continues to grow.

Expanding pinniped populations in general have resulted in increased human-caused serious injury and mortality, due to shootings, entrainment in power plants, interactions with recreational hook and line fisheries, separation of mothers and pups due to human disturbance, dog bites, and vessel and vehicle strikes (Carretta et al. 2014b).

STATUS OF STOCK

California sea lions in the U.S. are not listed as "endangered" or "threatened" under the Endangered Species Act or as "depleted" under the MMPA. The optimum sustainable population (OSP) status of this population has not been formally determined. The average annual commercial fishery mortality is 331 animals per year (Table 1). Other sources of human-caused mortality (shootings, direct removals, recreational hook and line fisheries, tribal takes, entrainment in power plant intakes, etc.) average 58 animals per year. Total human-caused mortality of this stock is at least 389 animals per year. California sea lions are not considered "strategic" under the MMPA because total human-caused mortality is less than the PBR (9,200). The total fishery mortality and serious injury rate (389 animals/year) for this stock is less than 10% of the calculated PBR and, therefore, is considered to be insignificant and approaching a zero mortality and serious injury rate.

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HARBOR SEAL (*Phoca vitulina richardii*): California Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

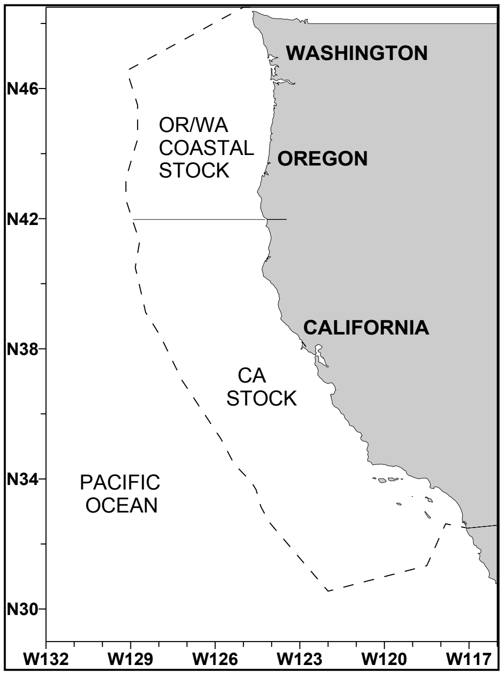

Figure 1. Stock boundaries for the California and Oregon/Washington coastal stocks of harbor seals. Dashed line represents the U.S. EEZ.

Harbor seals (*Phoca vitulina*) are widely distributed in the North Atlantic and North Pacific. Two subspecies exist in the Pacific: *P. v. stejnegeri* in the western North Pacific, near Japan, and *P. v. richardii* in the eastern North Pacific. The latter subspecies inhabits coastal and estuarine areas from Mexico to Alaska. These seals do not make extensive pelagic migrations, but do travel 300-500 km to find food or suitable breeding areas (Herder 1986; Harvey and Goley 2011). In California, approximately 400-600 harbor seal haulout sites are widely distributed along the mainland and on offshore islands, including intertidal sandbars, rocky shores and beaches (Hanan 1996; Lowry *et al.* 2008).

Within the subspecies *P. v. richardii*, abundant evidence of geographic structure comes from differences in mitochondrial DNA (Huber *et al.* 1994, 2010, 2012; Burg 1996; Lamont *et al.* 1996; Westlake and O'Corry-Crowe 2002; O'Corry-Crowe *et al.* 2003), mean pupping dates (Temte 1986), pollutant loads (Calambokidis *et al.* 1985), pelage coloration (Kelly 1981) and movement patterns (Jeffries 1985; Brown 1988). LaMont *et al.* (1996) identified four discrete subpopulation differences in mtDNA between harbor seals from Washington (two locations), Oregon, and California. Another mtDNA study (Burg 1996) supported the existence of three separate groups of harbor seals between Vancouver Island and southeastern Alaska. Three genetically distinct populations of harbor seals within Washington inland waters are also evident, based on work by Huber *et al.* (2010, 2012). Although geographic structure exists along an almost continuous distribution of harbor seals from California to Alaska, stock boundaries are difficult to draw because any rigid line is arbitrary from a biological perspective. Nonetheless, failure to recognize geographic structure in defining management stocks can lead to depletion of local populations. Previous assessments of the status of harbor seals have recognized three stocks along the west coast of the continental U.S.: 1) California, 2) Oregon and Washington outer coast waters, and 3) inland waters of Washington. Although the need for stock boundaries for management is real and is supported by biological information, the exact placement of a boundary between California and Oregon was largely a political/jurisdictional convenience. An unknown number of harbor seals also occur along the west coast of Baja California, at least as far south as Isla Asuncion, which is about 100 miles south of Punta Eugenia. Animals along Baja California are not considered to be a part of the California stock because it is not known if there is any demographically significant movement of harbor seals between California and Mexico and there is no international agreement for joint management of harbor seals. Lacking any new information on which to base a revised boundary, the harbor seals of California are treated as a separate stock in this report (Fig. 1). Other Marine Mammal Protection Act (MMPA) stock assessment reports cover the other stocks that are recognized along the U.S. west coast: 1) Southern Puget Sound (south of the Tacoma Narrows Bridge); 2) Washington Northern Inland Waters (including Puget Sound north of the Tacoma Narrows Bridge, the San Juan Islands, and the Strait of Juan de Fuca); 3) Hood Canal; and 4) Oregon/Washington Coast.

POPULATION SIZE

A complete count of all harbor seals in California is impossible because not all animals are hauled out simultaneously. A complete pup count (as is done for other pinnipeds in California) is also not possible because harbor seal pups enter the water almost immediately after birth. Population size is estimated by counting the number of seals ashore during the peak haul-out period (May to July) and by multiplying this count by a correction factor equal to the inverse of the estimated fraction of seals on land. Harvey and Goley (2011) calculated a correction factor of 1.54 (CV=0.157), based on 180 radio-tagged seals in California. This correction factor is based on the mean of four date-specific correction factors (1.31, 1.38, 1.62, 1.84) calculated for central and northern California. Based on the most recent harbor seal counts during May-July of 2012 (20,109 animals) (NMFS unpublished data) and the Harvey and Goley (2011) correction factor, the harbor seal population in California in 2012 is estimated to number 30,968 seals (CV=0.157).

Minimum Population Estimate

The minimum population size is estimated from the number of hauled out seals counted in 2012 (20,109), multiplied by the lower 20th percentile of the correction factor (1.36), or 27,348 seals.

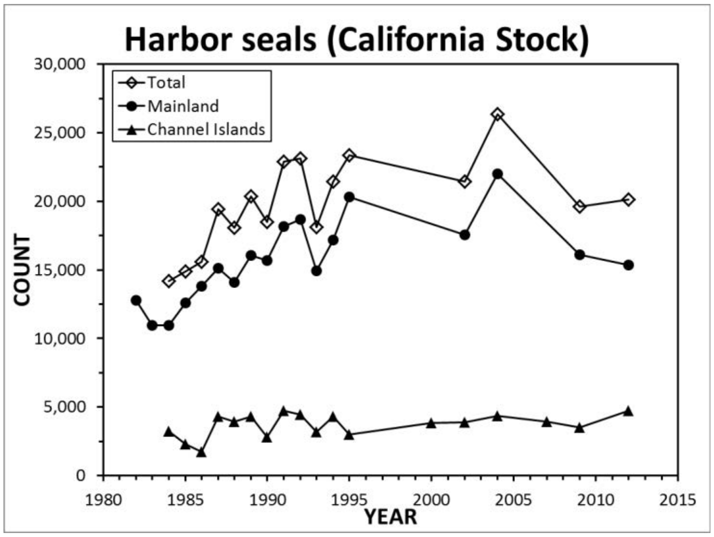

Figure 2. Harbor seal haulout counts in California during May to July (Hanan 1996; R. Read, CDFG unpubl. data; Lowry *et al.* 2008, NMFS unpubl. data from 2009-2012 surveys).

Current Population Trend

Counts of harbor seals in California increased from 1981 to 2004 when the statewide maximum count was recorded. Subsequent surveys conducted in 2009 and 2012 have been lower than the 2004 maximum count (Fig. 2).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Historically, the largest known source of human-caused mortality of California harbor seals was the California halibut set gillnet fishery (Julian and Beeson 1998), where estimates of bycatch mortality were approximately 1-2% of the estimated population size between 1990 and 1995. Since 1996, that fishery been observed infrequently and at low observer coverage levels, though fishing effort levels have declined. Any estimate of current net productivity level should account for human-caused mortality, otherwise estimated net productivity will be negatively-biased. At this time, there are insufficient data on bycatch (only 3 of the last 5 years have observations from the fishery, with low observer coverage) and uncertainty regarding the degree of negative biases for other sources of human-caused mortality to reliably estimate the current net productivity level. An assessment of *maximum net productivity levels* is not possible, because abundance estimates were not available when the population was very small and presumably recovering from past exploitation (Bonnot 1928).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (27,348) times one half the default maximum net productivity rate for pinnipeds (½ of 12%) times a recovery factor of 1.0 (for a stock of unknown status that is growing or for a stock at OSP, Wade and Angliss 1997), resulting in a PBR of 1,641 animals per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Serious Injury Guidelines

NMFS uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to distinguish serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*".

Historical Takes

Prior to state and federal protection and especially during the nineteenth century, harbor seals along the west coast of North America were greatly reduced by commercial hunting (Bonnot 1928, 1951; Bartholomew and Boolootian 1960). Only a few hundred individuals survived in a few isolated areas along the California coast (Bonnot 1928). In the last half of the last century, the population increased dramatically.

Fishery Information

A summary of known commercial fishery mortality and serious injury for this stock of harbor seals for the period 2008-2012 is given in Table 1. Historically, the set gillnet fishery for halibut and white seabass was the largest source of fishery mortality and remains the most likely fishery in California to interact with harbor seals. Julian and Beeson (1998) reported a range of annual mortality estimates from 227 to 1,204 seals (mean = 584) from 1990 to 1994, based on 5% to 15% fishery observer coverage and representing between 1-2% of the estimated population size. This fishery has been observed infreqently since 1995 and fishing effort has declined from approximately 5,000 trips in the early 1990s to 1,300 trips in 2012 (Carretta *et al*. 2014a.).

Table 1. Summary of available information on the mortality and serious injury of harbor seals (California stock) in commercial fisheries that might take this species (Carretta and Enriquez 2006, 2009, Carretta *et al*. 2014a; Heery *et al*. 2010); n/a indicates that data are not available. Mean annual takes are based on 2008-2012 data unless noted otherwise.

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed Mortality	Estimated Mortality (CV in parentheses)	Mean Annual Takes (CV in parentheses)
CA halibut and white seabass set gillnet fishery	2008	observer	0%	0	n/a	23 (0.59)
	2009		0%	0	n/a	
	2010		12.5%	3	23 (0.59)	
	2011		8.0%	0	n/a	
	2012		5.5%	0	n/a	
CA small-mesh drift gillnet fishery for white seabass, yellowtail, barracuda, and tuna	2010	observer	0.7%	0	0 (n/a)	0 (n/a)
	2011		3.3%	0	0 (n/a)	
	2012		4.6%	0	0 (n/a)	
WA, OR, CA groundfish trawl (includes at-sea hake and other limited-entry groundfish sectors)	2005	observer	99% to 100% of tows in at-sea hake fishery; 18%-26% of landings in other groundfish sectors	1	1 (n/a)	6.4 (n/a)
	2006			1	1 (n/a)	
	2007			0	0 (n/a)	
	2008			4	29 (n/a)	
	2009			1	1 (n/a)	
Unknown net fisheries	2008-2012	stranding	n/a	5	n/a	≥ 1.0
Total annual takes						30 (0.59)

Other Mortality

NMFS stranding records for California for the period 2008-2012 include the following human-caused mortality and serious injury not included in Table 1: shootings (1), ship/vessel strikes (3), entrainment in power plants (40), hook and line fisheries (6), human-induced abandonment of pups or harassment (9), marine debris entanglement (2), stabbing/gaff wounds (2), and research-related deaths (1) (Carretta *et al*. 2014b.). The total non-fishery related mortality and serious injury for the period totals 64 harbor seals, or an annual average of 12.8 seals.

STATUS OF STOCK

A review of harbor seal dynamics through 1991 concluded that their status relative to OSP could not be determined with certainty (Hanan 1996). California harbor seals are not listed as "endangered" or "threatened" under the Endangered Species Act nor designated as "depleted" under the MMPA. Annual human-caused mortality from commercial fisheries (30/yr) and other human-caused sources (12.8/yr) is 42.8 animals, which is less than the calculated PBR for this stock (1,641), and thus they are <u>not</u> considered a "strategic" stock under the MMPA. The average annual rate of incidental commercial fishery mortality (30 animals) is less than 10% of the calculated PBR (1,641 animals); therefore, fishery mortality is considered insignificant and approaching zero mortality and serious injury rate. The population size has increased since the 1980s when statewide censuses were first conducted. The highest population counts occurred in 2004 and subsequent counts in 2009 and 2012 have been lower. Expanding pinniped populations in general have resulted in increased human-caused serious injury and mortality, due to shootings, entrainment in power plants, interactions with recreational hook and line fisheries, separation of mothers and pups due to human disturbance, dog bites, and vessel and vehicle strikes (Carretta et al. 2014b). All west-coast harbor seals that have been tested for morbilliviruses were found to be seronegative, indicating that this disease is not endemic in the population and that this population is extremely susceptible to an epidemic of this disease (Ham-Lammé *et al*. 1999).

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HARBOR SEAL (*Phoca vitulina richardii*): Oregon/Washington Coast Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Harbor seals inhabit coastal and estuarine waters off Baja California, north along the western coasts of the continental U.S., British Columbia, and Southeast Alaska, west through the Gulf of Alaska and Aleutian Islands, and in the Bering Sea north to Cape Newenham and the Pribilof Islands. They haul out on rocks, reefs, beaches, and drifting glacial ice and feed in marine, estuarine, and occasionally fresh waters. Harbor seals generally are non-migratory, with local movements associated with tides, weather, season, food availability, and reproduction (Scheffer and Slipp 1944; Fisher 1952; Bigg 1969, 1981). Harbor seals do not make extensive pelagic migrations, though some long distance movement of tagged animals in Alaska (900 km) and along the U.S. west coast (up to 550 km) have been recorded (Brown and Mate 1983, Herder 1986, Womble 2012). Harbor seals have also displayed strong fidelity to haulout sites (Pitcher and Calkins 1979, Pitcher and McAllister 1981).

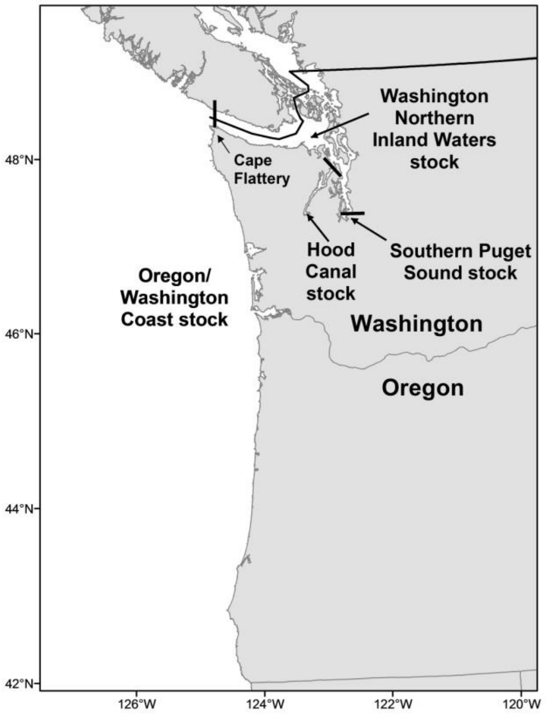

Figure 1. Harbor seal stocks in the U.S. Pacific Northwest

Until recently, differences in mean pupping date (Temte 1986), movement patterns (Jeffries 1985, Brown 1988), pollutant loads (Calambokidis et al. 1985), and fishery interactions led to the recognition of three separate harbor seal stocks along the west coast of the continental U.S. (Boveng 1988): 1) inland waters of Washington State (including Hood Canal, Puget Sound, and the Strait of Juan de Fuca out to Cape Flattery), 2) outer coast of Oregon and Washington, and 3) California Recent genetic evidence suggests that the population of harbor seals in Washington inland waters has more structure than was previously recognized. Studies of pupping phenology, mitochondrial DNA, and microsatellite variation of harbor seals in Washington and Canada-U.S. transboundary waters confirm the currently recognized stock boundary between the Washington Coast and Washington Inland Waters harbor seal stocks, but three genetically distinct populations of harbor seals within Washington inland waters are also evident (Huber et al. 2010, 2012). Within U.S. west coast waters, five stocks of harbor seals are recognized: 1) Southern Puget Sound (south of the Tacoma Narrows Bridge); 2) Washington Northern Inland Waters (including Puget Sound north of the Tacoma Narrows Bridge, the San Juan Islands, and the Strait of Juan de Fuca); 3) Hood Canal; 4) Oregon/Washington Coast; and 5) California. This report considers only the Oregon/Washington Coast stock. Stock assessment reports for California harbor seals and harbor seals in Washington inland waters (including the Southern Puget Sound, Washington Northern Inland Waters, and Hood Canal stocks) also appear in this volume. Harbor seal stocks that occur in the inland and coastal waters of Alaska are discussed separately in the Alaska Stock Assessment Reports. Harbor seals occurring in British Columbia are not included in any of the U.S. Marine Mammal Protection Act (MMPA) stock assessment reports.

POPULATION SIZE

Aerial surveys of harbor seals in Oregon and Washington were conducted by personnel from the National Marine Mammal Laboratory (NMML) and the Oregon and Washington Departments of Fish and Wildlife (ODFW and WDFW) during the 1999 pupping season. Total numbers of hauled-out seals (including pups) were counted during these surveys. In 1999, the mean count of harbor seals occurring along the Washington coast was 10,430 (CV=0.14) animals (Jeffries et al. 2003). In 1999, the mean count of harbor seals occurring along the Oregon coast and in the Columbia River was 5,735 (CV=0.14) animals (Brown 1997; ODFW, unpublished data). Combining these counts results in 16,165 (CV=0.10) harbor seals in the Oregon/Washington Coast stock.

Radio-tagging studies conducted at six locations (three Washington inland waters sites and three Oregon and Washington coastal sites) collected information on haulout patterns from 63 harbor seals in 1991 and 61 harbor seals in 1992. Haulout data from coastal and inland sites were not significantly different and were thus pooled, resulting in a correction factor of 1.53 (CV=0.065) to account for animals in the water which are missed during the aerial surveys (Huber et al. 2001). Using this correction factor results in a population estimate of 24,732 (16,165 x 1.53; CV=0.12) for the Oregon/Washington Coast stock of harbor seals in 1999 (Jeffries et al. 2003; ODFW, unpublished data). However, because the most recent abundance estimate is >8 years old, there is no current estimate of abundance available for this stock.

Minimum Population Estimate

No current information on abundance is available to obtain a minimum population estimate for the Oregon/Washington Coast stock of harbor seals.

Current Population Trend

Historical levels of harbor seal abundance in Oregon and Washington are unknown. The population apparently decreased during the 1940s and 1950s due to state-financed bounty programs. Approximately 17,133 harbor seals were killed in Washington by bounty hunters between 1943 and 1960 (Newby 1973). More than 3,800 harbor seals were killed in Oregon between 1925 and 1972 by bounty hunters and a state-hired seal hunter (Pearson 1968). The population remained relatively low during the 1960s but, since the termination of the harbor seal bounty program and with the protection provided by the passage of the MMPA in 1972, harbor seal counts for this stock have increased from 6,389 in 1977 to 16,165 in 1999 (Jeffries et al. 2003; ODFW, unpublished data). Based on the analyses of Jeffries et al. (2003) and Brown et al. (2005), both the Washington and Oregon portions of this stock were reported as reaching carrying capacity (Fig. 2). In the absence of recent abundance estimates, the current population trend is unknown.

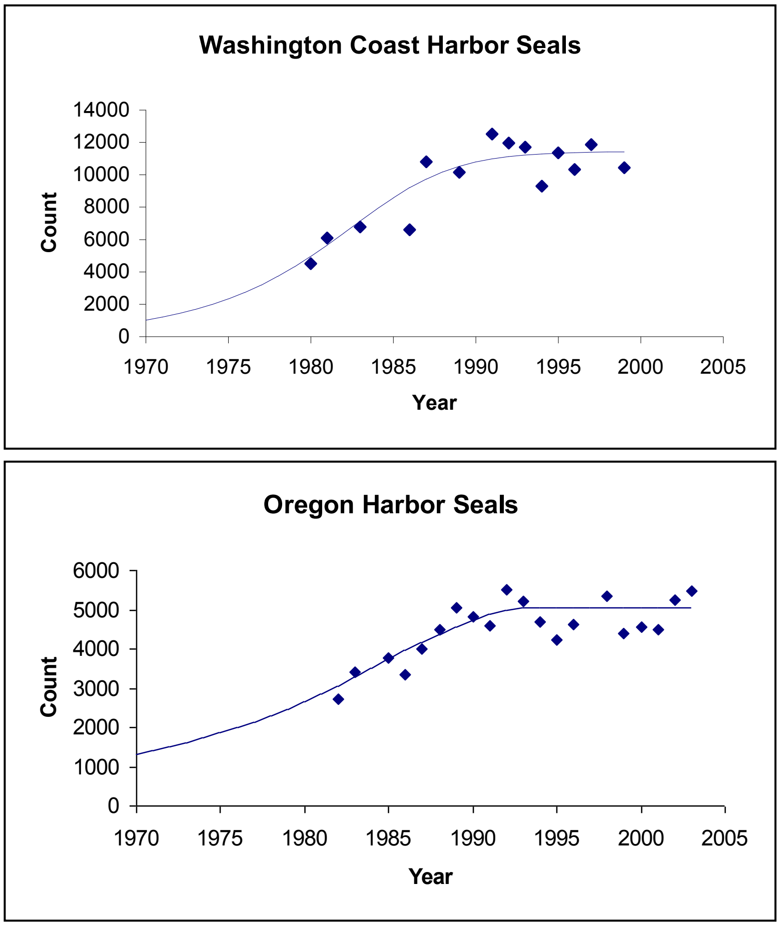

Figure 2. Generalized logistic growth curves of Washington Coast (Jeffries et al. 2003) and Oregon (Brown et al. 2005) harbor seals.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The Oregon/Washington Coast harbor seal stock increased at an annual rate of 7% from 1983 to 1992 and at 4% from 1983 to 1996 (Jeffries et al. 1997). Because the population was not at a very low level by 1983, the observed rates of increase may underestimate the maximum net productivity rate (R_{MAX}). When a logistic model was fit to the Washington portion of the 1975-1999 abundance data, the resulting estimate of R_{MAX} was 18.5% (95% CI = 12.9-26.8%) (Jeffries et al. 2003). When a logistic model was fit to the Oregon portion of the 1977-2003 abundance data, estimates of R_{MAX} ranged from 6.4% (95% CI = 4.6-27%) for the south coast of Oregon to 10.1% (95% CI = 8.6-20%) for the north coast (Brown et al. 2005). Until a combined analysis for the entire stock is completed, the pinniped default maximum theoretical net productivity rate (R_{MAX}) of 12% will be used for this harbor seal stock (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

Because there is no current estimate of minimum abundance, a potential biological removal (PBR) cannot be calculated for this stock.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen *et al*. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*". Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fisheries Information

Fishing effort in the northern Washington marine gillnet tribal fishery is conducted within the range of the Oregon/Washington Coast and Washington Northern Inland Waters stocks of harbor seals. Movement of animals between Washington's coastal and inland waters is likely, although tagging data do not show movement of harbor seals between the two locations (Huber et al. 2001). For the purposes of this report, animals taken in waters south and west of Cape Flattery, WA, are assumed to belong to the Oregon/Washington Coast stock and Table 1 includes data only from that portion of the fishery. Fishing effort in the coastal marine set gillnet tribal fishery has declined since 2004. A test set gillnet fishery, with 100% observer coverage, was conducted in coastal waters in 2008 and 2010. This test fishery required the use of nets equipped with acoustic alarms, and observers reported one harbor seal death in 2008 and three in 2010 (Makah Fisheries Management, unpublished data). The mean annual mortality for the marine set gillnet tribal fishery in 2007-2011 is 0.8 (CV=0) harbor seals from observer data.

The U.S. West Coast groundfish fishery was monitored for incidental takes in 2005-2009 (Jannot et al. 2011). Harbor seal deaths were observed in the groundfish trawl fishery (Pacific hake at-sea processing component) in 2005, 2006, and 2008; the nearshore fixed gear fishery in 2006 and 2008; and the non-nearshore fixed gear (limited entry non-primary sablefish) fishery in 2009. The mean annual mortality for each of these fisheries in 2005-2009 is 1.0 (CV=0.24) harbor seals for the groundfish trawl fishery, 5.6 (CV=0.68) for the nearshore fixed gear fishery, and 0.2 for the non-nearshore fixed gear fishery.

Table 1. Summary of available information on the incidental mortality and serious injury of harbor seals (Oregon/Washington Coast stock) in commercial and tribal fisheries that might take this species and calculation of the mean annual mortality rate; n/a indicates that data are not available. Mean annual takes are based on 2007-2011 data unless otherwise noted.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean annual takes (CV in parentheses)
Northern WA marine set gillnet (tribal test fishery in coastal waters)	2007	observer data	no fishery	0	0 (0)	0.8 (0)
	2008		100%	1	1 (0)	
	2009		no fishery	0	0 (0)	
	2010		100%	3	3 (0)	
	2011		no fishery	0	0 (0)	
West Coast groundfish trawl (Pacific hake at-sea processing component)	2005	observer data	67%[1]	1	1 (0.52)	1.0 (0.24)
	2006		83%[1]	1	1 (0.42)	
	2007		73%[1]	0	0	
	2008		76%[1]	2	3 (0.34)	
	2009		79%[1]	0	0	
West Coast groundfish nearshore fixed gear	2005	observer data	5%[2]	0	0	5.6 (0.68)
	2006		11%[2]	1	n/a[3]	
	2007		9%[2]	0	0	
	2008		7%[2]	2	27 (0.68)	
	2009		4%[2]	0	0	

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean annual takes (CV in parentheses)
West Coast groundfish non-nearshore fixed gear (limited entry non-primary sablefish)	2009	observer data	n/a	1	n/a[3]	>0.2 (n/a)
WA Grays Harbor salmon drift gillnet[2]	1991-1993	observer data	4-5%	0, 1, 1	0, 10, 10	see text[24]
WA Willapa Bay drift gillnet[2]	1991-1993	observer data	1-3%	0, 0, 0	0, 0, 0	see text[24]
WA Willapa Bay drift gillnet[2]	1990-1993	fisherman self-reports	n/a	0, 0, 6, 8	n/a	see text[24]
Unknown West Coast fisheries	2007-2011	stranding data	n/a	0, 0, 0, 0, 3	n/a	>0.6 (n/a)
Minimum total annual takes						>8.2 (0.52)

[1] Percent hauls observed for marine mammals.

[2] Percent observed landings of target species.

[3] Bycatch estimate not provided due to high CV (>80%) for estimate; minimum bycatch of one observed harbor seal is included in the calculation of mean annual take.

[4] This fishery has not been observed since 1993 (see text); these data are not included in the calculation of recent minimum total annual takes.

Commercial salmon drift gillnet fisheries in Washington outer coast waters (Grays Harbor, Willapa Bay) were last observed in 1993 and 1994, with observer coverage levels typically less than 10% (Erstad et al. 1996, Pierce et al. 1994, Pierce et al. 1996, NWIFC 1995). Drift gillnet fishing effort in the outer coast waters has declined considerably since 1994 because fewer vessels participate today (NMFS NW Region, unpublished data), but entanglements of harbor seals likely continue to occur. The most recent data on harbor seal mortality from commercial and tribal gillnet fisheries is included in Table 1.

Combining recent estimates from commercial fisheries observer data for the West Coast groundfish trawl (1.0), West Coast groundfish nearshore fixed gear (5.6), and West Coast groundfish non-nearshore fixed gear (0.2) fisheries results in a mean annual mortality rate of 6.8 harbor seals from these fisheries. An additional 0.8 harbor seals per year were taken in the northern Washington marine set gillnet tribal fishery.

Strandings of harbor seals entangled in fishing gear or with serious injuries caused by interactions with gear are another source of fishery-related mortality. Based on stranding network data, there were three commercial fishery-related deaths of harbor seals from this stock reported in 2011 (listed as unknown West Coast fisheries in Table 1), resulting in a mean annual mortality of 0.6 harbor seals in 2007-2011. Fishery entanglements included two gillnet and one trawl net interaction. Hook and line gear is used by both commercial (salmon troll) and recreational fisheries in coastal waters. Two harbor seal deaths due to ingested hooks were reported in 2007-2011, resulting in an additional mean annual mortality of 0.4 seals from unknown hook and line fisheries. Estimates from stranding data are considered minimum estimates because not all stranded animals are found, reported, or examined for cause of death (via necropsy by trained personnel). An additional harbor seal that stranded with a serious hook injury in 2011 was treated and released with non-serious injuries (Carretta et al. 2013); therefore, it was not included in the mean annual mortality in this report.

Data on fisheries mortality reported in Table 1 likely represent minimum estimates, particularly for fisheries where observer coverage is low and bycatch events are too infrequent to be documented by fishery observers. The magnitude of negative bias in mortality estimates is unknown and methods to correct for such negative biases in these fisheries have not been developed.

Other Mortality

During 2007-2011, one harbor seal from this stock was incidentally killed during scientific halibut longline operations in 2011, resulting in a mean annual research-related mortality of 0.2 animals.

According to Northwest Marine Mammal Stranding Network records, maintained by the NMFS Northwest Region (NMFS, Northwest Regional Office, unpublished data), a total of nine human-caused harbor seal deaths were reported from non-fisheries sources in 2007-2011. Six animals were shot, two animals were struck by boats, and one animal was killed by a dog, resulting in a mean annual mortality of 1.8 harbor seals from this stock. This estimate is considered a minimum because not all stranded animals are found, reported, or examined for cause of death (via necropsy by trained personnel).

Subsistence Harvests by Northwest Treaty Indian Tribes

Tribal subsistence takes of this stock may occur, but no data on recent takes are available.

STATUS OF STOCK

Harbor seals are not considered to be “depleted” under the MMPA or listed as “threatened” or “endangered” under the ESA. Based on currently available data, the minimum level of human-caused mortality and serious injury is 10.6 harbor seals per year: (8.2 from fishery sources in Table 1, plus 0.4 from unknown hook and line fisheries, plus 0.2 scientific takes annually, plus 1.8 non-fishery causes annually). A PBR cannot be calculated for this stock because there is no current abundance estimate. Human-caused mortality relative to PBR is unknown, but it is considered to be small relative to the stock size. Therefore, the Oregon/Washington Coast stock of harbor seals is not classified as a “strategic” stock. The minimum annual commercial fishery mortality and serious injury for this stock, based on recent observer data (6.8) and stranding data (0.6) is 7.4. Since a PBR cannot be calculated for this stock, fishery mortality relative to PBR is unknown. The stock was previously reported to be within its Optimum Sustainable Population (OSP) range (Jeffries et al. 2003, Brown et al. 2005), but in the absence of recent abundance estimates, this stock’s status relative to OSP is unknown.

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Revised 7/15/2014

HARBOR SEAL (*Phoca vitulina richardii*): Washington Inland Waters Stocks: (Hood Canal, Southern Puget Sound, Washington Northern Inland Waters)

STOCK DEFINITION AND GEOGRAPHIC RANGE

Harbor seals inhabit coastal and estuarine waters off Baja California, north along the western coasts of the continental U.S., British Columbia, and Southeast Alaska, west through the Gulf of Alaska and Aleutian Islands, and in the Bering Sea north to Cape Newenham and the Pribilof Islands. They haul out on rocks, reefs, beaches, and drifting glacial ice and feed in marine, estuarine, and occasionally fresh waters. Harbor seals generally are non-migratory, with local movements associated with such factors as tides, weather, season, food availability, and reproduction (Scheffer and Slipp 1944; Fisher 1952; Bigg 1969, 1981). Harbor seals do not make extensive pelagic migrations, though some long distance movement of tagged animals in Alaska (900 km) and along the U.S. west coast (up to 550 km) have been recorded (Brown and Mate 1983, Herder 1986, Womble 2012). Harbor seals have also displayed strong fidelity for haulout sites (Pitcher and Calkins 1979, Pitcher and McAllister 1981).

Until recently, differences in mean pupping date (Temte 1986), movement patterns (Jeffries 1985, Brown 1988), pollutant loads (Calambokidis et al. 1985), and fishery interactions have led to the recognition of three separate harbor seal stocks along the west coast of the continental U.S. (Boveng 1988): 1) inland waters of Washington State (including Hood Canal, Puget Sound, and the Strait of Juan de Fuca out to Cape Flattery), 2) outer coast of Oregon and Washington, and 3) California Recent genetic evidence suggests that the population of harbor seals in Washington inland waters has more structure than is currently was previously recognized . Studies of pupping phenology, mitochondrial DNA, and microsatellite variation of harbor seals in Washington and Canada-U.S. transboundary waters confirm the currently recognized stock boundary between the Washington Coast and Washington Inland Waters harbor seal stocks, but three genetically distinct populations of harbor seals within Washington inland waters are also evident (Huber et al. 2010, 2012). Within U.S. west coast waters, five stocks of harbor seals are recognized: 1) Southern Puget Sound (south of the Tacoma Narrows Bridge); 2) Washington Northern Inland Waters (including Puget Sound north of the Tacoma Narrows Bridge, the San Juan Islands, and the Strait of Juan de Fuca); 3) Hood Canal; 4) Oregon/Washington Coast; and 5) California. This report includes only the stocks in Washington's inland waters. Stock assessment reports for Oregon/Washington Coast and California harbor seals also appear in this volume. Harbor seal stocks that occur in the inland and coastal waters of Alaska are discussed separately in the Alaska Stock Assessment Reports. Harbor seals occurring in British Columbia are not included in any of the U.S. Marine Mammal Protection Act (MMPA) stock assessment reports.

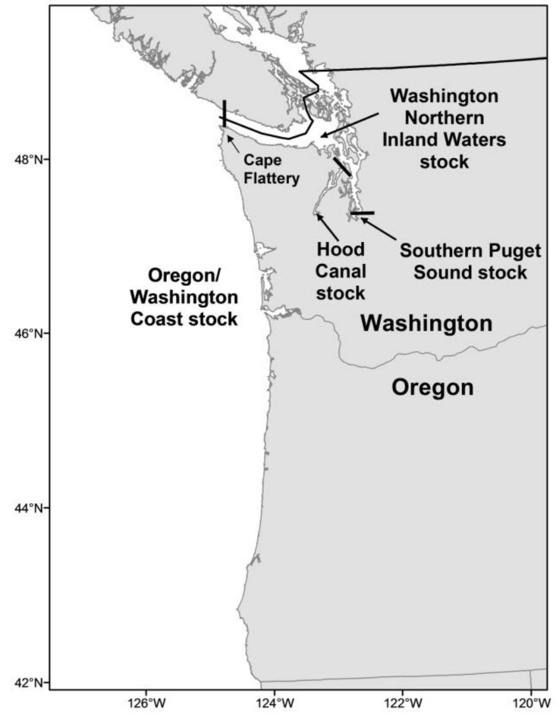

Figure 1. Approximate distribution of harbor seal stocks in the U.S. Pacific Northwest (shaded area). Stock boundaries separating the three stocks are shown.

POPULATION SIZE

Aerial surveys of harbor seals in Washington were conducted during the pupping season in 1999, during which time the total numbers of hauled-out seals (including pups) were counted. In 1999, the mean count of harbor seals occurring in Washington's inland waters was 7,213 (CV=0.14) in Washington Northern Inland Waters, 711 (CV=0.14) in Hood Canal, and 1,025 (CV=0.14) in Southern Puget Sound (Jeffries et al. 2003).

Radio-tagging studies conducted at six locations (three Washington inland waters sites and three Oregon and Washington coastal sites) collected information on haulout patterns from 63 harbor seals in 1991 and 61 harbor seals in 1992. Data from coastal and inland sites were not significantly different and were thus pooled, resulting in a correction factor of 1.53 (CV=0.065) to account for animals in the water which are missed during the aerial surveys (Huber et al. 2001). Using this correction factor results in a population estimates of 11,036 (7,213 x 1.53; CV=0.15) for the Washington Northern Inland Waters stock; 1,088 (711 x 1.53; CV=0.15) for the Hood Canal stock; and 1,568 (1,025 x 1.53; CV=0.15) for the Southern Puget Sound stock of harbor seals (Jeffries et al. 2003). However, because the most recent abundance estimates are >8 years old, there are no current estimates of abundance for these stocks. Surveys of harbor seals in Washington inland waters are planned for 2013.

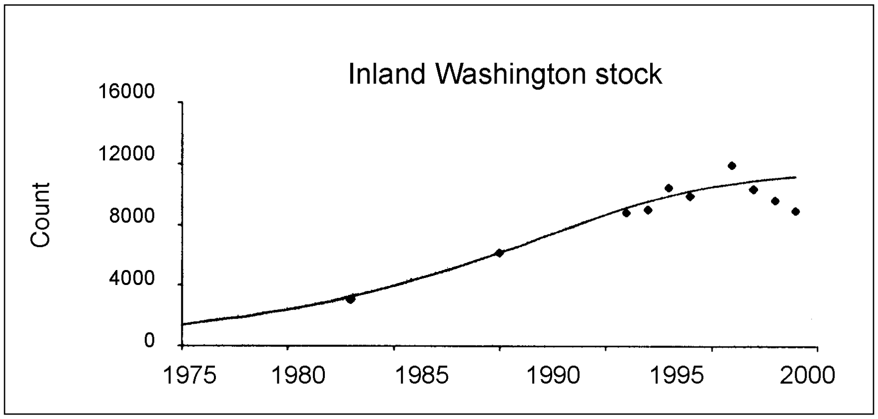

Figure 2. Generalized logistic population growth curve for the Washington Inland Waters stock of harbor seals, 1978-1999 (Jeffries et al. 2003).

Minimum Population Estimate

No current information on abundance is available to obtain a minimum population estimate for the Washington Inland Waters stock of harbor seals.

Current Population Trend

Historical levels of harbor seal abundance in Washington are unknown. The population apparently decreased during the 1940s and 1950s due to a state-financed bounty program. Approximately 17,133 harbor seals were killed in Washington by bounty hunters between 1943 and 1960 (Newby 1973). The population remained relatively low during the 1970s but, since the termination of the harbor seal bounty program in 1960 and with the passage of the Marine Mammal Protection Act (MMPA) in 1972, harbor seal numbers in Washington have increased (Jeffries 1985).

Between 1983 and 1996, the annual rate of increase for this stock was 6% (Jeffries et al. 1997). The peak count occurred in 1996 and, based on a fitted generalized logistic model (Fig. 2), the population is thought to be stable (Jeffries et al. 2003). In the absence of recent abundance estimates, the current population trend is unknown.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

From 1991 to 1996, counts of harbor seals in Washington State have increased at an annual rate of 10% (Jeffries et al. 1997). Because the population was not at a very low level by 1991, the observed rate of increase may underestimate the maximum net productivity rate (R_{MAX}). When a logistic model was fit to the 1978-1999 abundance data, the resulting estimate of R_{MAX} was 12.6% (95% CI = 9.4-18.7%) (Jeffries et al. 2003). This value of R_{MAX} is very close to the default pinniped maximum theoretical net productivity rate of 12% (R_{MAX}), therefore, 12% will be employed for this harbor seal stock (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

Because there is no current estimate of minimum abundance, a potential biological removal (PBR) cannot be calculated for this stock.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen *et al.* 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*". Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fisheries Information

Fishing effort in the northern Washington marine gillnet tribal fishery is conducted within the range of the Oregon/Washington Coast and Washington Northern Inland Waters stocks of harbor seals. Some movement of animals between Washington's coastal and inland waters is likely, although data from tagging studies have not shown movement of harbor seals between the two locations (Huber et al. 2001). For the purposes of this stock assessment report, the animals taken in waters east of Cape Flattery, WA, are assumed to have belonged to the Washington Northern Inland Waters stock, and Table 1 includes data only from that portion of the fishery. There was no observer coverage in the northern Washington marine set gillnet tribal fishery in inland waters in 2007-2011; however, there were two fishermen self-reports of harbor seal deaths in this fishery in 2008 and five in 2009 (Makah Fisheries Management, unpublished data). The mean annual mortality for this fishery in 2007-2011 is 1.4 harbor seals from self-reports. Fishing effort in the northern Washington marine drift gillnet tribal fishery in inland waters is also conducted within the range of the Washington Northern Inland Waters stock of harbor seals. This fishery is not observed; however, there was one self-report of a harbor seal death in 2008 (Makah Fisheries Management, unpublished data). The mean annual mortality for this fishery in 2007-2011 is 0.2 harbor seals from self-reports.

Commercial salmon drift gillnet fisheries in Washington inland waters were last observed in 1993 and 1994, with observer coverage levels typically less than 10% (Erstad et al. 1996, Pierce et al. 1994, Pierce et al. 1996, NWIFC 1995). Drift gillnet fishing effort in the inland waters has declined considerably since 1994 because far fewer vessels participate today (NMFS NW Region, unpublished data), but entanglements of harbor seals likely continue to occur. The most recent data on harbor seal mortality from commercial gillnet fisheries is included in Table 1.

Table 1. Summary of available information on the incidental mortality and serious injury of harbor seals (Washington Northern Inland Waters, Hood Canal, and Southern Puget Sound stocks) in commercial and tribal fisheries that might take this species and calculation of the mean annual mortality rate; n/a indicates that data are not available. Mean annual takes are based on 2007-2011 data unless noted otherwise.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean annual takes (CV in parentheses)
Northern WA marine set gillnet (tribal fishery in inland waters)	2008 2009	fisherman self-reports	-	2 5	n/a n/a	1.4 (n/a)
Northern WA marine drift gillnet (tribal fishery in inland waters)	2008	fisherman self-reports	-	1	n/a	>0.2 (n/a)
WA Puget Sound Region salmon set/drift gillnet (observer programs listed below covered segments of this fishery):	-	-	-	-	-	-
Puget Sound non-treaty salmon gillnet (all areas and species)	1993	observer data	1.3%	2	n/a	see text
Puget Sound non-treaty chum salmon gillnet (areas 10/11 and 12/12B)[1]	1994	observer data	11%	1	10	see text[1]
Puget Sound treaty chum salmon gillnet (areas 12, 12B, and 12C)[1]	1994	observer data	2.2%	0	0	see text[1]
Puget Sound treaty chum and sockeye salmon gillnet (areas 4B, 5, and 6C)[1]	1994	observer data	7.5%	0	0	see text[1]
Puget Sound treaty and non-treaty sockeye salmon gillnet (areas 7 and 7A)[1]	1994	observer data	7%	1	15	see text[1]

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean annual takes (CV in parentheses)
Unknown Washington Northern Inland Waters fisheries	2007-2011	stranding data	n/a	1, 1, 1, 1, 2	n/a	≥1.2 (n/a)
Unknown Hood Canal fisheries	2007-2011	stranding data	n/a	0, 0, 0, 0, 1	n/a	> 0.2 (n/a)
Unknown Southern Puget Sound fisheries	2007-2011	stranding data	n/a	0, 5, 0, 0, 0	n/a	>1.0 (n/a)
Minimum total annual takes Washington Northern Inland Waters						> 2.8 (n/a)
Minimum total annual takes Hood Canal						> 0.2 (n/a)
Minimum total annual takes Southern Puget Sound						>1.0 (n/a)

[1] This fishery has not been observed since 1994 (see text); these data are not included in the calculation of recent minimum total annual takes.

Strandings of harbor seals entangled in fishing gear or with serious injuries caused by interactions with gear are a final source of fishery-related mortality information. As these strandings could not be attributed to a particular fishery, they have been included in Table 1 as occurring in unknown Washington inland waters fisheries. According to Northwest Marine Mammal Stranding Network records, maintained by the NMFS Northwest Region (NMFS, Northwest Regional Office, unpublished data), 12 fishery-related harbor seal deaths and serious injuries were reported in Washington inland waters in 2007-2011: six from the Washington Northern Inland Waters stock, one from the Hood Canal stock, and five from the Southern Puget Sound stock, resulting in mean annual takes of 1.2 harbor seals in Washington Northern Inland Waters, 0.2 in Hood Canal, and 1.0 in Southern Puget Sound. Fishery interactions included two gaff injuries, two gillnet entanglements, in one fishing net entanglement, and one entanglement in fishing gear in Washington Northern Inland Waters; one gillnet entanglement in Hood Canal; and five gillnet entanglements in Southern Puget Sound. Harbor seal deaths caused by interactions with recreational hook and line fishing gear were also reported in 2007-2011: two seals had hook injuries and one ingested a hook in Washington Northern Inland Waters and two seals ingested hooks in Southern Puget Sound, resulting in mean annual mortalities of 0.6 and 0.4, respectively, from these two stocks. Estimates from stranding data are considered minimum estimates because not all stranded animals are found, reported, or examined for cause of death (via necropsy by trained personnel). Two additional harbor seals that stranded with serious hook injuries from recreational hook and line gear in Washington Northern Inland Waters in 2007-2011 were treated and released with non-serious injuries (Carretta et al. 2013); therefore, they were not included in the mean annual mortality in this report.

Other Mortality

According to Northwest Marine Mammal Stranding Network records, maintained by the NMFS Northwest Region (NMFS, Northwest Regional Office, unpublished data), a total of 32 human-caused harbor seal deaths or serious injuries were reported from non-fisheries sources in 2007-2011 for the Washington Northern Inland Waters stock. Eight animals were shot, 13 nine were struck by boats, two died in oil spills, three two were killed by dogs, and 13 were entangled in marine debris, resulting in a mean annual mortality of 6.4 harbor seals from this stock. During the same time period, 10 human-caused deaths or serious injuries were reported for the Southern Puget Sound stock: one animal entangled in marine debris, six were shot, one was killed by a dog, one entangled in a buoy line, and one entangled in a scientific research net, resulting in a mean annual mortality of 2.0 harbor seals. These are considered minimum estimates because not all stranded animals are found, reported, or examined for cause of death (via necropsy by trained personnel). An additional seriously injured harbor seal was disentangled from marine debris and released with non-serious injuries in Washington Northern Inland Waters in 2007 (Carretta et al. 2013); therefore, it was not included in the mean annual mortality in this report.

Subsistence Harvests by Northwest Treaty Indian Tribes

Tribal subsistence takes of this stock may occur, but no data on recent takes are available.

STATUS OF STOCK

Harbor seals are not considered to be "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Based on currently available data, the minimum level of human-caused mortality and serious injury is 9.8 harbor seals per year for the Washington Northern Inland Waters stock (2.8 from fishery sources in Table 1 + 0.6 from recreational hook and line fisheries + 6.4 from non-fishery sources). Annual human-caused serious injury and mortality for the Hood Canal stock is 0.2 from unknown fishery sources. Annual human-caused serious injury and mortality for the Southern Puget Sound stock is 3.4, including 1.0 from fishery sources listed in Table 1, 0.4 from recreational hook and line fisheries, and 2.0 from non-fishery sources. PBRs cannot be calculated for these stocks because there are no current abundance estimates. Human-caused mortality relative to PBR is unknown for these stocks, but is considered to be small relative to stock size. Therefore, the Washington Northern Inland Waters, Hood Canal, and Southern Puget Sound stocks of harbor seals are not classified as "strategic" stocks. At present, the minimum annual fishery mortality and serious injury for these stocks (based on stranding data) are 1.2 for the Washington Northern Inland Waters stock, 0.2 for the Hood Canal stock, and 1.0 for the Southern Puget Sound stock. Since a PBR cannot be calculated for these stocks, fishery mortality relative to PBR is unknown. The stock was previously reported to be within its Optimum Sustainable Population (OSP) range (Jeffries et al. 2003), but in the absence of recent abundance estimates, this stock's status relative to OSP is unknown.

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Revised 7/31/2015

NORTHERN ELEPHANT SEAL (*Mirounga angustirostris*): California Breeding Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

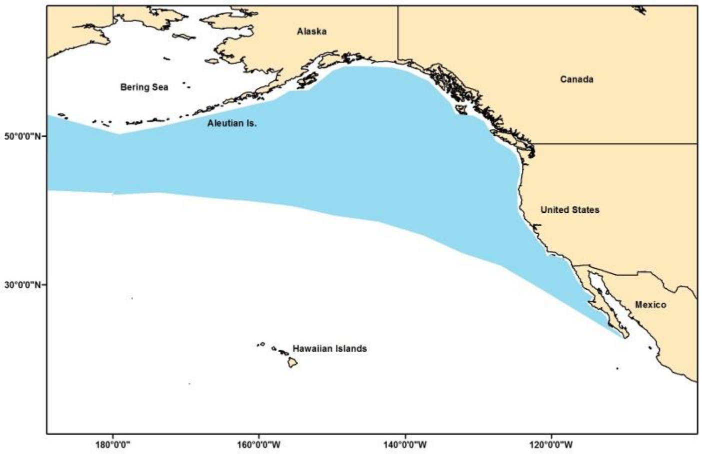

Figure 1. Pelagic range of northern elephant seals in the eastern North Pacific. Major breeding rookeries occur along the west coast of Baja California and the California coast, as described in Lowry et al. (2014).

Northern elephant seals breed and give birth in California (U.S.) and Baja California (Mexico), primarily on offshore islands (Stewart et al. 1994), from December to March (Stewart and Huber 1993). Spatial segregation in foraging areas between males and females is evident from satellite tag data (Le Beouf et al. 2000). Males migrate to the Gulf of Alaska and western Aleutian Islands along the continental shelf to feed on benthic prey, while females migrate to pelagic areas in the Gulf of Alaska and the central North Pacific to feed on pelagic prey (Le Beouf et al. 2000). Adults return to land between March and August to molt, with males returning later than females. Adults return to their feeding areas again between their spring/summer molting and their winter breeding seasons.

Populations of northern elephant seals in the U.S. and Mexico have recovered after being nearly hunted to extinction (Stewart et al. 1994). Northern elephant seals underwent a severe population bottleneck and loss of genetic diversity when the population was reduced to an estimated 10-30 individuals (Hoelzel *et al*. 2002). Although movement and genetic exchange continues between rookeries, most elephant seals return to natal rookeries when they start breeding (Huber et al. 1991). The California breeding population is now demographically isolated from the Baja California population. No international agreements exist for the joint management of this species by the U.S. and Mexico. The California breeding population is considered here to be a separate stock.

POPULATION SIZE

A complete population count of elephant seals is not possible because all age classes are not ashore simultaneously. Elephant seal population size is estimated by counting the number of pups produced and multiplying by the inverse of the expected ratio of pups to total animals (McCann 1985). Based on counts of elephant seals at U.S. rookeries in 2010, Lowry *et al.* (2014) reported that 40,684 pups were born. Lowry *et al.* (2014) applied a multiplier of 4.4 to extrapolate from total pup counts to a population estimate of approximately 179,000 elephant seals. This multiplier is derived from life tables based on published elephant seal fecundity and survival rates, and reflects a population with approximately 23% pups (Cooper & Stewart, 1983; Le Boeuf & Reiter, 1988; Hindell, 1991; Huber et al., 1991; Reiter & Le Boeuf, 1991; Clinton & Le Boeuf, 1993; Le Boeuf et al., 1994; Pistorius & Bester, 2002; McMahon et al., 2003; Pistorius et al., 2004; Condit et al., 2014).

Minimum Population Estimate

The minimum population size for northern elephant seals in 2010 can be estimated very conservatively as 81,368 seals, which is equal to twice the observed pup count (to account for the pups and their mothers) .

Current Population Trend

The population is reported to have grown at 3.8% annually since 1988 (Lowry *et al.* 2014).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATE

An annual growth rate of 17% for elephant seals in the U.S. from 1958 to 1987 is reported by Lowry *et al.* (2014), but some of this growth is likely due to immigration of animals from Mexico and the consequences of a small population recovering from past exploitation. From 1988 to 2010, the population is estimated to have grown 3.8% annually (Lowry et al. 2014). For this stock assessment report, we use the default maximum theoretical net productivity rate for pinnipeds, or 12% (Wade and Angliss 1997).

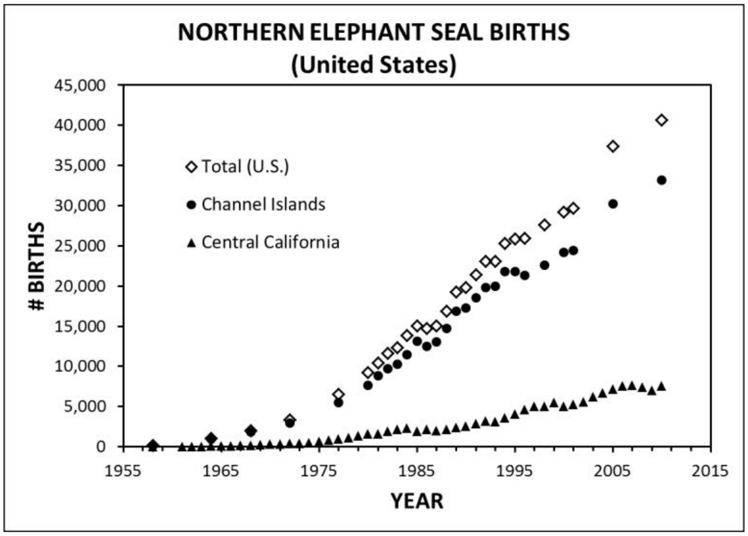

Figure 2. Estimated number of northern elephant seal births in California 1958-2010. Multiple independent estimates are presented for the Channel Islands 1988-91. Estimates are from Stewart et al. (1994), Lowry et al. (1996), Lowry (2002), Lowry et al. (2014), and unpublished data from Sarah Allen, Dan Crocker, Brian Hatfield, Ron Jameson, Bernie Le Boeuf, Mark Lowry, Pat Morris, Guy Oliver, Derek Lee, and William Sydeman.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (81,368) times one half the observed maximum net growth rate for this stock (½ of 12%) times a recovery factor of 1.0 (for a stock of unknown status that is increasing, Wade and Angliss 1997) resulting in a PBR of 4,882 animals per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Serious Injury Guidelines

NMFS uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to distinguish serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*".

Fisheries Information

A summary of known commercial fishery mortality and serious injury for this stock of northern elephant seals is given in Table 1. More detailed information on these fisheries is provided in Appendix 1.

Table 1. Summary of available information on the mortality and serious injury of northern elephant seals (California breeding stock) in commercial fisheries that might take this species (Carretta and Enriquez 2009, 2010, 2012a, 2012b, Carretta *et al.* 2014a). n/a indicates information is not available. Mean annual takes are based on 2008-2012 data unless noted otherwise.

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed Mortality	Estimated Mortality (CV in parentheses)	Mean Annual Takes (CV in parentheses)
CA thresher shark/swordfish drift gillnet fishery	2008	observer data	13.5%	0	0	0 (n/a)
	2009		13.3%	0	0	
	2010		11.9%	0	0	
	2011		19.5%	0	0	
	2012		18.6%	0	0	

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed Mortality	Estimated Mortality (CV in parentheses)	Mean Annual Takes (CV in parentheses)
CA halibut and white seabass set gillnet fishery	2008 2009 2010 2011 2012	observer data	0% 0% 12.5% 8.0% 5.5%	n/a n/a 0 0 0	n/a n/a 0 0 0	0 (n/a)
CA small-mesh drift gillnet fishery for white seabass, yellowtail, barracuda, and tuna	2010 2011 2012	observer data	0.7% 3.3% 4.6%	0 0 0	0 0 0	0 (n/a)
WA, OR, CA domestic groundfish trawl fishery (includes at-sea hake and other limited-entry groundfish sectors)	2005 2006 2007 2008 2009	observer data	98% to 100% of tows in at-sea hake fishery Generally less than 30% of landings observed in other groundfish sectors	0 1 3 7 2	0 (n/a) 1 (n/a) 3 (n/a) 9 (n/a) 2 (n/a)	3 (n/a)
Unknown gillnet fishery	2008-2012	stranding	n/a	1	1 (n/a)	≥1
Total annual takes						≥4.0 (n/a)

Although all of the mortality in Table 1 occurred in U.S. waters, some may be of seals from Mexico's breeding population that are migrating through U.S. waters.

Other Mortality

For the period 2008-2012, mortality and serious injuries from the following non-commercial fishery sources were documented: shootings (9); marine debris entanglement (7); hook and line fisheries (3); power plant entrainment (2); research-related (1); tar/oil (1); and vessel strike (1) (Carretta *et al.* 2014b). These non-commerical fishery sources of mortality and serious injury total 24 animals, or an average of 4.8 elephant seals annually (Carretta *et al.* 2014b).

STATUS OF STOCK

Northern elephant seals are not listed as "endangered" or "threatened" under the Endangered Species Act nor designated as "depleted" under the MMPA. Because their annual human-caused mortality (≥8.8) is much less than the calculated PBR for this stock (4,882), northern elephant seals are not considered a "strategic" stock under the MMPA. The average rate of incidental fishery mortality for this stock over the last five years ≥4.0) also appears to be less than 10% of the calculated PBR; therefore, the total fishery mortality appears to be insignificant and approaching a zero mortality and serious injury rate. The population growth rate between 1958 and 1987 was 17% annually (Lowry *et al.* 2014). From 1988 to 2010, the population grew at an annual rate of 3.8% (Lowry *et al.* 2014). The population continues to grow, with most births occurring at southern California rookeries (Lowry et al. 2014). No estimate of carrying capacity is available for this population and the population status relative to OSP is unknown. There are no known habitat issues that are of concern for this stock. However, expanding pinniped populations in general have resulted in increased human-caused serious injury and mortality, due to shootings, entrainment in power plants, interactions with recreational hook and line fisheries, separation of mothers and pups due to human disturbance, dog bites, and vessel and vehicle strikes (Carretta et al. 2014b).

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Revised 2/8/2017

GUADALUPE FUR SEAL (*Arctocephalus townsendi*)

STOCK DEFINITION AND GEOGRAPHIC RANGE

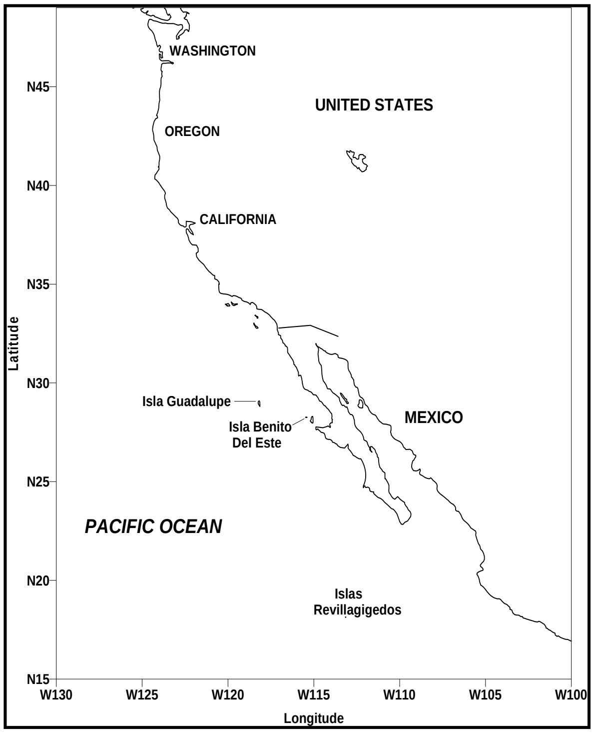

Figure 1. Geographic range of the Guadalupe fur seal, showing location of two rookeries at Isla Guadalupe and Isla Benito Del Este.

Commercial sealing during the 19th century reduced the once abundant Guadalupe fur seal to near extinction in 1894 (Townsend 1931). Prior to the harvest it ranged from Monterey Bay, California, to the Revillagigedo Islands, Mexico (Hanni *et al.* 1997, Repenning *et al.* 1971; Figure 1). The prehistoric distribution of Guadalupe fur seals during the Holocene was apparently quite different from today, as the archeological record indicates Guadalupe fur seal remains accounted for 40%-80% of all pinniped bones at the California Channel Islands (Rick *et al.* 2009). The live capture of two adult males (and killing of ~ 60 more animals) at Guadalupe Island in 1928 established the continued existence of the species (Townsend 1931). Guadalupe fur seals pup and breed mainly at Isla Guadalupe, Mexico. In 1997, a second rookery was discovered at Isla Benito del Este, Baja California (Maravilla-Chavez and Lowry 1999) and a pup was born at San Miguel Island, California (Melin and DeLong 1999). Since 2008, individual adult females, subadult males, and between one and three pups have been observed annually on San Miguel Island (NMFS, unpublished data). The population at Isla Benito del Este is now well-established, though very few pups are observed there. Population increases at Isla San Benito are attributed to immigration of animals from Isla Guadalupe (Aurioles-Gamboa *et al.* 2010, García-Capitanachi 2011). Along the U.S. west coast, strandings occur almost annually in California waters and animals are increasingly observed in Oregon and Washington waters. In 2015-2016, Guadalupe fur seal strandings totaled approximately 175 animals along the coast of California (compared with approximately 10 animals annually in prior years), and NMFS declared an unusual mortality event[1]. Most strandings involved animals less than 2 years old with evidence of malnutrition. Individuals have stranded or been sightedinside the Gulf of California and as far south as Zihuatanejo, Mexico (Hanni et al. 1997 and Aurioles-Gamboa and Hernadez-Camacho 1999) and another in 2012, at Cerro Hermoso, Oaxaca, Mexico (Esperon-Rodriguez and Gallo-Reynoso 2012). Recent video records of pinnipeds hooked in the mouth from international waters west of the California Current involving the shallow set Hawaii longline fishery were independently reviewed by pinniped experts and at least one animal in early 2016 was identified as a Guadalupe fur seal. Guadalupe fur seals that stranded in central California and treated at rehabilitation centers were fitted with satellite tags and documented to travel as far north as Graham Island and Vancouver Island, British Columbia, Canada (Norris *et al.* 2015). Some satellite-tagged animals traveled far offshore outside the U.S. EEZ to areas 700 nmi west of the California / Oregon border. The population is considered to be a single stock because all are recent descendants from one breeding colony at Isla Guadalupe, Mexico.

POPULATION SIZE

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[1] http://www.nmfs.noaa.gov/pr/health/mmume/guadalupefurseals2015.html

The size of the population prior to the commercial harvests of the 19th century is not known, but estimates range from 20,000 to 100,000 animals (Fleischer 1987). Surveys conducted between 2008 and 2010 resulted in a total estimated population size of approximately 20,000 animals, with ~17,500 at Isla Guadalupe and ~2,500 at Isla San Benito (García-Capitanachi 2011, Aurioles-Gamboa 2015). These estimates are corrected for animals not seen during the surveys.

Minimum Population Estimate

All the individuals of the population cannot be counted because all age and sex classes are never ashore at the same time and some individuals that are on land are not visible during the census. Direct counts of animals at Isla Guadalupe and Isla San Benito during 2010 resulted in a minimum of 13,327 animals and 2,503 animals respectively, for a minimum population size of 15,830 animals (García-Capitanachi 2011).

Current Population Trend

Counts of Guadalupe fur seals have been made sporadically since 1954. Records of Guadalupe fur seal counts through 1984 were compiled by Seagars (1984), Fleischer (1987), and Gallo (1994). The count for 1988 was taken from Torres et al. (1990). More recent counts from 1977-2010 are summarized in García-Capitanachi (2011). Also, the counts that are documented in the literature generally provide only the total of all Guadalupe fur seals counted (i.e., the counts are not separated by age/sex class). The counts that were made during the breeding season, when the maximum number of animals are present at the rookery, were used to examine population growth (Gallo 1994, García-Capitanachi 2011). The natural logarithm of the counts was regressed against year to calculate the growth rate of the population. These data indicate that Guadalupe fur seals are increasing at an average annual growth rate of 10.3% (Figure 2).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Reported annual growth rates of 21% at Isla San Benito over an 11-year period are too high and likely result from immigration from Isla Guadalupe (Esperón-Rodríguez and Gallo-Reynoso 2012). The maximum net productivity rate can be assumed to be equal to the maximum annual growth rate observed between 1955 and 1993 (13.7%) because the population was at a very low level and should have been growing at nearly its maximum rate (Gallo 1994). Based on direct counts of animals at Guadalupe Island between 1955 and 2010, the estimated annual population growth rate is 10.3%.

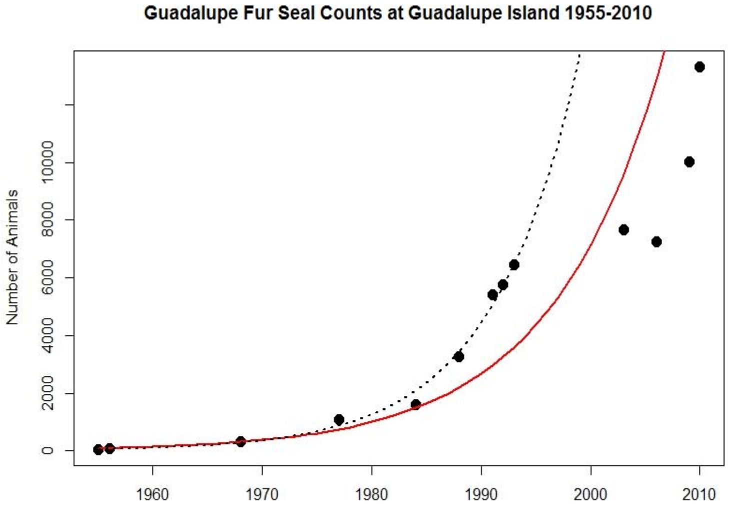

Figure 2. Counts of Guadalupe fur seals at Guadalupe Island, Mexico, and the estimated population growth curves derived from counts made during the breeding season. Direct counts of animals are shown as black dots. An estimated annual growth rate of 13% is based on counts made between 1955 and 1993 (black dashed line). The estimated growth rate over the period 1955-2010 is approximately 10% annually (solid red line).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) for this stock is calculated as the minimum population size (15,830) times one half the maximum net growth rate observed for this species (½ of 13.7%) times a recovery factor of 0.5 (for a threatened species, Wade and Angliss 1997), resulting in a PBR of 542 Guadalupe fur seals per year. The vast majority of this PBR would apply towards incidental mortality in Mexico as most of the population occurs outside of U.S. waters.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Table 1. Summary of available information on the incidental mortality and injury of Guadalupe fur seals in commercial fisheries and other unidentified fisheries that might take this species.

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed Mortality and Serious Injury	Estimated Mortality and Serious Injury (CV)	Mean Annual Takes (CV)
CA driftnet fishery for sharks and swordfish	2010-2014	observer	12%-37%	0	0	0
CA set gillnet fishery for halibut/white seabass and other species	2010-2014	observer	9%	0	0	0
Unidentified fishery interactions	2010-2014	strandings	n/a	16	≥ 16	≥ 3.2
Minimum total annual takes						≥3.2

No Guadalupe fur seals have been observed entangled in California gillnet fisheries between 1990 and 2014 (Julian and Beeson 1998, Carretta *et al.* 2004, Carretta *et al.* 2016b), although stranded animals have been found entangled in gillnet of unknown origin (see 'Other mortality' below). Gillnets have been documented to entangle marine mammals off Baja California (Sosa-Nishizaki *et al.* 1993), but no recent bycatch data from Mexico are available.

One confirmed interaction of a mouth-hooked Guadalupe fur seal in the Hawaii shallow set longline fishery has been reviewed by U.S. west coast pinniped experts from video taken at sea in early 2016. Two additional videos of unidentified pinnipeds that were hooked in the mouth in 2015 in the same fishery were also reviewed. These interactions occurred outside of the U.S. EEZ, west of the California Current.

Other mortality and serious injury

There were 16 records of human-related deaths and/or serious injuries to Guadalupe fur seals from stranding data for the most recent 5-year period of 2010-2014 (Carretta *et al.* 2016a). These strandings included entanglement in marine debris and gillnet of unknown origin, and shootings. The average annual observed human-caused mortality and serious injury of Guadalupe fur seals for 2010-2014 is 3.2 animals annually (16 animals / 5 years). Observed human-caused mortality and serious injury for this stock very likely represents a fraction of the true impacts because not all cases are documented. No correction factors to account for undetected mortality and injury are currently available for pinnipeds along the U.S. west coast.

STATUS OF STOCK

The Endangered Species Act lists the Guadalupe fur seal as a threatened species, which automatically qualifies this stock as "depleted" and "strategic" stock under the Marine Mammal Protection Act. There is insufficient information to determine whether fishery mortality in Mexico exceeds the PBR for this stock, but given the observed growth of the population over time, this is unlikely. The total U.S. fishery mortality and serious injury for this stock (≥ 3.2 animals per year) is less than 10% of the calculated PBR for the entire stock, but it is not currently possible to calculate a prorated PBR for U.S. waters with which to compare serious injury and mortality from U.S. fisheries. Therefore, it is unknown whether total U.S. fishery mortality is insignificant and approaching zero mortality and serious injury rate. The population is growing at approximately 10% per year.

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NORTHERN FUR SEAL (*Callorhinus ursinus*): California Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

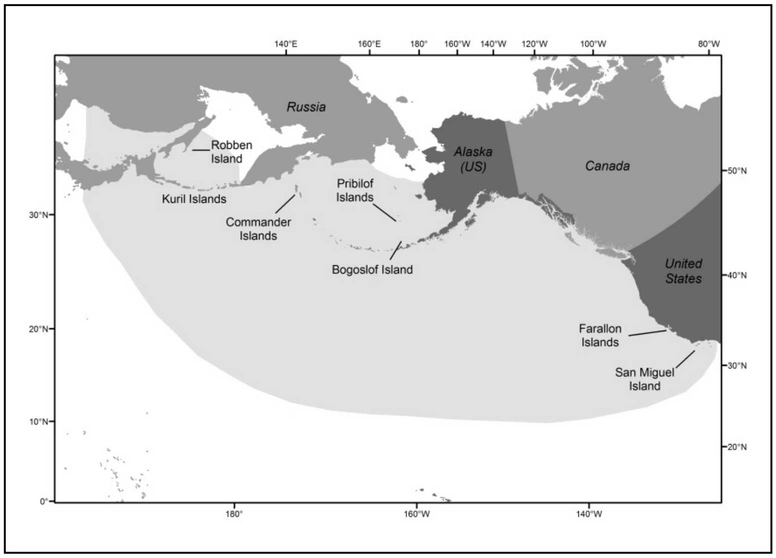

Figure 1. Approximate distribution of northern fur seals in the North Pacific (shaded area).

Northern fur seals occur from southern California north to the Bering Sea and west to the Okhotsk Sea and Honshu Island, Japan (Fig. 1). As of 2014, the worldwide population size is approximately 1.1 million animals (Gelatt *et al*. 2015). During the breeding season, approximately 45% of the worldwide population is found on the Pribilof Islands in the southern Bering Sea, with the remaining animals spread throughout the North Pacific Ocean (Gelatt *et al*. 2015). Of the seals in U.S. waters outside of the Pribilofs, approximately 9% of the population is found on Bogoslof Island in the southern Bering Sea, 1% on San Miguel Island off southern California, and 0.3% on the Farallon Islands off central California (Gelatt *et al*. 2015). Northern fur seals may temporarily haul out on land at other sites in Alaska, British Columbia, and on islets along the coast of the continental United States, but generally this occurs outside of the breeding season (Fiscus 1983).

Due to differing requirements during the annual reproductive season, adult males and females typically occur ashore at different, though overlapping, times. Adult males occur ashore and defend reproductive territories during a 3-month period from June through August, though some may be present until November (well after giving up their territories). Adult females are found ashore for as long as 6 months (June-November). After their respective times ashore, fur seals of both sexes spend the next 7 to 8 months at sea (Roppel 1984). Adult females and pups from the Pribilof Islands migrate through the Aleutian Islands into the North Pacific Ocean, often to waters off Washington, Oregon, and California. Many pups may remain at sea for 22 months before returning to their natal rookery. Adult females and pups from San Miguel Island and the Farallon Islands migrate northward to these same areas (Lea *et al*. 2009). Adult males from the Pribilof Islands generally migrate only as far south as the Gulf of Alaska (Kajimura 1984). Little is known about where adult males from San Miguel Island and the Farallon Islands migrate.

The following information was considered in classifying stock structure based on the Dizon *et al*. (1992) phylogeographic approach: 1) Distributional data: continuous geographic distribution during feeding, geographic separation during the breeding season, and high natal site fidelity (DeLong 1982); 2) Population response data: substantial differences in population dynamics between the Pribilofs and San Miguel Island (DeLong 1982, DeLong and Antonelis 1991, NMFS 2007); 3) Phenotypic data: unknown; and 4) Genotypic data: little evidence of genetic differentiation among breeding islands (Ream 2002, Dickerson *et al*. 2010). Based on this information, two separate stocks of northern fur seals are recognized within U.S. waters: an Eastern Pacific stock and a California stock (including San Miguel Island and the Farallon Islands). The Eastern Pacific stock is reported separately in the Stock Assessment Reports for the Alaska Region.

POPULATION SIZE

The population estimate for northern fur seals on San Miguel Island is calculated as the estimated number of pups at rookeries multiplied by an expansion factor. Based on research conducted on the Eastern Pacific stock of northern fur seals, Lander's (1981) life table analysis was used to estimate the number of yearlings, two-year-olds, three-year-olds, and animals at least four years old. The resulting population estimate was equal to the pup count multiplied by 4.475. The expansion factors are based on a sex and age distribution estimated after the commercial harvest of juvenile males was terminated in 1984. A more appropriate expansion factor for San Miguel Island is 4.0, because immigration of recruitment-aged females is occurring in the population (DeLong 1982), as well as mortality and possible emigration of adults associated with the El Niño events in 1982-1983 and 1997-1998 (Melin *et al.* 2008). A 1998 pup count resulted in an 80% decrease from the 1997 count (Melin *et al*. 2005). In 1999, the population began to recover, and in 2010 the highest total pup count of 3,408 was recorded (Orr *et al*. in review). A possible cause for the decline in total pup counts from 2010 to 2011 was a combination of oceanographic events that occurred in the California Current in 2009, a coastal upwelling relaxation event in May and June and an El Niño event from Fall 2009 to Spring 2010. The oceanographic events caused fewer reproductive males and females to return to San Miguel Island to breed in 2010. During 2012, the population increased 9.4% from 2011 and this level was maintained during 2013. No counts were conducted at Castle Rock in 2014; however, a record number of pups (2,289) were counted at Adam's Cove that year. Additionally, the second highest number of territorial bulls (224) was observed in 2014 (Orr *et al*. in review). Based on these factors, and assuming the trends were similar at Castle Rock, the population size during 2014 would have been the highest recorded. However, based on the 2013 count (the most recent complete data set) and the expansion factor, the most recent population estimate of northern fur seals at San Miguel Island is 13,384 (3,346 x 4.0) northern fur seals (Orr *et al*. in review). Currently, a coefficient of variation (CV) for the expansion factor is unavailable; however, studies are underway to determine the accuracy and precision of the expansion factor.

The population estimate for northern fur seals on the Farallon Islands is calculated as the highest number of pups, juveniles, and adults counted at the rookery. The long-term population estimate at the Farallon Islands should be regarded as an index of abundance rather than a precise indicator of population size for several reasons: 1) population censuses are incomplete because researchers do not enter rookery areas until the end of the breeding/pupping season in order to reduce human disturbance to other breeding pinnipeds and nesting seabirds; 2) mortality occurring early in the season is not accounted for; and 3) estimates of the number of pups are compromised because by the time counts are conducted, many pups have learned to swim and may not be present at the rookery. Additionally, yearlings may be present at rookeries and misidentified as pups. Keeping these factors in mind, the peak counts of northern fur seals increased steadily from 1995 to 2006 and have increased exponentially from 2008 to 2013 (Tietz 2012, Berger *et al*. 2013). Based solely on the count, the population estimate of northern fur seals at the Farallon Islands was 666 in 2013 and increased to 1,019 in 2014 (Orr *et al*. in review).

The most recent population estimate for the entire stock of California northern fur seals, which incorporates estimates from San Miguel Island and the Farallon Islands in 2013, is 14,050 (13,384 + 666).

Minimum Population Estimate

Minimum population size is calculated as the sum of the minimum number of animals at San Miguel Island and the Farallon Islands in 2013 (Tietz 2012, Berger *et al*. 2013, Orr *et al*. in review). The minimum number of animals at San Miguel Island is twice the pup count (3,346 x 2 = 6,692), to account for pups and mothers, plus the number of territorial males (166) counted the same year (i.e., 2013), or 6,858 fur seals. The minimum number at the Farallon Islands is the total number of individuals (666) counted during the survey in 2013. It should be noted that 1,019 individuals were counted in 2014, but this number is not used here to be consistent with data collected at San Miguel Island. The total minimum population size is the sum of the minimum population sizes at San Miguel Island (6,858) and the Farallon Islands (666) in 2013, or 7,524 northern fur seals.

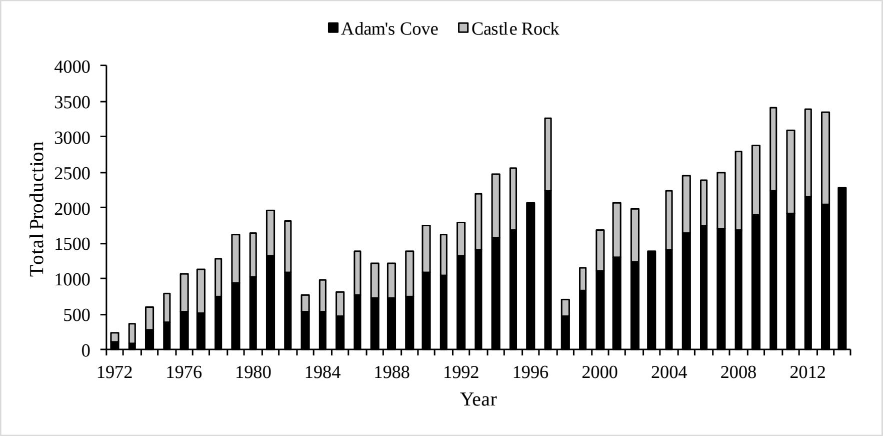

Figure 2. Total production of northern fur seal pups counted on San Miguel Island, including the mainland (Adam's Cove) and the offshore islet (Castle Rock), 1972-2014.

Current Population Trend

Northern fur seals were extirpated on San Miguel Island and the Farallon Islands during the late 1700s and early 1800s. Immigrants from the Pribilof Islands and Russian populations recolonized San Miguel Island during the late 1950s or early 1960s (DeLong 1982). The colony has increased steadily, since its discovery in 1968, except for severe declines in 1983 and 1998 associated with El Niño events in 1982-1983 and 1997-1998 (DeLong and Antonelis 1991, Melin *et al*. 2005). El Niño events impact population growth of northern fur seals at San Miguel Island and are an important regulatory mechanism for this population (DeLong and Antonelis 1991; Melin and DeLong 1994, 2000; Melin *et al*. 1996, 2005, 2008; Orr *et al*. 2012, in review).

Live pup counts increased about 24% annually from 1972 through 1982 (Fig. 2), partly due to immigration of females from the Bering Sea and the western North Pacific Ocean (DeLong 1982). The 1982-1983 El Niño event resulted in a 60% decline in the northern fur seal population at San Miguel Island (DeLong and Antonelis 1991). It took the population 7 years to recover from this decline, because adult female mortality or emigration occurred in addition to pup mortality (Melin and DeLong 1994). The 1992-1993 El Niño resulted in reduced pup production in 1992, but the population recovered in 1993 and increased during 1994 (Melin *et al*. 1996).

The northern fur seal population appears to be greatly affected by El Niño events. These events cause changes in marine communities by altering sea-level height, sea-surface temperature, thermocline and nutricline depths, current-flow patterns, and upwelling strength. Fur seal prey generally move to more productive areas farther north and deeper in the water column and, thereby, become less accessible for fur seals. Consequently, fur seals at San Miguel Island are in poor physical condition during El Niño events and the population experiences reduced reproductive success and high mortality of pups and, occasionally, adults. From July 1997 through May 1998, the most severe El Niño event in recorded history affected California coastal waters (Lynn *et al*. 1998). In 1997, total fur seal pup production was the highest recorded since the colony has been monitored. However, it appears that up to 87% of the pups born in 1997 died before weaning, and total production in 1998 declined 80% from 1997 (Melin *et al*. 2005). Total production increased to a record high of 3,408 in 2010 and, except for a slight decrease during 2011, levels have remained around 3,350 individuals in subsequent years (Orr *et al*. in review). The total production of northern fur seals has exceeded the 1997 levels during three of the last four years with complete counts; therefore, the San Miguel Island population has recovered from the 1997-1998 El Niño event.

Compared to San Miguel Island, less information is known about the population of northern fur seals on the Farallon Islands. Based on tag-resight data, it appears that the population originated from emigrants from San Miguel Island. The first pup was observed on the Farallon Islands in 1996 (Pyle *et al*. 2001). After this discovery, annual ground surveys were conducted in early fall to document population trends of the colony (Tietz 2012). The colony increased steadily from 1996 to the early 2000s. However, the population has grown exponentially during the past several years, with an occasional decline (Tietz 2012). Because counts are conducted during the fall after the breeding season, population trends and demographic information are less clear than for San Miguel Island.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Currently, productivity rates for northern fur seals on the Farallon Islands are unknown. A growth rate of 20% was calculated for northern fur seals on San Miguel Island in 1972-1982 by linear regression of the natural logarithm of pup count against year. However, it is clear that this rate of increase was due in part to immigration of females from Russian and Pribilof Islands populations (DeLong 1982). Immigration was also occurring from the early 1980s to 1997. In the absence of a reliable estimate of the maximum net productivity rate for the California stock of northern fur seals, the pinniped default maximum theoretical net productivity rate (R_{MAX}) of 12% (Wade and Angliss 1997) is used as an estimate of R_{MAX}.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population estimate (7,524) times one-half the default maximum net growth rate (½ of 12%) times a recovery factor of 1.0 (for stocks of unknown status that are increasing in size: Wade and Angliss 1997), resulting in a PBR of 451 northern fur seals from the California stock per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Northern fur seals taken by commercial fisheries during the winter/spring along the west coast of the continental U.S. could be from either the Eastern Pacific or California stock; therefore, any mortality or serious injury of northern fur seals reported off the coasts of California, Oregon, or Washington during December through May will be assigned to both the Eastern Pacific and California stocks of northern fur seals. There were no observer reports of northern fur seal deaths or serious injuries in any observed fishery along the west coast of the continental U.S. in 2009-2013 (Carretta and Enriquez 2010, 2012a, 2012b; Jannot *et al*. 2011; Carretta *et al*. 2014a, 2015).

Table 1. Summary of available information on the incidental mortality and serious injury of the California stock of northern fur seals in commercial fisheries that might take this species and calculation of the mean annual mortality and serious injury rate; n/a indicates that data are not available. Mean annual takes are based on 2009-2013 data unless noted otherwise.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean annual takes (CV in parentheses)
Unknown West Coast fisheries	2009-2013	stranding data	n/a	1, 0, 2, 1, 0	n/a	≥0.8 (n/a)
Minimum total annual takes						≥0.8 (n/a)

Strandings of northern fur seals entangled in fishing gear or with serious injuries caused by interactions with gear are another source of fishery-related mortality information. According to stranding records for California, Oregon, and Washington (Carretta *et al*. 2014b, 2015), four fishery-related deaths (in unidentified net and unknown trawl fisheries) were reported between 2009 and 2013 (Table 1), resulting in a mean annual mortality and serious injury rate of 0.8 California northern fur seals. This estimate is considered a minimum because not all stranded animals are found, reported, or examined for cause of death (via necropsy by trained personnel). Two of the fishery-related deaths (one in an unidentified fishing net in February 2009 and one in trawl gear in April 2011) were also assigned to the Eastern Pacific stock of northern fur seals. Two additional northern fur seal strandings in 2012 (one in May and one in July) with serious injuries due to fishery interactions were treated and released with non-serious injuries (Carretta *et al*. 2014b). Both of these animals were assigned to the California stock of northern fur seals and the animal that stranded in May 2012 was also assigned to the Eastern Pacific stock.

Other Mortality

Since the Eastern Pacific and California stocks of northern fur seals overlap off the west coast of the continental U.S. during December through May, non-fishery mortality and serious injury reported off the coasts of California, Oregon, or Washington during that time will be assigned to both stocks. Mortality and serious injury of northern fur seals may occur incidental to research fishery activities. In 2007 and 2008, four northern fur seals were incidentally killed in California waters during scientific sardine trawling operations conducted by NMFS (Carretta *et al*. 2013): one death in 2007 and one in 2008 occurred before NMFS scientists implemented a mitigation plan to avoid future mortality. The initial mitigation plan included use of 162 dB acoustic pingers, a marine mammal watch, and scheduling trawls to occur when the ship first arrived on station to avoid attracting animals to a stationary vessel. Two additional northern fur seals were killed in subsequent 2008 trawls, so a marine mammal excluder device was added to the trawls in 2009 and no northern fur seal deaths or serious injuries were observed in this research fishery in 2009-2013. However, one northern fur seal was killed in a scientific rockfish trawling operation conducted by NMFS (Carretta *et al.* 2014b) in California waters in May 2009. This death was assigned to both the California and Eastern Pacific stocks of northern fur seals. The mean annual research-related mortality and serious injury rate of California northern fur seals from 2009 to 2013 is 0.2 northern fur seals.

According to stranding records for California, Oregon, and Washington (Carretta *et al*. 2014b, 2015), four human-caused northern fur seal deaths were reported from non-fisheries sources in 2009-2013. Three northern fur seals were entangled in marine debris in Oregon waters in April 2009 and one was entrained in the cooling water system of a California power plant in May 2012. All four of these deaths were assigned to both the California and Eastern Pacific stocks of northern fur seals. The mean annual mortality and serious injury rate from non-fishery sources in 2009-2013 is 0.8 California northern fur seals. This estimate is considered a minimum because not all stranded animals are found, reported, or examined for cause of death (via necropsy by trained personnel).

STATUS OF STOCK

The California northern fur seal stock is not considered to be "depleted" under the Marine Mammal Protection Act (MMPA) or listed as "threatened" or "endangered" under the Endangered Species Act. Based on currently available data, the minimum annual level of total human-caused mortality and serious injury (1.8) does not exceed the PBR (451). Therefore, the California stock of northern fur seals is not classified as a "strategic" stock. The minimum annual commercial fishery mortality and serious injury rate for this stock (0.8) is not known to exceed 10% of the calculated PBR (45) and, therefore, appears to be insignificant and approaching zero mortality and serious injury rate. The stock (based on San Miguel Island data) decreased 80% from 1997 to 1998, began to recover in 1999, and currently has surpassed the 1997 level by 2%. The status of this stock relative to its Optimum Sustainable Population (OSP) is unknown, unlike the Eastern Pacific northern fur seal stock which is formally listed as "depleted" under the MMPA.

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HAWAIIAN MONK SEAL (*Neomonachus schauinslandi*)

STOCK DEFINITION AND GEOGRAPHIC RANGE

Hawaiian monk seals are distributed throughout the Northwestern Hawaiian Islands (NWHI), with subpopulations at French Frigate Shoals, Laysan Island, Lisianski Island, Pearl and Hermes Reef, Midway Atoll, Kure Atoll, and Necker and Nihoa Islands. They also occur throughout the main Hawaiian Islands (MHI). Genetic variation among monk seals is extremely low and may reflect a long-term history at low population levels and more recent human influences (Kretzmann *et al*. 1997, 2001, Schultz *et al*. 2009). Though monk seal subpopulations often exhibit asynchronous variation in demographic parameters (such as abundance trends and survival rates), they are connected by animal movement throughout the species' range (Johanos *et al*. 2013). Genetic analysis (Schultz *et al*. 2011) indicates the species is a single panmictic population. The Hawaiian monk seal is therefore considered a single stock. Scheel et al. (2014) established a new genus, *Neomonachus*, comprising the Caribbean and Hawaiian monk seals, based upon molecular and skull morphology evidence.

POPULATION SIZE

The best estimate of the total population size is 1,272, which is the sum of abundance estimates throughout the species' range (Table 1). In 2014, for the third consecutive year, NWHI field camps were shorter in duration relative to historic field effort levels. The low effort at some sites certainly resulted in negatively-biased abundance estimates and a degradation of the long-term monk seal demographic database. The number of individual seals identified is used as the population estimate at NWHI sites where total enumeration is achieved, according to the criteria established by Baker *et al*. (2006). Where total enumeration is not achieved, capture-recapture estimates from Program CAPTURE are used (Baker 2004; Otis *et al*. 1978, Rexstad & Burnham 1991, White *et al*. 1982). When no reliable estimator is obtainable in Program CAPTURE (i.e., the model selection criterion is < 0.75, following Otis *et al*. 1978), the total number of seals identified is the best available estimate. Sometimes capture-recapture estimates are less than the known minimum abundance (Baker 2004), and in these cases, the total number of seals actually identified is used. In 2014, total enumeration was achieved only at Kure Atoll, and capture-recapture estimates were obtained for Laysan Island and Midway Atoll. At French Frigate Shoals, Lisianski Island and Pearl and Hermes Reef, capture-recapture estimates were either not obtainable or were lower than known minimum abundance. Consequently, only minimum abundance was available for those sites. Counts at Necker and Nihoa Islands are conducted from zero to a few times per year. A new method for estimating non-pup abundance uses the empirical distribution of the ratio of beach counts to total population size at other NWHI subpopulations to correct beach counts at Necker and Nihoa Islands. This method is described in a manuscript currently in preparation (Harting *et al*. in prep.) and the resulting estimates are presented in Table 1. Pups are born over the course of many months and have very different haulout patterns compared to older animals. Therefore, pup production at Necker and Nihoa Islands is estimated as the mean of the total pups observed in the past 5 years, excluding counts occurring early in the pupping season when most have yet to be born. There were no counts conducted at Necker Island in 2014, so two beach counts conducted in 2013 were used to estimate abundance (no change in abundance since 2013 assumed). Three counts were conducted at Nihoa Island in 2014.

In the MHI, NMFS collects information on seal sightings reported throughout the year by a variety of sources, including a volunteer network, the public, and directed NMFS observation effort. In recent years, a small number of surveys of Ni'ihau and nearby Lehua Islands have been conducted through a collaboration between NMFS, Ni'ihau residents and the U.S. Navy. Total MHI monk seal abundance is estimated by adding the number of individually identifiable seals documented in 2014 on all MHI other than Ni'ihau and Lehua to an estimate for these latter two islands based on counts expanded by a haulout correction factor. A recent telemetry study (Wilson *et al*., in prep.) found that MHI monk seals (N=23) spent a greater proportion of time ashore than Harting *et al*. (in prep) estimated for NWHI seals. Therefore, the total non-pup estimate for Ni'ihau and Lehua Islands was the total beach count at those sites (less three individual seals already counted at other MHI) divided by the mean proportion of time hauled out in the MHI (Wilson *et al*., in prep). The total pups observed at Ni'ihau and Lehua Islands were added to obtain the total (Table 1).

Table 1. Total and minimum estimated abundance of Hawaiian monk seals by location in 2014. The estimation method is indicated for each site.

	Total			**Minimum**			
Location	**Non-pups**	**Pups**	**Total**	**Non-pups**	**Pups**	**Total**	**Method**
French Frigate Shoals	136	38	174	136	38	174	Minimum count
Laysan	188	35	223	181	35	216	Capture-recapture
Lisianski	129	11	140	129	11	140	Minimum count
Pearl and Hermes Reef	119	16	135	119	16	135	Minimum count
Midway	55	8	63	53	8	61	Capture-recapture
Kure	62	13	75	62	13	75	Total enumeration
Necker	63	5	68	50	5	55	Haulout correction
Nihoa	110	9	119	87	9	96	Haulout correction
MHI_(without Ni'ihau/ Lehua)	132	15	147	132	15	147	Minimum count
Ni'ihau/Lehua	108	20	128	86	20	106	Haulout correction
Total	*1102*	*170*	***1272***	*1035*	*170*	***1205***	

Minimum Population Estimate

The total numbers of seals identified at the NWHI subpopulations other than Necker and Nihoa, and in the MHI other than Ni'ihau and Lehua, are the best estimates of minimum population size at those sites. Minimum population sizes for Necker and Nihoa Islands are estimated as the lower 20th percentiles of the non-pup abundance distributions generated using the Harting *et al*. (in prep.) haulout correction, plus the pup estimate. The mean proportion of time non-pups spent hauled out in the MHI was 0.370 (sd = 0.089, CV = 0.241) (Wilson *et al*. in prep.). Minimum abundance at Ni'ihau and Lehua Islands were calculated by applying the formula in Wade and Angliss (1997) to the Ni'ihau and Lehua non-pup estimate with a CV of 0.241, plus the observed pup tally. The minimum abundance estimates for each site and for all sites combined (1,205) are presented in Table 1.

Current Population Trend

In past years, the total stock abundance was not adequately assessed. However, in 2014, a range-wide total abundance estimate was generated using new methods for correcting beach counts at rarely visited sites (Necker, Nihoa and Ni'ihau/Lehua). Maintaining the commitment to conduct future counts at these latter sites will allow for the eventual estimation of total population trend. The following describes trends within different portions of the monk seal's range. The trend in abundance at the six most-studied NWHI subpopulations estimated with a log-linear regression of estimated abundance on year for the past 10 years (2005- 2014) yields a decline of -2.8% yr^{-1} (95% CI = -3.7% to -1.9% yr^{-1}). This rate of decline has been moderating in recent years. Sporadic beach counts at Necker and Nihoa Islands suggest either stability or some positive growth over the past decade. The MHI monk seal population appears to be increasing. Using life table analysis, Baker *et al*. (2011) estimated an intrinsic population growth rate (λ) of 6.5% per year based on data available through 2008. An updated analysis using MHI monk seal data through 2014 yields an estimated growth rate of 5.2% per year. However, the realized growth rate may differ considerably from λ, depending upon the unknown current age and sex structure. Given the uncertainties in these regional trends, it is not known whether the total stock abundance is decreasing, stable or possibly increasing. A reliable conclusion regarding population trend will only be apparent after more annual range-wide abundance estimates have accrued.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Trends in abundance vary considerably among subpopulations. Mean non-pup beach counts are used as a long-term index of abundance for years when data are insufficient to estimate total abundance as described above. Prior to 1999, beach count increases of up to 7% annually were observed at Pearl and Hermes Reef, and this is the highest estimate of the maximum net productivity rate (R_{max}) observed for this species.

POTENTIAL BIOLOGICAL REMOVAL

Using current minimum population size (1,205), R_{max} (0.07) and a recovery factor (F_r) for ESA endangered stocks (0.1), would yield a Potential Biological Removal (PBR) of 4.2. However, PBR is designed to allow stocks to recover to, or remain above, the maximum net productivity level (MNPL) (Wade 1998). An underlying assumption in the application of the PBR equation is that marine mammal stocks exhibit certain dynamics. Specifically, it is assumed that a depleted stock will naturally grow toward OSP (Optimum Sustainable Population), and that some surplus growth could be removed while still allowing recovery. The Hawaiian monk seal population is far below historical levels and has undergone a prolonged decline in abundance. Thus, past reports have concluded that the stock's dynamics do not conform to the underlying model for calculating PBR such that PBR for the Hawaiian monk seal has been undetermined. Given what appears to be an easing of the decline in the NWHI and continued growth in the MHI, this situation may have changed. If future monitoring reveals that the population is exhibiting positive growth, a valid PBR could be determined.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Human-related mortality has caused two major declines of the Hawaiian monk seal (Ragen 1999). In the 1800s, this species was decimated by sealers, crews of wrecked vessels, and guano and feather hunters (Dill and Bryan 1912; Wetmore 1925; Bailey 1952; Clapp and Woodward 1972). Following a period of at least partial recovery in the first half of the 20th century (Rice 1960), most subpopulations again declined. This second decline has not been fully explained, but long-term trends at several sites appear to have been driven both by variable oceanic productivity (represented by the Pacific Decadal Oscillation) and by human disturbance (Baker *et al*. 2012, Ragen 1999, Kenyon 1972, Gerrodette and Gilmartin 1990). Currently, human activities in the NWHI are limited and human disturbance is relatively rare, but human-seal interactions, have become an important issue in the MHI. Intentional killing of seals in the MHI is a relatively new and alarming issue (Table 2).

Table 2. Intentional and potentially intentional killings of MHI monk seals, and anthropogenic mortalities not associated with fishing gear since 2010.

Year	Age/sex	Island	Cause of Death	Comments
2010	Juvenile female	Kauai	Multiple skull fractures, blunt force trauma	Intent unconfirmed
2011	Adult male	Molokai	Skull fracture, blunt force trauma	Intent unconfirmed
	Juvenile female	Molokai	Skull fracture, blunt force trauma	Intent unconfirmed
2012	Juvenile male	Kauai	Gunshot wound	
	Subadult male	Kauai	Skull fracture	Intent unconfirmed
2014	Adult male	Oahu	Suspected trauma	Intent unconfirmed
	Pup female	Kauai	Skull fracture, blunt force trauma	Likely intentional
	Pup male	Kauai	Dog attack/bite wounds	4 other seals injured during this event

In July 2014, single or multiple dogs on Kauai attacked and injured at least five monk seals, one of which, a nursing pup, died from its wounds. The other four injured seals all recovered, one of which was a female nursing pup that required subsequent treatment for a bite-caused abscess. Four months later this same pup was killed on Kauai when its skull was crushed, likely by a human using a rock that was found nearby. An adult male on Oahu also died from what appeared to be trauma in 2014, but the carcass was too decomposed to draw conclusions about the cause of death. It is extremely unlikely that all carcasses of intentionally killed monk seals are discovered and reported. Studies of the recovery rates of carcasses for other marine mammal species have shown that the probability of detecting and documenting most deaths (whether from human or natural causes) is quite low (Peltier *et al*. 2012; Williams *et al*. 2011; Perrin *et al*. 2011; Punt and Wade 2010).

Fishery Information

Fishery interactions with monk seals can include direct interaction with gear (hooking or entanglement), seal consumption of discarded catch, and competition for prey. Entanglement of monk seals in derelict fishing gear, which is believed to originate outside the Hawaiian archipelago, is described in a separate section. Fishery interactions are a serious concern in the MHI, especially involving nearshore fisheries managed by the State of Hawaii. In 2014, 14 seal hookings were documented, 13 of which either were captured and had the hooks removed, or the hooks detached without intervention. A yearling male seal was found dead as result of hooking and the necropsy revealed that a 'J' hook had perforated the esophagus and part of one lung, causing pneumothorax and acute death. The remaining 13 hookings were all classified as non-serious injuries, although 9 of these would have been deemed serious had they not been mitigated. Several incidents involved hooks used to catch ulua (jacks, *Caranx* spp.). Nearshore gillnets became a more common source of mortality in the 2000s, with three seals confirmed dead in these gillnets (2006, 2007, and 2010), and one additional seal in 2010 may have also died in similar circumstances but the carcass was not recovered. No gillnet-related mortality or injuries have been documented since 2010. Most reported hookings and gillnet entanglements have occurred since 2000 (NMFS unpubl. data). The MHI monk seal population appears to have been increasing in abundance during this period (Baker *et al*. 2011). No mortality or serious injuries have been attributed to the MHI bottomfish handline fishery (Table 3). Published studies on monk seal prey selection based upon scat/spew analysis and video from seal-mounted cameras revealed evidence that monk seals fed on families of bottomfish which contain commercial species (many prey items recovered from scats and spews were identified only to the level of family; Goodman-Lowe 1998, Longenecker *et al*. 2006, Parrish *et al*. 2000). Quantitative fatty acid signature analysis (QFASA) results support previous studies illustrating that monk seals consume a wide range of species (Iverson *et al*. 2011). However, deepwater-slope species, including two commercially targeted bottomfishes and other species not caught in the fishery, were estimated to comprise a large portion of the diet for some individuals. Similar species were estimated to be consumed by seals regardless of location, age or gender, but the relative importance of each species varied. Diets differed considerably between individual seals. These results highlight the need to better understand potential ecological interactions with the MHI bottomfish handline fishery.

Table 3. Summary of mortality, serious and non-serious injury of Hawaiian monk seals due to fisheries and calculation of annual mortality rate. n/a indicates that sufficient data are not available. Percent observer coverage for the deep and shallow-set components, respectively, of the pelagic longline fishery, are shown. Total non-serious injuries are presented as well as, in parentheses, the number of those injuries that would have been deemed serious had they not been mitigated (*e.g.*, by de-hooking or disentangling). Data for MHI bottomfish and nearshore fisheries are based upon incidental observations (i.e., hooked seals and those entangled in active gear). All hookings not clearly attributable to either fishery with certainty were attributed to the bottomfish fishery, and hookings which resulted in injury of unknown severity were classified as serious. Nearshore fisheries injuries and mortalities include seals entangled/drowned in nearshore gillnets and hooked/entangled in hook-and-line gear, recognizing that it is not possible to determine whether the nets or hook-and-line gear involved were being used for commercial purposes.

Fishery Name	Year	Data Type	% Obs. coverage	Observed/Reported Mortality/Serious Injury	Estimated Mortality/ Serious Injury	Non-serious (Mitigated serious)	Mean Takes (CV)
Pelagic Longline	2010 2011 2012 2013 2014	observer observer observer observer observer	21.1% & 100% 20.3% & 100% 20.4% & 100% 20.4% & 100% 20.8% & 100%	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 (0)
MHI Bottomfish	2010 2011 2012 2013 2014	Incidental observations of seals	none	0 0 0 0 0	n/a	0 0 0 0 0	n/a
Nearshore	2010 2011 2012 2013 2014	Incidental observations of seals	none	1 0 4 0 1	n/a	11(2) 9 (3) 12 (5) 15 (6) 14 (9)	≥ 1.2
Minimum total annual takes							≥ 1.2

There are no fisheries operating in or near the NWHI. In the past, interactions between the Hawaii-based domestic pelagic longline fishery and monk seals were documented (Nitta and Henderson 1993). This fishery targets swordfish and tunas and does not compete with Hawaiian monk seals for prey. In October 1991, in response to 13 unusual seal wounds thought to have resulted from interactions with this fishery, NMFS established a Protected Species Zone extending 50 nautical miles around the NWHI and the corridors between the islands. Subsequently, no additional monk seal interactions with the swordfish or tuna components of the longline fishery have been observed.

Fishery Mortality Rate

Total fishery mortality and serious injury is not insignificant and approaching a rate of zero. Monk seals are being hooked and entangled in the MHI at a rate that has not been reliably assessed but is certainly greater than zero. The information above represents only reported direct interactions, and without directed observation effort, the true interaction rate cannot be estimated. Monk seals also die from entanglement in fishing gear and other debris throughout their range (likely originating from various sources outside of Hawaii), and NMFS along with partner agencies are pursuing a program to mitigate entanglement (see below). Indirect interactions (i.e., involving competition for prey or consumption of discards) remain a topic of ongoing investigation.

Entanglement in Marine Debris

Hawaiian monk seals become entangled in fishing and other marine debris at rates higher than reported for other pinnipeds (Henderson 2001). A total of 347 cases of monk seals entangled in fishing gear or other debris have been observed from 1982 to 2014 (Henderson 2001; NMFS, unpubl. data). Nine documented deaths resulted from entanglement in marine debris (Henderson 1990, 2001; NMFS, unpubl. data). The fishing gear fouling the reefs and beaches of the NWHI and entangling monk seals only rarely includes types used in Hawaii fisheries. For example, trawl net and monofilament gillnet accounted for approximately 35% and 34%, respectively, of the debris removed from reefs in the NWHI by weight, and trawl net alone accounted for 88% of the debris by frequency (Donohue *et al*. 2001), despite the fact that trawl fisheries have been prohibited in Hawaii since the 1980s.

The NMFS and partner agencies continue to mitigate impacts of marine debris on monk seals as well as turtles, coral reefs and other wildlife. Marine debris is removed from beaches and seals are disentangled during annual population assessment activities at the main reproductive sites. Since 1996, annual debris survey and removal efforts in the NWHI coral reef habitat have been ongoing (Donohue *et al*. 2000, Donohue *et al*. 2001, Dameron *et al*. 2007).

Other Mortality

In the past 10 years (2004-2013) two monk seals died during enhancement activities (in 2005 and 2006) and one died during research in 2007 (NMFS unpubl. data).

Sources of mortality that impede recovery include food limitation (see Habitat Issues), single and multiple-male intra-species aggression (mobbing), shark predation, and disease/parasitism. Male seal aggression has caused episodes of mortality and injury. Past interventions to remove aggressive males greatly mitigated, but have not eliminated, this source of mortality (Johanos *et al*. 2010). Galapagos shark predation on monk seal pups has been a chronic and significant source of mortality at French Frigate Shoals since the late 1990s, despite mitigation efforts by NMFS (Gobush 2010). Infectious disease effects on monk seal demographic trends are low relative to other stressors. However, land-to-sea transfer of pathogens has been increasingly evident; since the early 2000's through 2014, six monk seal mortalities have been directly caused by protozoal infections, most often by *Toxoplasma gondii*, a protozoal parasite that is shed in the feces of cats. Furthermore, the consequences of a disease outbreak introduced from livestock, feral animals, pets or other carrier wildlife may be catastrophic to the immunologically naïve monk seal population. Key disease threats include West Nile virus, morbillivirus and influenza.

Habitat Issues

Poor juvenile survival rates and variability in the relationship between weaning size and survival suggest that prey availability is limiting recovery of NWHI monk seals (Baker and Thompson 2007, Baker *et al*. 2007, Baker 2008). Multiple strategies for improving juvenile survival, including translocation and captive care are being implemented (Baker and Littnan 2008, Baker *et al*. 2013, Norris 2013). A testament to the effectiveness of past actions to improve survival, Harting *et al.* (2014) demonstrated that approximately one-third of the monk seal population alive in 2012 was made up of seals that either had been intervened with to mitigate life-threatening situations, or were descendants of such seals. In 2014, NMFS produced a final Programmatic Environmental Impact Statement (PEIS) on current and future anticipated research and enhancement activities, and issued a permit covering the activities described in the PEIS preferred alternative (http://www.nmfs.noaa.gov/pr/permits/eis/hawaiianmonksealeis.htm). A major habitat issue involves loss of terrestrial habitat at French Frigate Shoals, where some pupping and resting islets have shrunk or virtually disappeared (Antonelis *et al*. 2006). Projected increases in global average sea level may further significantly reduce terrestrial habitat for monk seals in the NWHI (Baker *et al*. 2006, Reynolds *et al*. 2012).

Goodman-Lowe (1998) provided information on prey selection using hard parts in scats and spewings. Information on at-sea movement and diving is available for seals at all six main subpopulations in the NWHI using satellite telemetry (Stewart *et al*. 2006). Cahoon (2011) and Cahoon *et al*. (2013) described diet and foraging behavior of MHI monk seals, and found no striking difference in prey selection between the NWHI and MHI.

Remains of the seawall at Tern Island, French Frigate Shoals, is an entrapment hazard for seals. Vessel groundings pose a continuing threat to monk seals and their habitat, through potential physical damage to reefs, oil spills, and release of debris into habitats.

Monk seal abundance is increasing in the main Hawaiian Islands (Baker *et al*. 2011). Further, the excellent condition of pups weaned on these islands suggests ample prey resource availability, perhaps in part due to fishing pressure that has reduced monk seal competition with large fish predators (sharks and jacks) (Baker and Johanos 2004). If the monk seal population continues to expand in the MHI, it may bode well for the species' recovery and long-term persistence. In contrast, there are many challenges that may limit the potential for growth in this region. The human population in the MHI is approximately 1.4 million compared to fewer than 100 in the NWHI, so that the potential impact of disturbance in the MHI is great. Intentional killing of seals (noted above) is a very serious concern. Also, the same fishing pressure that may have reduced the monk seal's competitors is a source of injury and mortality. Finally, vessel traffic in the populated islands carries the potential for collision with seals and impacts from oil spills. The causes of two recent non-serious injuries (in 2010 and 2011) to seals were attributed to boat propellers. Thus, issues surrounding monk seals in the main Hawaiian Islands will likely become an increasing focus for management and recovery of this species.

STATUS OF STOCK

In 1976, the Hawaiian monk seal was designated depleted under the Marine Mammal Protection Act and as endangered under the Endangered Species Act. The species is well below its optimum sustainable population and has not recovered from past declines. Therefore, the Hawaiian monk seal is a strategic stock. Annual human-caused mortality for the most recent 5-year period (2010-2014) was at least ≥2.8 animals, including fishery-related mortality in nearshore gillnets and hook-and-line gear (≥1.2/yr, Table 3), and intentional killings and other human-caused mortalities (≥1.6/yr, Table 2).

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HARBOR PORPOISE (*Phocoena phocoena*): Morro Bay Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

In the Pacific, harbor porpoise are found in coastal and inland waters from Point Conception, California to Alaska and across to Kamchatka and Japan (Gaskin 1984). Harbor porpoise appear to have more restricted movements along the western coast of the continental U.S. than along the eastern coast. Regional differences in pollutant residues in harbor porpoise indicate that they do not move extensively between California, Oregon, and Washington (Calambokidis and Barlow 1991). That study also showed some regional differences within California (although the sample size was small). This pattern stands as a sharp contrast to the eastern coast of the U.S. and Canada where harbor porpoise are believed to migrate seasonally from as far south as the Carolinas to the Gulf of Maine and Bay of Fundy (Polacheck et al. 1995). A phylogeographic analysis of genetic data from northeast Pacific harbor porpoise did not show complete concordance between DNA sequence types and geographic location (Rosel 1992). However, an analysis of molecular variance (AMOVA) of the same data with additional samples found significant genetic differences for four of the six pair-wise comparisons between the four areas investigated: California, Washington, British Columbia, and Alaska (Rosel et al. 1995). These results demonstrate that harbor porpoise along the west coast of North America are not panmictic or migratory, and movement is sufficiently restricted that genetic differences have evolved. Subsequent genetic analyses of samples ranging from Monterey Bay, California to Vancouver Island, British Columbia indicate that there is small-scale subdivision within the U.S. portion of this range (Chivers *et al.*, 2002, 2007).

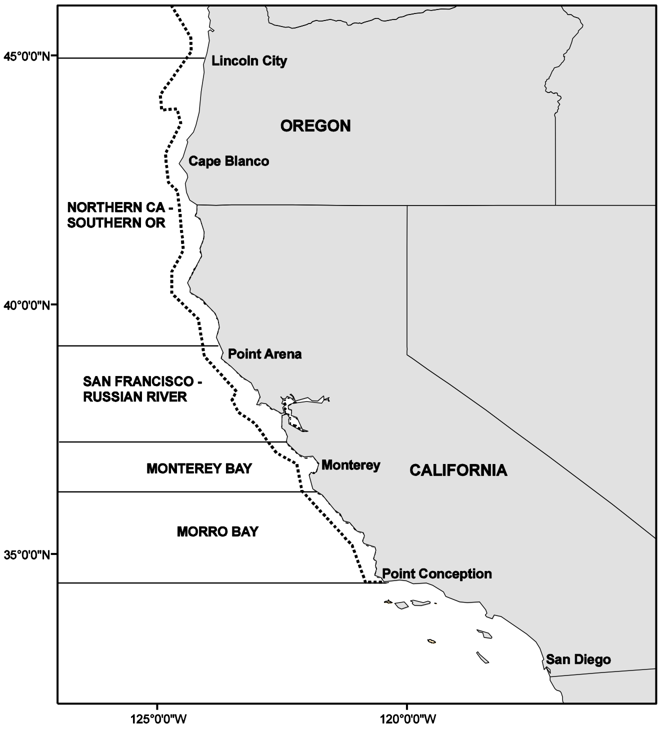

Figure 1. Stock boundaries and distributional range of harbor porpoise along the California and southern Oregon coasts. Dashed line represents harbor porpoise habitat (0-200 m) in this region.

In their assessment of harbor porpoise, Barlow and Hanan (1995) recommended that the animals inhabiting central California (defined to be from Point Conception to the Russian River) be treated as a separate stock. Their justifications for this were: 1) fishery mortality of harbor porpoise was limited to central California, 2) movement of individual animals appears to be restricted within California, and consequently 3) fishery mortality could cause the local depletion of harbor porpoise if central California is not managed separately. Although geographic structure exists along an almost continuous distribution of harbor porpoise from California to Alaska, stock boundaries are difficult to draw because any rigid line is (to a greater or lesser extent) arbitrary from a biological perspective. Nonetheless, failure to recognize geographic structure by defining management stocks can lead to depletion of local populations. Based on more recent genetic findings (Chivers *et al.*, 2002, 2007), California coast stocks were re-evaluated, and significant genetic differences were found among 4 identified sampling sites. Revised stock boundaries are presented here based on these genetic data and density discontinuities identified from aerial surveys, resulting in six California/Oregon/Washington stocks where previously there had been four (Carretta *et al.*

2001a). The stock boundaries for animals that occur in California/southern Oregon waters are shown in Figure 1. For the 2009 Marine Mammal Protection Act (MMPA) Stock Assessment Reports, other Pacific coast harbor porpoise stocks include: 1) a Monterey Bay stock, 2) a San Francisco-Russian River stock, 3) a northern California/southern Oregon stock, 4) a northern Oregon/Washington coast stock, 5) an Inland Washington stock, 6) a Southeast Alaska stock, 7) a Gulf of Alaska stock, and 8) a Bering Sea stock. Stock assessment reports for harbor porpoise stocks within waters of California, Oregon, and Washington appear in this volume. The three Alaska harbor porpoise stocks are reported separately in the Stock Assessment Reports for the Alaska Region.

POPULATION SIZE

Previous estimates of abundance for California harbor porpoise were based on aerial surveys conducted between the coast and the 50-fm isobath during 1988-95 (Barlow and Forney 1994, Forney 1999). These estimates did not include an unknown number of animals found in deeper waters. Barlow (1988) found that the vast majority of harbor porpoise in California were within the 0-50-fm depth range; however, Green et al. (1992) found that 24% of harbor porpoise seen during aerial surveys of Oregon and Washington were between the 100m and 200m isobaths (55 to 109 fathoms). A systematic ship survey of depth strata out to 90 m in northern California showed that porpoise abundance declined significantly in waters deeper than 60 m (Carretta *et al.* 2001b). Since 1999, aerial surveys have extended farther offshore (to the 200m depth contour or a minimum of 10 nmi from shore in the region of the Morro Bay stock) to provide a more complete abundance estimate. The most recent estimate of abundance for the Morro Bay stock, based on 2012 aerial surveys is 2,917 (CV=0.41) harbor porpoises (Forney et al. 2013). This estimate includes a correction factor of 3.42 (1/g(0); g(0)=0.292, CV=0.366) (Laake *et al.* 1997), to adjust for groups missed by aerial observers.

Minimum Population Estimate

The minimum population estimate for the Morro Bay harbor porpoise stock is taken as the lower 20th percentile of the log-normal distribution of the abundance estimated from the 2012 aerial surveys, or 2,102 animals.

Current Population Trend

The latest abundance estimate is greater than previous estimates dating back to 1988, which were < 2,100 harbor porpoises (see previous stock assessment reports). However, confidence limits are wide and estimates are not independent, so it is not statistically valid to infer a population trend directly from these points. Further analyses will be required to estimate population trends from the available abundance estimates, taking into account the fact that individual estimates were derived using common parameters and some shared survey data.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Based on what are argued to be biological limits of the species (i.e. females give birth first at age 4 and produce one calf per year until death), the theoretical, maximum-conceivable growth rate of a closed harbor porpoise population was estimated as 9.4% per year based on a human survivorship curve (Barlow and Boveng 1991). This maximum theoretical rate represents maximum survival in a protected environment and may not be achievable for any wild population (Barlow and Boveng 1991). Woodley and Read (1991) calculate a maximum growth rate of approximately 5% per year, but their argument for this being a maximum (i.e. that porpoise survival rates cannot exceed those of Himalayan thar) is not well justified. Population growth rates have not actually been measured for any harbor porpoise population. Because a reliable estimate of the maximum net productivity rate is not available for harbor porpoise, we use the default maximum net productivity rate (R_{MAX}) of 4% for cetaceans (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (2,102) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.5 (for a stock of unknown status; Wade and Angliss 1997), resulting in a PBR of 21.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Gillnet fisheries for halibut and white seabass that historically operated in the vicinity of Morro Bay were eliminated in this stock's range in 2002 by a ban on gillnets inshore of 60 fathoms (~110 m) from Point Arguello to Point Reyes, California. The large-mesh drift gillnet fishery for swordfish and thresher shark operates too far offshore to interact with harbor porpoise in this region. In the most recent five-year period for which data are available (2007-2011), one fishery-related stranding of harbor porpoise was documented within this stock's range (in 2008, Table 1). The responsible fishery has not been identified.

Table 1. Summary of available on incidental mortality and serious injury of Morro Bay Stock harbor porpoise in commercial fisheries that might take this species. Mean annual takes are based on 2007-2011 data. n/a indicates that data are not available.

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed Mortality	Kill/Day	Estimated Mortality (CV in parentheses)	Mean Annual Takes (CV in parentheses)
Unidentified gillnet fishery	2007-2011	Stranding	n/a	1	n/a	≥1	≥ 0.2 (n/a)
Minimum total annual takes							≥ 0.2 (n/a)

STATUS OF STOCK

Harbor porpoise in California are not listed as threatened or endangered under the Endangered Species Act nor as depleted under the Marine Mammal Protection Act. Barlow and Hanan (1995) calculate the status of harbor porpoise relative to historic carrying capacity (K) using a technique called back-projection. They calculate that the central California population (including Morro Bay, Monterey Bay, and San Francisco-Russian River stocks) could have been reduced to between 30% and 97% of K by incidental fishing mortality, depending on the choice of input parameters. They conclude that there is no practical way to reduce the range of this estimate. New information does not change this conclusion, and the status of central California harbor porpoise populations relative to their Optimum Sustainable Population (OSP) levels must be treated as unknown.

Fishery-related mortality of harbor porpoises is occasionally documented through strandings within this stock's range, although the total bycatch levels and responsible fisheries are unknown. Because the overall level of fishery mortality is unknown relative to the PBR it cannot be considered to be insignificant and approaching zero mortality and injury rate. Although there is uncertainty regarding the observed levels of fishery-related mortality for this stock, documented mortality is much less than the PBR, and thus this stock is not considered "strategic" under the MMPA. There are no known habitat issues that are presently of concern for this stock, although harbor porpoise are sensitive to disturbance by anthropogenic sound sources, such as those generated during the installation and operation of marine renewable energy facilities (Teilmann and Carstensen 2012).

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Revised 6/4/2014

HARBOR PORPOISE (*Phocoena phocoena*): Monterey Bay Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

In the Pacific, harbor porpoise are found in coastal and inland waters from Point Conception, California to Alaska and across to Kamchatka and Japan (Gaskin 1984). Harbor porpoise appear to have more restricted movements along the western coast of the continental U.S. than along the eastern coast. Regional differences in pollutant residues in harbor porpoise indicate that they do not move extensively between California, Oregon, and Washington (Calambokidis and Barlow 1991). That study also showed some regional differences within California (although the sample size was small). This pattern stands as a sharp contrast to the eastern coast of the U.S. and Canada where harbor porpoise are believed to migrate seasonally from as far south as the Carolinas to the Gulf of Maine and Bay of Fundy (Polacheck et al. 1995). A phylogeographic analysis of genetic data from northeast Pacific harbor porpoise did not show complete concordance between DNA sequence types and geographic location (Rosel 1992). However, an analysis of molecular variance (AMOVA) of the same data with additional samples found significant genetic differences for four of the six pair-wise comparisons between the four areas investigated: California, Washington, British Columbia, and Alaska (Rosel et al. 1995). These results demonstrate that harbor porpoise along the west coast of North America are not panmictic or migratory, and movement is sufficiently restricted that genetic differences have evolved. Subsequent genetic analyses of samples ranging from Monterey Bay, California to Vancouver Island, British Columbia indicate that there is small-scale subdivision within the U.S. portion of this range (Chivers *et al*., 2002, 2007).

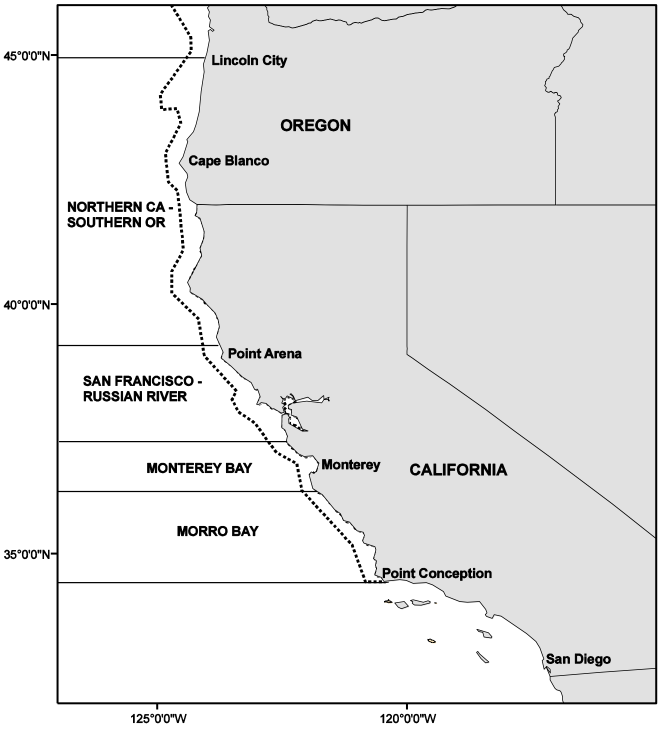

Figure 1. Stock boundaries and distributional range of harbor porpoise along the California/southern Oregon coast. Dashed line represents harbor porpoise habitat (0-200 m) along the U.S. west coast.

In their assessment of harbor porpoise, Barlow and Hanan (1995) recommended that the animals inhabiting central California (defined to be from Point Conception to the Russian River) be treated as a separate stock. Their justifications for this were: 1) fishery mortality of harbor porpoise was limited to central California, 2) movement of individual animals appears to be restricted within California, and consequently 3) fishery mortality could cause the local depletion of harbor porpoise if central California is not managed separately. Although geographic structure exists along an almost continuous distribution of harbor porpoise from California to Alaska, stock boundaries are difficult to draw because any rigid line is (to a greater or lesser extent) arbitrary from a biological perspective. Nonetheless, failure to recognize geographic structure by defining management stocks can lead to depletion of local populations. Based on more recent genetic findings (Chivers *et al*., 2002, 2007), California coast stocks were re-evaluated, and significant genetic differences were found among 4 identified sampling sites. Revised stock boundaries are presented here based on these genetic data and density discontinuities identified from aerial surveys, resulting in six California/Oregon/Washington stocks where previously there had been four (Carretta *et al.* 2001a). The stock boundaries for animals that occur in California/southern Oregon waters are shown in Figure 1. For the 2009 Marine Mammal Protection Act (MMPA) Stock Assessment Reports, other Pacific coast harbor porpoise stocks include: 1) a Monterey Bay stock, 2) a San Francisco-Russian River stock, 3) a northern California/southern Oregon stock, 4) a northern Oregon/Washington coast stock, 5) an Inland Washington stock, 6) a Southeast Alaska stock, 7) a Gulf of Alaska stock, and 8) a Bering Sea stock. Stock assessment reports for harbor porpoise stocks within waters of California, Oregon, and Washington appear in this volume. The three Alaska harbor porpoise stocks are reported separately in the Stock Assessment Reports for the Alaska Region.

POPULATION SIZE

Previous estimates of abundance for California harbor porpoise were based on aerial surveys conducted between the coast and the 50-fm isobath during 1988-95 (Barlow and Forney 1994, Forney 1999). These estimates did not include an unknown number of animals found in deeper waters. Barlow (1988) found that the vast majority of harbor porpoise in California were within the 0-50-fm depth range; however, Green et al. (1992) found that 24% of harbor porpoise seen during aerial surveys of Oregon and Washington were between the 100m and 200m isobaths (55 to 109 fathoms). A systematic ship survey of depth strata out to 90 m in northern California showed that porpoise abundance declined significantly in waters deeper than 60 m (Carretta et al. 2001b). Starting in 1999, aerial surveys extended farther offshore (to the 200m depth contour or a minimum of 15 nmi from shore in the region of the Monterey Bay stock) to provide a more complete abundance estimate. The most recent estimate of abundance for the Monterey Bay stock, based on 2011 aerial surveys is 3,715 (CV=0.51) harbor porpoises (Forney et al. 2013). This estimate includes a correction factor of 3.42 (1/g(0); g(0)=0.292, CV=0.366) (Laake *et al.* 1997), to adjust for groups missed by aerial observers.

Minimum Population Estimate

The minimum population estimate for the Monterey Bay harbor porpoise stock is taken as the lower 20th percentile of the log-normal distribution of the abundance estimated from the 2011 aerial surveys, or 2,480 animals.

Current Population Trend

The latest abundance estimate is markedly greater than previous estimates dating back to 1988, which were < 1,500-2,000 harbor porpoises (see previous stock assessment reports), but confidence limits are wide. Further analyses will be required to estimate population trends from the available abundance estimates, particularly because the abundance estimates are derived using common parameters and some shared survey data.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Based on what are argued to be biological limits of the species (i.e. females give birth first at age 4 and produce one calf per year until death), the theoretical, maximum-conceivable growth rate of a closed harbor porpoise population was estimated as 9.4% per year based on a human survivorship curve (Barlow and Boveng 1991). This maximum theoretical rate represents maximum survival in a protected environment and may not be achievable for any wild population (Barlow and Boveng 1991). Woodley and Read (1991) calculate a maximum growth rate of approximately 5% per year, but their argument for this being a maximum (i.e. that porpoise survival rates cannot exceed those of Himalayan thar) is not well justified.. Population growth rates have not actually been measured for any harbor porpoise population. Because a reliable estimate of the maximum net productivity rate is not available for harbor porpoise, we use the default maximum net productivity rate (R_{MAX}) of 4% for cetaceans (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (2,480) <u>times</u> one half the default maximum net growth rate for cetaceans (½ of 4%) <u>times</u> a recovery factor of 0.50(for a stock of unknown status ; Wade and Angliss 1997), resulting in a PBR of 25.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Gillnet fisheries for halibut and white seabass that historically operated in the vicinity of Monterey Bay were eliminated in this stock's range in 2002 by a ban on gillnets inshore of 60 fathoms (~110 m) from Point Arguello to Point Reyes, California. The large-mesh drift gillnet fishery for swordfish and thresher shark operates too far offshore to interact with harbor porpoise in this region. In the most recent five-year period for which data are available (2007-2011), no fishery-related mortality or injury of harbor porpoise within the range of the Monterey Bay stock has been documented.

Table 1. Summary of available on incidental mortality and injury of harbor porpoise in commercial fisheries that might take this species. Mean annual takes are based on 2007-2011 data. n/a indicates that data are not available.

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed Mortality	Kill/Day	Estimated Mortality (CV in parentheses)	Mean Annual Takes (CV in parentheses)
Unidentified fisheries	2007-2011	Stranding	n/a	none	n/a	n/a	0 (n/a)
Minimum total annual takes							0 (n/a)

STATUS OF STOCK

Harbor porpoise in California are not listed as threatened or endangered under the Endangered Species Act nor as depleted under the Marine Mammal Protection Act. Barlow and Hanan (1995) calculate the status of harbor porpoise relative to historic carrying capacity (K) using a technique called back-projection. They calculate that the central California population could have been reduced to between 30% and 97% of K by incidental fishing mortality, depending on the choice of input parameters. They conclude that there is no practical way to reduce the range of this estimate. New information does not change this conclusion, and the status of harbor porpoise relative to their Optimum Sustainable Population (OSP) levels in central California must be treated as unknown.

No fishery-related mortality of harbor porpoise has been documented within this stock's range during 2007-2011, and fishery mortality can be considered insignificant and approaching zero mortality rate. The Monterey Bay harbor porpoise stock is not considered "strategic" under the MMPA. There are no known habitat issues that are of particular concern for this stock, although harbor porpoise are sensitive to disturbance by anthropogenic sound sources, such as those generated during the installation and operation of marine renewable energy facilities (Teilmann and Carstensen 2012).

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HARBOR PORPOISE (*Phocoena phocoena*): San Francisco-Russian River Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

In the Pacific, harbor porpoise are found in coastal and inland waters from Point Conception, California to Alaska and across to Kamchatka and Japan (Gaskin 1984). Harbor porpoise appear to have more restricted movements along the western coast of the continental U.S. than along the eastern coast. Regional differences in pollutant residues in harbor porpoise indicate that they do not move extensively between California, Oregon, and Washington (Calambokidis and Barlow 1991). That study also showed some regional differences within California (although the sample size was small). This pattern stands as a sharp contrast to the eastern coast of the U.S. and Canada where harbor porpoise are believed to migrate seasonally from as far south as the Carolinas to the Gulf of Maine and Bay of Fundy (Polacheck et al. 1995). A phylogeographic analysis of genetic data from northeast Pacific harbor porpoise did not show complete concordance between DNA sequence types and geographic location (Rosel 1992). However, an analysis of molecular variance (AMOVA) of the same data with additional samples found significant genetic differences for four of the six pair-wise comparisons between the four areas investigated: California, Washington, British Columbia, and Alaska (Rosel et al. 1995). These results demonstrate that harbor porpoise along the west coast of North America are not panmictic or migratory, and movement is sufficiently restricted that genetic differences have evolved. Subsequent genetic analyses of samples ranging from Monterey Bay, California to Vancouver Island, British Columbia indicate that there is small-scale subdivision within the U.S. portion of this range (Chivers *et al.*, 2002, 2007).

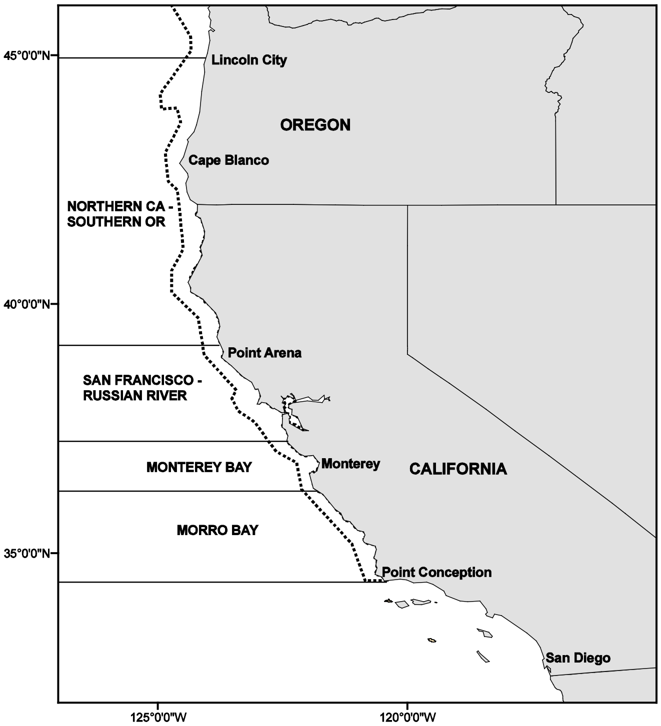

Figure 1. Stock boundaries and distributional range of harbor porpoise along the California and southern Oregon coasts. Dashed line represents harbor porpoise habitat (0-200 m) along the U.S. west coast.

In their assessment of harbor porpoise, Barlow and Hanan (1995) recommended that the animals inhabiting central California (defined to be from Point Conception to the Russian River) be treated as a separate stock. Their justifications for this were: 1) fishery mortality of harbor porpoise was limited to central California, 2) movement of individual animals appears to be restricted within California, and consequently 3) fishery mortality could cause the local depletion of harbor porpoise if central California is not managed separately. Although geographic structure exists along an almost continuous distribution of harbor porpoise from California to Alaska, stock boundaries are difficult to draw because any rigid line is (to a greater or lesser extent) arbitrary from a biological perspective. Nonetheless, failure to recognize geographic structure by defining management stocks can lead to depletion of local populations. Based on more recent genetic findings (Chivers *et al.*, 2002, 2007), California coast stocks were re-evaluated, and significant genetic differences were found among 4 identified sampling sites. Revised stock boundaries are presented here based on these genetic data and density discontinuities identified from aerial surveys, resulting in six California/Oregon/Washington stocks where previously there had been four (Carretta *et al.*

2001a). The stock boundaries for animals that occur in California/southern Oregon waters are shown in Figure 1. For the 2002 Marine Mammal Protection Act (MMPA) Stock Assessment Reports, other Pacific coast harbor porpoise stocks include: 1) a Morro Bay stock, 2) a Monterey Bay stock, 3) a northern California/southern Oregon stock, 4) a northern Oregon/Washington coast stock, 5) an Inland Washington stock, 6) a Southeast Alaska stock, 7) a Gulf of Alaska stock, and 8) a Bering Sea stock. Stock assessment reports for harbor porpoise stocks within waters of California, Oregon, and Washington appear in this volume. The three Alaska harbor porpoise stocks are reported separately in the Stock Assessment Reports for the Alaska Region.

POPULATION SIZE

Previous estimates of abundance for California harbor porpoise were based on aerial surveys conducted between the coast and the 50-fm isobath during 1988-95 (Barlow and Forney 1994, Forney 1999). These estimates did not include an unknown number of animals found in deeper waters. Barlow (1988) found that the vast majority of harbor porpoise in California were within the 0-50-fm depth range; however, Green et al. (1992) found that 24% of harbor porpoise seen during aerial surveys of Oregon and Washington were between the 100m and 200m isobaths (55 to 109 fathoms). A systematic ship survey of depth strata out to 90 m in northern California showed that porpoise abundance declined significantly in waters deeper than 60 m (Carretta *et al.* 2001b). Since 1999, aerial surveys extended farther offshore (to the 200m depth contour or a minimum of 15 nmi from shore in the region of the San Francisco-Russian River stock) to provide a more complete abundance estimate. The most recent estimate of abundance for the San Francisco-Russian River stock, based on 2007-2011 aerial surveys is 9,886 (CV=0.51) harbor porpoises (Forney et al. 2013). This estimate includes a correction factor of 3.42 (1/g(0); g(0)=0.292, CV=0.366) (Laake *et al*. 1997), to adjust for groups missed by aerial observers.

Minimum Population Estimate

The minimum population estimate for the San Francisco-Russian River harbor porpoise stock is taken as the lower 20th percentile of the log-normal distribution of the abundance estimated from 2007-2011 aerial surveys, or 6,625 animals.

Current Population Trend

The latest abundance estimate is very similar to the previous 2002-2007 estimate of 9,189 harbor porpoises (see previous stock assessment reports), and no recent trend is apparent. Further analyses will be required to estimate long-term population trends from the available abundance estimates, particularly because the abundance estimates are derived using common parameters and some shared survey data.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Based on what are argued to be biological limits of the species (i.e. females give birth first at age 4 and produce one calf per year until death), the theoretical, maximum-conceivable growth rate of a closed harbor porpoise population was estimated as 9.4% per year based on a human survivorship curve (Barlow and Boveng 1991). This maximum theoretical rate represents maximum survival in a protected environment and may not be achievable for any wild population (Barlow and Boveng 1991). Woodley and Read (1991) calculate a maximum growth rate of approximately 5% per year, but their argument for this being a maximum (i.e. that porpoise survival rates cannot exceed those of Himalayan thar) is not well justified. Population growth rates have not actually been measured for any harbor porpoise population. Because a reliable estimate of the maximum net productivity rate is not available for harbor porpoise, we use the default maximum net productivity rate (R_{MAX}) of 4% for cetaceans (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (6,625) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.5 (for a stock of unknown status; Wade and Angliss 1997), resulting in a PBR of 66.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Although coastal gillnets are prohibited throughout this stock's range, there have been fishery-related strandings in past years. In the most recent five-year period for which data are available (2007-2011), no fishery-related mortality or injury of harbor porpoise within the range of the San Francisco-Russian River stock has been documented.

Table 1. Summary of available information on incidental mortality and injury of harbor porpoise (San Francisco-Russian River stock) in commercial fisheries that might take this species. No fishery takes or fishery-related strandings were reported in this region between 2007 and 2011. n/a indicates that data are not available.

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed Mortality	Kill/Day	Estimated Mortality (CV in parentheses)	Mean Annual Takes (CV in parentheses)
Unknown fishery	2007-2011	stranding	n/a	none	n/a	n/a	0 (n/a)
Minimum total annual takes							0 (n/a)

STATUS OF STOCK

Harbor porpoise in California are not listed as threatened or endangered under the Endangered Species Act nor as depleted under the Marine Mammal Protection Act. Barlow and Hanan (1995) calculate the status of harbor porpoise relative to historic carrying capacity (K) using a technique called back-projection. They calculate that the central California population (including Morro Bay, Monterey Bay, and San Francisco-Russian River stocks) could have been reduced to between 30% and 97% of K by incidental fishing mortality, depending on the choice of input parameters. They conclude that there is no practical way to reduce the range of this estimate. New information does not change this conclusion, and the status of central California harbor porpoise populations relative to their Optimum Sustainable Population (OSP) levels must be treated as unknown. Because the known human-caused mortality or serious injury (zero harbor porpoise per year) is less than the PBR (66), this stock is not considered a "strategic" stock under the MMPA, and fishery mortality can be considered insignificant and approaching zero mortality and serious injury rate. There are no known habitat issues that are presently of concern for this stock, although harbor porpoise are sensitive to disturbance by anthropogenic sound sources, such as those generated during the installation and operation of marine renewable energy facilities (Teilmann and Carstensen 2012).

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HARBOR PORPOISE (*Phocoena phocoena*): Northern California/Southern Oregon Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

In the Pacific, harbor porpoise are found in coastal and inland waters from Point Conception, California to Alaska and across to Kamchatka and Japan (Gaskin 1984). Harbor porpoise appear to have more restricted movements along the western coast of the continental U.S. than along the eastern coast. Regional differences in pollutant residues in harbor porpoise indicate that they do not move extensively between California, Oregon, and Washington (Calambokidis and Barlow 1991). That study also showed some regional differences within California (although the sample size was small). This pattern stands as a sharp contrast to the eastern coast of the U.S. and Canada where harbor porpoise are believed to migrate seasonally from as far south as the Carolinas to the Gulf of Maine and Bay of Fundy (Polacheck et al. 1995). A phylogeographic analysis of genetic data from northeast Pacific harbor porpoise did not show complete concordance between DNA sequence types and geographic location (Rosel 1992). However, an analysis of molecular variance (AMOVA) of the same data with additional samples found significant genetic differences for four of the six pair-wise comparisons between the four areas investigated: California, Washington, British Columbia, and Alaska (Rosel et al. 1995). These results demonstrate that harbor porpoise along the west coast of North America are not panmictic or migratory, and movement is sufficiently restricted that genetic differences have evolved. Subsequent genetic analyses of samples ranging from Monterey Bay, California to Vancouver Island, British Columbia indicate that there is small-scale subdivision within the U.S. portion of this range Chivers *et al.*, 2002, 2007).

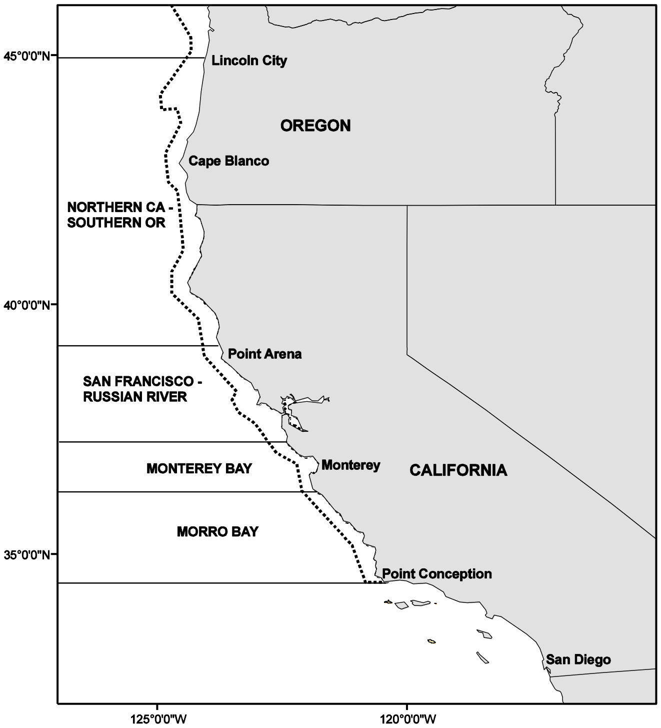

Figure 1. Stock boundaries and distributional range of harbor porpoise along the California/southern Oregon coasts. Dashed line represents harbor porpoise habitat (0-200 m) along the U.S. west coast.

In their assessment of harbor porpoise, Barlow and Hanan (1995) recommended that the animals inhabiting central California (defined to be from Point Conception to the Russian River) be treated as a separate stock. Their justifications for this were: 1) fishery mortality of harbor porpoise was limited to central California, 2) movement of individual animals appears to be restricted within California, and consequently 3) fishery mortality could cause the local depletion of harbor porpoise if central California is not managed separately. Although geographic structure exists along an almost continuous distribution of harbor porpoise from California to Alaska, stock boundaries are difficult to draw because any rigid line is (to a greater or lesser extent) arbitrary from a biological perspective. Nonetheless, failure to recognize geographic structure by defining management stocks can lead to depletion of local populations. Based on more recent genetic findings (Chivers *et al.*, 2002, 2007), California coast stocks were re-evaluated and significant genetic differences were found among four identified sampling sites. Revised stock boundaries were identified based on these genetic data and density discontinuities identified from aerial surveys (Figure 1). For the 2002 Marine Mammal Protection Act (MMPA) Stock Assessment Reports, other

Pacific coast harbor porpoise stocks include: 1) a Morro Bay stock, 2) a Monterey Bay stock, 3) a San Francisco-Russian River stock, 4) a northern Oregon/Washington coast stock, 5) an Inland Washington stock, 6) a Southeast Alaska stock, 7) a Gulf of Alaska stock, and 8) a Bering Sea stock. The stock assessment reports for harbor porpoise stocks within waters of California, Oregon, and Washington appear in this volume. The three Alaska harbor porpoise stocks are reported separately in the Stock Assessment Reports for the Alaska Region.

POPULATION SIZE

Previous estimates of abundance for California harbor porpoise were based on aerial surveys conducted between the coast and the 50-fm isobath during 1988-95 (Barlow and Forney 1994, Forney 1999). These estimates did not include an unknown number of animals found in deeper waters. Barlow (1988) found that the vast majority of harbor porpoise in California were within the 0-50-fm depth range; however, Green et al. (1992) found that 24% of harbor porpoise seen during aerial surveys of Oregon and Washington were between the 100m and 200m isobaths (55 to 109 fathoms). A systematic ship survey of depth strata out to 90 m in northern California showed that porpoise abundance declined significantly in waters deeper than 60 m (Carretta et al. 2001b). Since 1999, aerial surveys extended farther offshore (to the 200m depth contour or 15 nmi distance, whichever is farther) to provide a more complete abundance estimate. The most recent estimate of abundance for the northern California/southern Oregon stock, based on 2007-2011 aerial surveys is 35,769 (CV=0.52) harbor porpoises (Forney et al. 2013). This estimate includes a correction factor of 3.42 (1/g(0); g(0)=0.292, CV=0.366) (Laake *et al.* 1997), to adjust for groups missed by aerial observers.

Minimum Population Estimate

The minimum population estimate for harbor porpoise in northern California/southern Oregon is taken as the lower 20th percentile of the log-normal distribution of the abundance estimate obtained from 2007-2011 aerial surveys, or 23,749 animals.

Current Population Trend

The latest abundance estimate is similar to the previous 2002-2007 estimate of 39,581 harbor porpoises (see previous stock assessment reports), and no recent trend is apparent. Further analyses will be required to estimate long-term population trends from the available abundance estimates, particularly because the abundance estimates are derived using common parameters and some shared survey data.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Based on what are argued to be biological limits of the species (i.e. females give birth first at age 4 and produce one calf per year until death), the theoretical, maximum-conceivable growth rate of a closed harbor porpoise population was estimated as 9.4% per year based on a human survivorship curve (Barlow and Boveng 1991). This maximum theoretical rate represents maximum survival in a protected environment and may not be achievable for any wild population (Barlow and Boveng 1991). Woodley and Read (1991) calculate a maximum growth rate of approximately 5% per year, but their argument for this being a maximum (i.e. that porpoise survival rates cannot exceed those of Himalayan thar) is not well justified. Population growth rates have not actually been measured for any harbor porpoise population. Because a reliable estimate of the maximum net productivity rate is not available for harbor porpoise, we use the default maximum net productivity rate (R_{MAX}) of 4% for cetaceans (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (23,749) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 1.0 (for a species within its Optimal Sustainable Population; Wade and Angliss 1997), resulting in a PBR of 475.

HUMAN-CAUSED MORTALITY

Fishery Information

There were three harbor porpoise strandings in this stock's range that showed evidence of interactions with entangling net fisheries during 2007. Two of these were reported to be entangled in lost river salmon gillnet gear, while the third was an unidentified fishery interaction.

Table 1. Summary of available information on incidental mortality and injury of harbor porpoise (northern California/southern Oregon stock) in commercial fisheries that might take this species during 2007-2011. n/a indicates that data are not available.

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed Mortality	Estimated Mortality (CV in parentheses)	Mean Annual Takes (CV in parentheses)
Unknown fishery	2007-2011	Stranding	n/a	3	n/a	≥0.6 (n/a)
Minimum total annual takes						≥0.6 (n/a)

STATUS OF STOCK

Harbor porpoise in northern California/southern Oregon are not listed as threatened or endangered under the Endangered Species Act nor as depleted under the Marine Mammal Protection Act. The northern California portion of this harbor porpoise stock was determined to be within their Optimum Sustainable Population (OSP) level in the mid-1990s (Barlow and Forney 1994), based on a lack of significant anthropogenic mortality. The amount of anthropogenic mortality as documented through fishery-related strandings appears to be negligible compared with the population size and the stock is still considered to be within the range of OSP. Because the known human-caused mortality or serious injury (≥0.6 harbor porpoise per year) is less than the PBR (475), this stock is not considered a "strategic" stock under the MMPA. Because average annual fishery mortality is less than 10% of the PBR, the fishery mortality can be considered insignificant and approaching zero mortality and serious injury rate. There are no known habitat issues that are presently of concern for this stock, although harbor porpoise are sensitive to disturbance by anthropogenic sound sources, such as those generated during the installation and operation of marine renewable energy facilities (Teilmann and Carstensen 2012).

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HARBOR PORPOISE (*Phocoena phocoena*): Northern Oregon/Washington Coast Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

In the eastern North Pacific Ocean, harbor porpoise are found in coastal and inland waters from Point Barrow, along the Alaskan coast, and down the west coast of North America to Point Conception, California (Gaskin 1984). Harbor porpoise are known to occur year-round in the inland trans-boundary waters of Washington and British Columbia, Canada (Osborne *et al*. 1988) and along the Oregon/Washington coast (Barlow 1988, Barlow *et al*. 1988, Green *et al*. 1992). Aerial survey data from coastal Oregon and Washington, collected during all seasons, suggest that harbor porpoise distribution varies by depth (Green *et al*. 1992). Although distinct seasonal changes in abundance along the west coast have been noted, and attributed to possible shifts in distribution to deeper offshore waters during late winter (Dohl *et al*. 1983, Barlow 1988), seasonal movement patterns are not fully understood.

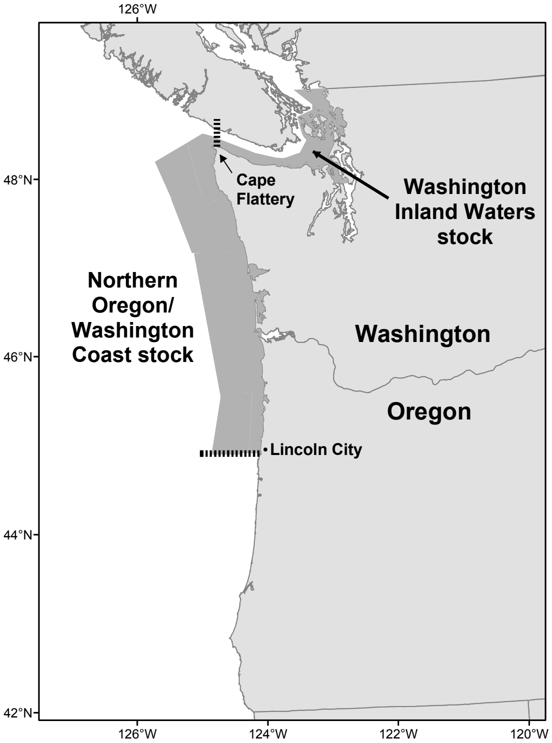

Figure 1. Stock boundaries (dashed lines) and approximate distribution (shaded areas) of harbor porpoise along the coasts of Washington and northern Oregon.

Investigation of pollutant loads in harbor porpoise ranging from California to the Canadian border suggests restricted harbor porpoise movements (Calambokidis and Barlow 1991). Stock discreteness in the eastern North Pacific was analyzed using mitochondrial DNA from samples collected along the west coast (Rosel 1992) and is summarized in Osmek *et al*. (1994). Two distinct mtDNA groupings or clades exist. One clade is present in California, Washington, British Columbia, and Alaska (no samples were available from Oregon), while the other is found only in California and Washington. Although these two clades are not geographically distinct by latitude, the results may indicate a low mixing rate for harbor porpoise along the west coast of North America. Further genetic testing of the same data, along with additional samples, found significant genetic differences for four of the six pair-wise comparisons between the four areas investigated: California, Washington, British Columbia, and Alaska (Rosel *et al*. 1995). These results demonstrate that harbor porpoise along the west coast of North America are not panmictic or migratory and that movement is sufficiently restricted that genetic differences have evolved. Recent preliminary genetic analyses of samples ranging from Monterey Bay, California, to Vancouver Island, British Columbia, indicate that there is small-scale subdivision within the U.S. portion of this range (Chivers *et al*. 2002, 2007). This is consistent with low movement suggested by genetic analysis of harbor porpoise specimens from the North Atlantic, where numerous stocks have been delineated with clinal differences over areas as small as the waters surrounding the British Isles.

Using the 1990-1991 aerial survey data of Calambokidis *et al*. (1993) for water depths <50 fathoms, Osmek *et al*. (1996) found significant differences in harbor porpoise mean densities (Z=6.9, P<0.001) between the waters of coastal Oregon/Washington and inland Washington/southern British Columbia, Canada (i.e., Strait of Juan de Fuca/San Juan Islands). Following a risk-averse management strategy, two stocks were recognized in the waters of Oregon and Washington, with a boundary at Cape Flattery, Washington. Based on recent genetic evidence, which suggests that the population of eastern

North Pacific harbor porpoise is more finely structured (Chivers *et al*. 2002, 2007), stock boundaries on the Oregon/Washington coast have been revised, resulting in three stocks in Oregon/Washington waters: a Northern California/Southern Oregon stock (Point Arena, CA, to Lincoln City, OR), a Northern Oregon/Washington Coast stock (Lincoln City, OR, to Cape Flattery, WA), and the Washington Inland Waters stock (in waters east of Cape Flattery). Additional analyses are needed to determine whether to adjust the stock boundaries for harbor porpoise in Washington inland waters (Chivers *et al*. 2007).

In their assessment of California harbor porpoise, Barlow and Hanan (1995) recommended two stocks be recognized in California, with the stock boundary at the Russian River. Based on recent genetic findings (Chivers *et al*. 2002, 2007), California coast stocks were re-evaluated and significant genetic differences were found among four identified sampling sites. Revised stock boundaries, based on these genetic data and density discontinuities identified from aerial surveys, resulted in six California/Oregon/Washington stocks where previously there had been four (e.g., Carretta *et al*. 2001): 1) the Washington Inland Waters stock, 2) the Northern Oregon/Washington Coast stock, 3) the Northern California/Southern Oregon stock, 4) the San Francisco-Russian River stock, 5) the Monterey Bay stock, and 6) the Morro Bay stock. The stock boundaries for animals that occur in northern Oregon/Washington waters are shown in Figure 1. This report considers only the Northern Oregon/Washington Coast stock. Stock assessment reports for Washington Inland Waters, Northern California/Southern Oregon, San Francisco-Russian River, Monterey Bay, and Morro Bay harbor porpoise also appear in this volume. Stock assessment reports for the three harbor porpoise stocks in the inland and coastal waters of Alaska, including 1) the Southeast Alaska stock, 2) the Gulf of Alaska stock, and 3) the Bering Sea stock, are reported separately in the Stock Assessment Reports for the Alaska Region. The harbor porpoise occurring in British Columbia have not been included in any of the U.S. stock assessment reports.

POPULATION SIZE

Two separate aerial surveys for leatherback turtles were conducted during 2010 and 2011 from the coast approximately to the 2,000 m isobath between Cape Blanco, Oregon, and Cape Flattery, Washington. Some additional adaptive surveys were conducted in areas of special interest for leatherback turtles; although these transects were not included in the analysis, the corresponding harbor porpoise sightings were included for estimation of the detection function in this study. Using a correction factor of 3.42 (1/g(0); g(0)=0.292, CV=0.366) (Laake *et al*. 1997a), to adjust for groups missed by aerial observers, the corrected estimate of abundance for harbor porpoise in the coastal waters of northern Oregon (north of Lincoln City) and Washington in 2010-2011 is 21,487 (CV = 0.44) (Forney et al. 2013).

Minimum Population Estimate

The minimum population estimate for this stock is calculated as the lower 20th percentile of the log-normal distribution (Wade and Angliss 1997) of the 2010-2011 population estimate of 21,487, which is 15,123 harbor porpoise.

Current Population Trend

There are no reliable data on population trends of harbor porpoise for coastal Oregon, Washington, or British Columbia waters; however, the uncorrected estimates of abundance for the Northern Oregon/Washington Coast stock in 1997 (6,406; SE=826.5) and 2002 (4,583) were not significantly different (Z=-1.73, P=0.08), although the survey area in 1997 (Regions I-S through III) was slightly larger than in 2002 (Strata D-G) (Laake *et al*. 1998a; J. Laake, unpublished data). The 2010-2011 Northern Oregon/Washington Coast stock estimate (21,487, CV = 0.44) is greater than the previous 2002 estimate of 15,674 (CV = 0.39), but the previous estimate is within the confidence limit of the current abundance estimate (Forney et al. 2013).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Based on what are argued to be biological limits of the species (i.e. females give birth first at age 4 and produce one calf per year until death), the theoretical, maximum-conceivable growth rate of a closed harbor porpoise population was estimated as 9.4% per year based on a human survivorship curve (Barlow and Boveng 1991). This maximum theoretical rate represents maximum survival in a protected environment and may not be achievable for any wild population (Barlow and Boveng 1991). Woodley and Read (1991) calculate a maximum growth rate of approximately 5% per year, but their argument for this being a maximum (i.e. that porpoise survival rates cannot exceed those of Himalayan thar) is not well justified. Population growth rates have not actually been measured for any harbor porpoise population. Because a reliable estimate of the maximum net productivity rate is not available for harbor porpoise, we use the default maximum net productivity rate (R_{MAX}) of 4% for cetaceans (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (15,123) times one-half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.5 (for a stock of unknown status, Wade and Angliss 1997), resulting in a PBR of 151 harbor porpoise per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Within the EEZ boundaries of the coastal waters of northern Oregon and Washington, harbor porpoise deaths are known to occur in the northern Washington marine set gillnet tribal fishery. Total fishing effort in this fishery is conducted within the range of both harbor porpoise stocks (Northern Oregon/Washington Coast and Washington Inland Waters) occurring in Washington State waters (Gearin *et al.* 1994). Some movement of harbor porpoise between Washington's coastal and inland waters is likely, but it is currently not possible to quantify the extent of such movements. For the purposes of this stock assessment report, the animals taken in waters south and west of Cape Flattery, WA, are assumed to have belonged to the Northern Oregon/Washington Coast stock, and Table 1 includes data only from that portion of the fishery. Fishing effort in the coastal marine set gillnet tribal fishery has declined since 2004. A test set gillnet fishery, with 100% observer coverage, was conducted in coastal waters in 2008 and 2011. This test fishery required the use of nets equipped with acoustic alarms, and no harbor porpoise deaths were reported (Makah Fisheries Management, unpublished data). The mean estimated mortality for this fishery in 2007-2011 is 0 (CV=0) harbor porpoise per year from observer data.

Table 1. Summary of incidental mortality and serious injury of harbor porpoise (Northern Oregon/Washington Coast stock) in commercial and tribal fisheries that might take this species and calculation of the mean annual mortality rate; n/a indicates that data are not available. Mean annual takes are based on 2007-2011 data unless noted otherwise.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean annual takes (CV in parentheses)
Northern WA marine set gillnet (tribal test fishery in coastal waters)[1]	2007 2008 2009 2010 2011	observer	no fishery 100% no fishery 100% no fishery	0 0 0 0 0	0 (0) 0 (0) 0 (0) 0 (0) 0 (0)	0 (0)
Unknown West Coast fisheries	2007-2011	stranding		2, 1, 3, 3, 6	n/a	>3.0 (n/a)
Minimum total annual takes						>3.0 (n/a)

[1] This is a tribal fishery; therefore, it is not listed in the NMFS list of commercial fisheries.

In 1995-1997, data were collected for the coastal portions (areas 4 and 4A) of the northern Washington marine set gillnet fishery as part of an experiment, conducted in cooperation with the Makah Tribe, designed to explore the merits of using acoustic alarms to reduce bycatch of harbor porpoise in salmon gillnets. Results in 1995-1996 indicated that the nets equipped with acoustic alarms had significantly lower entanglement rates, as only 2 of the 49 deaths occurred in alarmed nets (Gearin *et al.* 1996, 2000; Laake *et al.* 1997b). In 1997, 96% of the sets were equipped with acoustic alarms and 13 deaths were observed (Gearin *et al.* 2000; P. Gearin, unpublished data). Harbor porpoise were displaced by an acoustic buffer around the alarmed nets, but it is unclear whether the porpoise or their prey were repelled by the alarms (Kraus *et al.* 1997, Laake *et al.* 1998b). However, the acoustic alarms did not appear to affect the target catch (chinook salmon and sturgeon) in the fishery (Gearin *et al.* 2000). For the past decade, Makah tribal regulations have required nets set in coastal waters (areas 4 and 4A) to be equipped with acoustic alarms.

According to Northwest Marine Mammal Stranding Network records, maintained by the NMFS Northwest Region (NMFS, Northwest Regional Office, unpublished data), there were 15 fishery-related strandings of harbor porpoise from this stock reported on the northern Oregon/Washington coast in 2007-2011 (2 in 2007, 1 in 2008, 3 in 2009, 3 in 2010, and 6 in 2011), resulting in a mean annual mortality of 3.0 harbor porpoise in 2007-2011. Evidence of fishery interactions included net marks, rope marks, and knife cuts (Carretta et al. 2013). Since these deaths could not be attributed to a particular fishery, and were the only confirmed fishery-related deaths in this area in 2007-2011, they are listed in Table 1 as occurring in unknown West Coast fisheries. Seven additional strandings reported in 2007-2011 (2 in 2007, 1 in 2008, 1 in 2009 , and 3 in 2011) were considered possible fishery-related strandings but were not included in the estimate of mean annual mortality. This estimate is considered a minimum because not all stranded animals are found, reported, or examined for cause of death (via necropsy by trained personnel).

Other Mortality

A significant increase in the number of harbor porpoise strandings reported throughout Oregon and Washington in 2006 prompted the Working Group on Marine Mammal Unusual Mortality Events to declare an Unusual Mortality Event (UME) on 3 November 2006 (Huggins 2008). A total of 114 harbor porpoise strandings were reported and confirmed throughout Oregon/Washington coast and Washington inland waters in 2006 and 2007 (Huggins 2008). The cause of the UME has not been determined, and several factors, including contaminants, genetics, and environmental conditions, are still being investigated. Cause of death, determined for 48 of 81 porpoise that were examined in detail, was attributed mainly to trauma and infectious disease. Suspected or confirmed fishery interactions were the primary cause of adult/subadult traumatic injuries, while birth-related trauma was responsible for the neonate deaths. Although six of the Northern Oregon/Washington Coast harbor porpoise deaths examined as part of the UME were suspected to have been caused by fishery interactions, only two could be confirmed as fishery-related deaths; these two deaths are listed in Table 1 as occurring in unknown West Coast fisheries in 2007.

STATUS OF STOCK

Harbor porpoise are not listed as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act. Based on currently available data, the minimum annual level of total human-caused mortality and serious injury (3.0 per year) does not exceed the PBR (151). Therefore, the Northern Oregon/Washington Coast stock of harbor porpoise is not classified as “strategic.” The minimum annual fishery mortality and serious injury for this stock (3.0) is not known to exceed 10% of the calculated PBR (15.1) and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate The status of this stock relative to its Optimum Sustainable Population (OSP) level and population trends is unknown.

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HARBOR PORPOISE (*Phocoena phocoena vomerina*): Washington Inland Waters Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

In the eastern North Pacific Ocean, harbor porpoise are found in coastal and inland waters from Point Barrow, along the Alaskan coast, and down the west coast of North America to Point Conception, California (Gaskin 1984). Harbor porpoise are known to occur year-round in the inland trans-boundary waters of Washington and British Columbia, Canada (Osborne et al. 1988), and along the Oregon/Washington coast (Barlow 1988, Barlow et al. 1988, Green et al. 1992). Aerial survey data from coastal Oregon and Washington, collected during all seasons, suggest that harbor porpoise distribution varies by depth (Green et al. 1992). Although distinct seasonal changes in abundance along the west coast have been noted, and attributed to possible shifts in distribution to deeper offshore waters during late winter (Dohl et al. 1983, Barlow 1988), seasonal movement patterns are not fully understood.

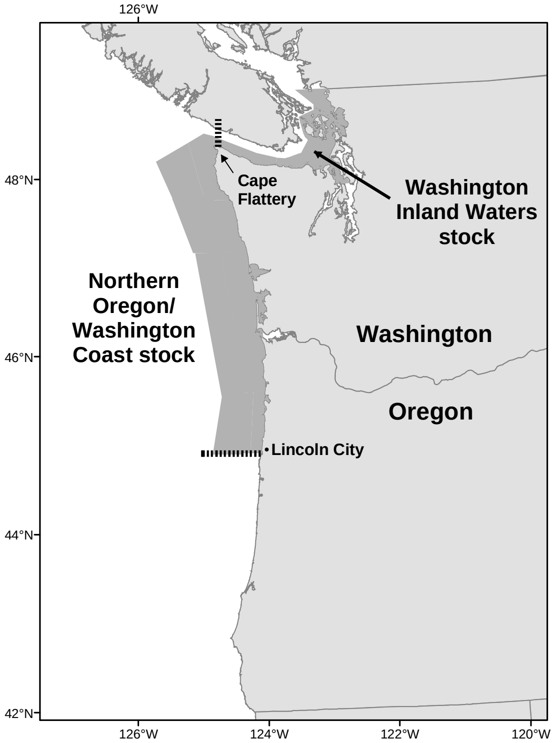

Figure 1. Stock boundaries (dashed lines) and approximate distribution (dark shaded areas) of harbor porpoise along the coasts of Washington and northern Oregon. The range of the Northern California/Southern Oregon stock of harbor porpoise (not shown), extends from Lincoln City. OR, south to Pt. Arena, CA.

Investigation of pollutant loads in harbor porpoise ranging from California to the Canadian border suggests restricted harbor porpoise movements (Calambokidis and Barlow 1991). Stock discreteness in the eastern North Pacific was analyzed using mitochondrial DNA from samples collected along the west coast (Rosel 1992) and is summarized in Osmek et al. (1994). Two distinct mtDNA groupings or clades exist. One clade is present in California, Washington, British Columbia, and Alaska (no samples were available from Oregon), while the other is found only in California and Washington. Although these two clades are not geographically distinct by latitude, the results may indicate a low mixing rate for harbor porpoise along the west coast of North America. Further genetic testing of the same data, along with additional samples, found significant genetic differences for four of the six pair-wise comparisons between the four areas investigated: California, Washington, British Columbia, and Alaska (Rosel et al. 1995). These results demonstrate that harbor porpoise along the west coast of North America are not panmictic or migratory and that movement is sufficiently restricted that genetic differences have evolved. Subsequent genetic analyses of samples ranging from Monterey Bay, California, to Vancouver Island, British Columbia, indicate that there is small-scale subdivision within the U.S. portion of this range (Chivers et al. 2002, 2007). This is consistent with low movement suggested by genetic analysis of harbor porpoise specimens from the North Atlantic, where numerous stocks have been delineated with clinal differences over areas as small as the waters surrounding the British Isles.

Using the 1990-1991 aerial survey data of Calambokidis et al. (1993) for water depths <50 fathoms, Osmek et al. (1996) found significant differences in harbor porpoise mean densities ($Z=6.9$, $P<0.001$) between the waters of coastal Oregon/Washington and inland Washington/southern British Columbia, Canada (i.e., Strait of Juan de Fuca/San Juan Islands). Following a risk averse management strategy, two stocks were recognized in the waters of Oregon and Washington, with a boundary at Cape Flattery, Washington. Based on more recent genetic evidence, which suggests that the population of eastern North Pacific harbor porpoise is more finely structured (Chivers et al. 2002, 2007), stock boundaries on the Oregon/Washington coast have been revised, resulting in three stocks in Oregon/Washington waters: a Northern California/Southern Oregon stock (Point Arena, CA, to Lincoln City, OR), a

Northern Oregon/Washington Coast stock (Lincoln City, OR, to Cape Flattery, WA), and the Washington Inland Waters stock (in waters east of Cape Flattery). Additional analyses are needed to determine whether to adjust the stock boundaries for harbor porpoise in Washington inland waters (Chivers et al. 2007).

Barlow and Hanan (1995) recommended two stocks of harbor porpoise be recognized in California, with the stock boundary at the Russian River. Based on more recent genetic findings (Chivers et al. 2002, 2007), California coast stocks were re-evaluated and significant genetic differences were found among four identified sampling sites. Revised stock boundaries, based on these genetic data and density discontinuities identified from aerial surveys, resulted in six California/Oregon/Washington stocks where previously there had been four (e.g., Carretta et al. 2001): 1) the Washington Inland Waters stock, 2) the Northern Oregon/Washington Coast stock, 3) the Northern California/Southern Oregon stock, 4) the San Francisco-Russian River stock, 5) the Monterey Bay stock, and 6) the Morro Bay stock. The stock boundaries for animals that occur in northern Oregon/Washington waters are shown in Figure 1. This report considers only the Washington Inland Waters stock. Stock assessment reports for Northern Oregon/Washington Coast, Northern California/Southern Oregon, San Francisco-Russian River, Monterey Bay, and Morro Bay harbor porpoise also appear in this volume. Stock assessment reports for the three harbor porpoise stocks in the inland and coastal waters of Alaska, including 1) the Southeast Alaska stock, 2) the Gulf of Alaska stock, and 3) the Bering Sea stock, are reported separately in the Stock Assessment Reports for the Alaska Region. The harbor porpoise occurring in British Columbia have not been included in any of the U.S. stock assessment reports.

POPULATION SIZE

Aerial surveys of the inside waters of Washington and southern British Columbia were conducted from 2013 to 2015 (Smultea *et al.* 2015a, 2015b). These aerial surveys included the Strait of Juan de Fuca, San Juan Islands, Gulf Islands, Strait of Georgia, Puget Sound, and Hood Canal. These are the waters inhabited by the Washington Inland Waters stock of harbor porpoise as well as harbor porpoise from British Columbia. Harbor porpoise abundance estimates were corrected for trackline animals missed by aerial observers using *g(0)* from prior studies in the same area and using similar methods (Laake *et al.* 1997). For U.S. waters, the current estimate of abundance is 11,233 porpoise (CV=0.37) (Smultea *et al.* 2015a).

Minimum Population Estimate

The minimum population estimate for the Washington Inland Waters stock of harbor porpoise is calculated as the lower 20th percentile of the log-normal distribution (Wade and Angliss 1997) of the 2015 population estimate of 11,233 harbor porpoise, or 8,308 animals.

Current Population Trend

Estimates of population size for Washington Inland waters from 1990-1991 aerial surveys were 3,298 (CV=0.26) animals, corrected for diving animals not seen by observers (Calambokidis *et al.* 1993). Estimates of harbor porpoise abundance for the same region from 2013-2015 surveys (11,233; CV=0.37, Smultea *et al.* 2015a), are considerably higher, however a formal trend analysis has not been performed for this stock.

In southern Puget Sound, harbor porpoise were common in the 1940s (Scheffer and Slipp 1948), but marine mammal surveys (Everitt et al. 1980), stranding records since the early 1970s (Osmek et al. 1995), and harbor porpoise surveys in 1991 (Calambokidis et al. 1992) and 1994 (Osmek et al. 1995) indicated that harbor porpoise abundance had declined in southern Puget Sound. In 1994, a total of 769 km of vessel survey effort and 492 km of aerial survey effort conducted during favorable sighting conditions produced no sightings of harbor porpoise in southern Puget Sound. Reasons for the apparent decline are unknown, but it may have been related to fishery interactions, pollutants, vessel traffic, or other factors (Osmek et al. 1995). Annual winter aerial surveys conducted by the Washington Department of Fish and Wildlife from 1995 to 2015 revealed an increasing trend in harbor porpoise in Washington inland waters, including the return of harbor porpoise to Puget Sound. The data suggest that harbor porpoise were already present in Juan de Fuca, Georgia Straits, and the San Juan Islands from the mid-1990s to mid-2000s, and then expanded into Puget Sound and Hood Canal from the mid-2000s to 2015, areas they had used historically but abandoned. Changes in fishery-related entanglement was suspected as the cause of their previous decline and more recent recovery, including a return to Puget Sound (Evenson *et al.* 2016). Seasonal surveys conducted in spring, summer, and fall 2013-2015 in Puget Sound and Hood Canal documented substantial numbers of harbor porpoise in Puget Sound. Observed porpoise numbers were twice as high in spring as in fall or summer, indicating a seasonal shift in distribution of harbor porpoise (Smultea 2015b). The reasons for the seasonal shift and for the increase in sightings is unknown.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is not available for harbor porpoise. Therefore, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate (R_{MAX}) of 4% (Wade and Angliss 1997) be employed for the Washington Inland Waters harbor porpoise stock.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) for this stock is calculated as the minimum population size (8,308) times one-half the default maximum net growth rate for cetaceans (1/2 of 4%) times a recovery factor of 0.4 (for a stock of unknown status and high uncertainty in the mortality and injury estimate), resulting in a PBR of 66 harbor porpoise per year. Although no CV is available for the mortality and serious injury estimate, there is large uncertainty because the available data are limited to stranding information, which is known to have a substantial downward bias (Carretta *et al*. 2016a, Williams *et al.* 2014). For this reason, the recovery factor was set equal to the value for a stock of unknown status with mortality and serious injury CV > 0.80 (Wade and Angliss 1997).

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Fishing effort in the northern Washington marine gillnet tribal fishery is conducted within the range of both harbor porpoise stocks (Northern Oregon/Washington Coast and Washington Inland Waters) occurring in Washington State waters (Gearin et al. 1994). Some movement of harbor porpoise between Washington's coastal and inland waters is likely, but it is currently not possible to quantify the extent of such movements. For the purposes of this stock assessment report, animals taken in waters east of Cape Flattery, WA, are assumed to have belonged to the Washington Inland Waters stock. Between 2010 and 2014, no harbor porpoise deaths or serious injuries were reported in this fishery (Makah Fisheries Management, unpublished data).

Table 1. Summary of incidental mortality and serious injury of harbor porpoise (Washington Inland Waters stock) in commercial and tribal fisheries that might take this species and calculation of the mean annual mortality rate; n/a indicates that data are not available. Mean annual takes are based on 2010-2014 data unless noted otherwise.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean annual takes (CV in parentheses)
WA Puget Sound Region salmon set/drift gillnet (observer programs listed below covered segments of this fishery):						
Puget Sound non-treaty salmon gillnet (all areas and species)	1993	observer data	1.3%	0	0	see text[1]
Puget Sound non-treaty chum salmon gillnet (areas 10/11 and 12/12B)	1994	observer data	11%	0	0	see text[1]
Puget Sound treaty chum salmon gillnet (areas 12, 12B, and 12C)	1994	observer data	2.2%	0	0	see text[1]
Puget Sound treaty chum and sockeye salmon gillnet (areas 4B, 5, and 6C)	1994	observer data	7.5%	0	0	see text[1]
Puget Sound treaty and non-treaty sockeye salmon gillnet (areas 7 and 7A)	1994	observer data	7%	1	15	see text[1]
Unknown Puget Sound Region fishery	2010-2014	stranding data		2, 0, 7, 1, 2	n/a	≥ 2.4 (n/a)
Minimum total annual takes						≥2.4 (n/a)

[1] This fishery has not been observed since 1994 (see text); these data are not included in the calculation of recent minimum total annual takes.

Commercial salmon drift gillnet fisheries in Washington inland waters were last observed in 1993 and 1994, with observer coverage levels typically <10% (Pierce et al. 1994, 1996; NWIFC 1995; Erstad et al. 1996). Drift gillnet fishing effort in the inland waters has declined considerably since 1994 because far fewer vessels participate today (NMFS WC Region, unpublished data), but entanglements of harbor porpoise likely continue to occur. The most recent data on harbor porpoise mortality from commercial gillnet fisheries is included in Table 1.

Strandings of dead or seriously injured harbor porpoise entangled in fishing gear are another source of fishery-related mortality. There were 12 fishery-related strandings of harbor porpoise from this stock in 2010-2014 (2 in 2010, 7 in 2012, 1 in 2013, and 2 in 2014), resulting in an average annual mortality and serious injury rate of 2.4 harbor porpoise per year (Carretta *et al.* 2016b). Evidence of fishery interactions included observed entanglements, net marks, and line marks. Since these deaths could not be attributed to a particular fishery, and were the only confirmed fishery-related deaths in this area in 2010-2014, they are listed in Table 1 as occurring in an unknown Puget Sound Region fishery. There are no observed fisheries in Washington inland waters, and the estimate of human-caused mortality of harbor porpoise (2.4/yr) is based solely on stranding data, which are uncorrected for negative biases in cetacean carcass recovery (Williams *et al.* 2014). The only published carcass recovery rate for harbor porpoise (<0.01) is from an oceanic-coast habitat in the NE United States (Moore and Read 2008), but due to the confined nature of inland waterways, recovery rates in Washington State inland waters are likely higher than that estimated by Moore and Read (2008). Wells *et al*. (2015) reported a carcass recovery rate (0.33) for bottlenose dolphins that inhabit the densely populated Sarasota Bay area. If this recovery rate of 0.33 is applied to Washington Inland Waters harbor porpoise fishery-related strandings for the period 2010-2014, annual mortality would be estimated at 7.2 (12 documented fishery-related strandings, times a correction factor of 3, divided by 5 years), which is less than the PBR of 66. In the absence of a carcass recovery correction factor for Washington inland waters harbor porpoise, a minimum correction factor of 3 from the Wells *et al*. (2015) coastal bottlenose dolphin study is applied to fishery-related strandings here, resulting in an estimate of 7.2 porpoise annually. Additional data are required to estimate a carcass recovery rate for harbor porpoise in Washington inland waters.

Although commercial gillnet fisheries in Canadian waters are known to have taken harbor porpoise in the past (Barlow et al. 1994, Stacey et al. 1997), few data are available because the fisheries were not monitored. In 2001, the Department of Fisheries and Oceans, Canada, conducted a federal fisheries observer program and a survey of license holders to estimate the incidental mortality of harbor porpoise in selected salmon fisheries in southern British Columbia (Hall et al. 2002). Based on the observed bycatch of porpoise (2 harbor porpoise deaths) in the 2001 fishing season, the estimated mortality for southern British Columbia in 2001 was 20 porpoise per 810 boat days fished or a total of 80 harbor porpoise. However, it is not known how many harbor porpoise from the Washington Inland Waters stock are currently taken in the waters of southern British Columbia.

Other Mortality

A significant increase in harbor porpoise strandings reported throughout Oregon and Washington in 2006 prompted the Working Group on Marine Mammal Unusual Mortality Events to declare an Unusual Mortality Event (UME) on 3 November 2006 (Huggins 2008). A total of 114 harbor porpoise strandings were reported and confirmed along the Oregon and Washington outer coasts and Washington inland waters in 2006 and 2007 (Huggins 2008). A more recent analysis of strandings before and after the suspected UME indicates that no UME occurred (Huggins *et al*. 2015). The perceived increase in mortality was the result of multiple factors: an increase in the population of harbor porpoise, a shift of the population into Washington inland waters, and a well-established stranding network with improved response and reporting (Huggins *et al*. 2015).

STATUS OF STOCK

Harbor porpoise are not listed as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act. Based on currently available data, the minimum annual level of total human-caused mortality and serious injury (7.2) harbor porpoise per year (corrected for undetected strandings) does not exceed the PBR of 66 animals. Therefore, the Washington Inland Waters harbor porpoise stock is not classified as “strategic.” The minimum annual fishery mortality and serious injury for this stock (7.2 harbor porpoise per year) exceeds 10% of PBR (6.6) and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. The status of this stock relative to its Optimum Sustainable Population (OSP) and population trends is unknown. Although harbor porpoise sightings in southern Puget Sound declined from the 1940s through the 1990s, harbor porpoise sightings have increased seasonally in this area in the last 10 years.

This stock is not recognized as “strategic,” however, the current mortality rate is based on stranding data, since the Washington Puget Sound Region salmon set/drift gillnet fishery has not been observed since 1994.

Evaluation of the estimated take level is complicated by a lack of knowledge about the extent to which harbor porpoise from U.S. waters frequent the waters of British Columbia and are, therefore, subject to fishery-related mortality. It is appropriate to consider whether the current take level is different from the take level in 1994, when the fishery was last observed. No new information is available about mortality per set, but 1) fishing effort has decreased since 1994. Based on surveys conducted in between 1991/1992 and 2015 (Calambokidis *et al.* 1993, Smultea *et al.* 2015a, 2015b), the population appears to have increased, but a statistical trend analysis has not been performed with existing data. However, an increase in harbor porpoise use of southern Puget Sound in recent years is apparent (Evenson *et al*. 2016).

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Revised 2/9/2017

DALL'S PORPOISE (*Phocoenoides dalli dalli*): California/Oregon/Washington Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Dall's porpoises are endemic to temperate waters of the North Pacific Ocean. Off the U.S. west coast, they are commonly seen in shelf, slope and offshore waters (Figure 1; Morejohn 1979). Sighting patterns from aerial and shipboard surveys conducted in California, Oregon and Washington (Green et al. 1992, 1993; Forney and Barlow 1998; Barlow 2016) suggest that north-south movement between these states occurs as oceanographic conditions change, both on seasonal and inter-annual time scales. The southern end of this population's range is not well-documented, but they are commonly seen off Southern California in winter, and during cold-water periods they probably range into Mexican waters off northern Baja California. The stock structure of eastern North Pacific Dall's porpoises is not known, but based on patterns of stock differentiation in the western North Pacific, where they have been more intensively studied, it is expected that separate stocks will emerge when data become available (Perrin and Brownell 1994). Although Dall's porpoises are not restricted to U.S. territorial waters, there are no cooperative management agreements with Mexico or Canada for fisheries which may take this species (e.g. gillnet fisheries). For the Marine Mammal Protection Act (MMPA) stock assessment reports, Dall's porpoises within the Pacific U.S. Exclusive Economic Zone are divided into two discrete, non-contiguous areas: 1) waters off California, Oregon and Washington (this report), and 2) Alaskan waters.

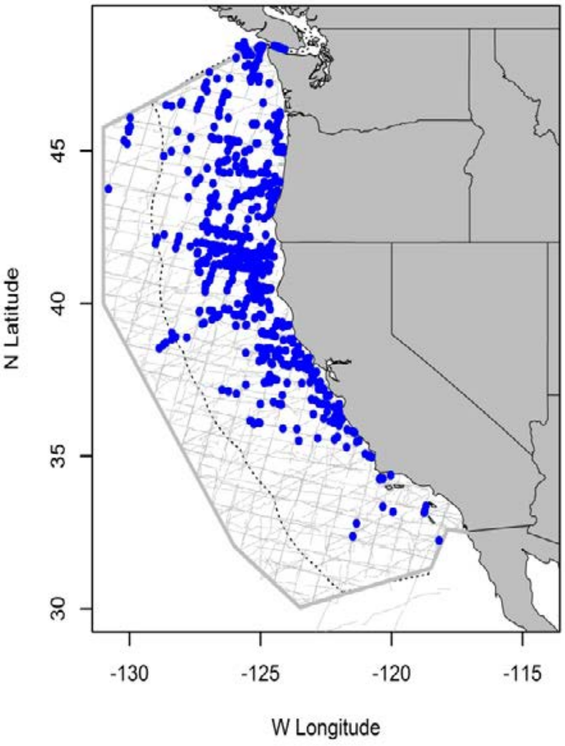

Figure 1. Dall's porpoise sightings based on shipboard surveys off California, Oregon, and Washington, 1991-2014 (Barlow 2016). Dashed line represents the U.S. EEZ, thin gray lines represent the completed transect effort of all surveys combined.

POPULATION SIZE

Dall's porpoise distribution in this region is highly variable between years and appears to be affected by oceanographic conditions (Forney 1997; Forney and Barlow 1998, Barlow 2016). Because animals may spend time outside the U.S. Exclusive Economic Zone as oceanographic conditions change, a multi-year average abundance estimate is the most appropriate for management within U.S. waters. The most recent estimate of Dall's porpoise abundance is the geometric mean of estimates from 2008 and 2014 summer/autumn vessel-based line-transect surveys of California, Oregon, and Washington waters, or 25,750 (CV=0.45) animals (Barlow 2016). This estimate includes new correction factors for animals missed during the surveys. Additional numbers of Dall's porpoises occur in the inland waters of Washington state, but the most recent abundance estimate obtained in 1996 (900 animals, CV=0.40) is over 8 years old (Calambokidis et al. 1997) and is not included in the overall estimate of abundance for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2008-2014 average abundance estimate for the outer coast of California, Oregon and Washington waters is 17,954 Dall's porpoises.

Current Population Trend

The distribution and abundance of Dall's porpoise off California, Oregon and Washington varies considerably at both seasonal and interannual time scales (Forney and Barlow 1998, Becker *et al*. 2012, Barlow 2016), but no longterm trends have been identified.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No information on current or maximum net productivity rates is available for Dall's porpoise off the U.S. west coast.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (17,954) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.48 (for a species of unknown status and mortality rate CV between 0.3 and 0.6; Wade and Angliss 1997), resulting in a PBR of 172 Dall's porpoises per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

A summary of recent fishery mortality and injury information for this stock of Dall's porpoises is given in Table 1. More detailed information on these fisheries is provided in Appendix 1. The estimate of mortality and serious injury for Dall's porpoise in the California drift gillnet fishery for the five most recent years of monitoring, 2010-2014, averages 0.3 animals per year (Carretta *et al*. 2017). Although Dall's porpoises have been incidentally killed in West Coast groundfish fisheries in the past, no takes of this species were observed during the five most recent years for which data are available, 2009-2013 (Jannot et al. 2011; NWFSC unpublished data). Gillnets have been documented to entangle marine mammals off Baja California (Sosa-Nishizaki et al. 1993), where Dall's porpoise may occasionally be found, but no recent bycatch data from Mexico are available.

Table 1. Summary of available information on the incidental mortality and serious injury of Dall's porpoises (California/ Oregon/Washington Stock) in commercial fisheries that might take this species (Carretta *et al*. 2017; Jannot *et al*. 2011). All observed entanglements of Dall's porpoises resulted in the death of the animal. Coefficients of variation for mortality estimates are provided in parentheses; n/a = not available. Mean annual takes are based on 2010-2014 data for the CA/OR swordfish drift gillnet fishery and 2005-2009 for groundfish fisheries.

Fishery Name	Data Type	Year(s)	Percent Observer Coverage	Observed Mortality	Estimated Annual Mortality (CV)	Mean Annual Takes (CV)
CA/OR thresher shark/swordfish drift gillnet fishery	observer	2010 2011 2012 2013 2014	12% 20% 19% 37% 24%	0 0 0 0 1	0 0 0 0.2 (2.3) 1.1 (0.29)	0.3 (0.53)
WA/OR/CA groundfish (bottom trawl)[a]	observer	2009-2013	23% (2009) 18% (2010) 100% (2011-2013)	0	0	0

WA/OR/CA groundfish (midwater trawl - at-sea hake sector)	observer	2009-2013	100%	0	0	0
WA/OR/CA groundfish (midwater trawl - shoreside hake sector)[b]	observer	2011-2013	100%	0	0	0
Minimum total annual takes						0.3 (0.53)

[a] The bottom trawl fishery was a limited entry fishery in 2010 and a catch shares fishery in 2011-2013.

[b] Fishery observers began monitoring the shoreside hake sector of the fishery in 2011.

STATUS OF STOCK

The status of Dall's porpoises in California, Oregon and Washington relative to OSP is not known, and there are insufficient data to evaluate potential trends in abundance. No habitat issues are known to be of concern for this species. It is not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. The average annual human-caused mortality of Dall’s porpoise (0.3 animals) is estimated to be less than the PBR (172), and they are not classified as a "strategic" stock under the MMPA. The total fishery mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate.

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Revised 2/9/2017

PACIFIC WHITE-SIDED DOLPHIN (*Lagenorhynchus obliquidens*): California/Oregon/Washington, Northern and Southern Stocks

STOCK DEFINITION AND GEOGRAPHIC RANGE

Pacific white-sided dolphins are endemic to temperate waters of the North Pacific Ocean, and common both on the high seas and along the continental margins (Brownell et al. 1999). Off the U.S. west coast, Pacific white-sided dolphins occur primarily in shelf and slope waters (Figure 1). Sighting patterns from aerial and shipboard surveys conducted in California, Oregon and Washington (Green et al. 1992; 1993; Forney and Barlow 1998; Barlow 2016) suggest seasonal north-south movements, with animals found primarily off California during the colder water months and shifting northward into Oregon and Washington as water temperatures increase in late spring and summer.

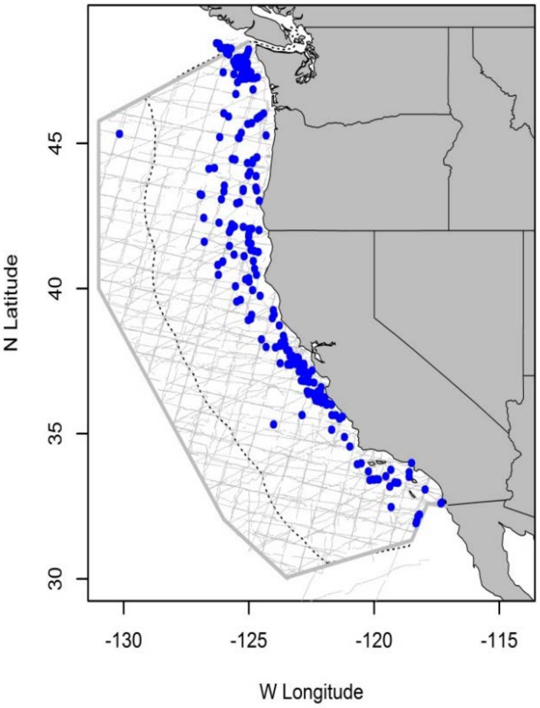

Figure 1. Pacific white-sided dolphin sightings based on shipboard surveys off California, Oregon, and Washington, 1991-2014 (Barlow 2016). Dashed line represents the U.S. EEZ, thin gray lines indicate completed transect effort of all surveys combined.

Stock structure throughout the North Pacific is poorly understood, but based on morphological evidence, two forms are known off the California coast (Walker et al. 1986). Specimens belonging to the northern form were collected from north of about 33ºN, (Southern California to Alaska), and southern specimens were obtained from about 36ºN southward along the coasts of California and Baja California. Samples of both forms have been collected in the Southern California Bight, but it is unclear whether this indicates sympatry in this region or whether they may occur there at different times (seasonally or interannually). Genetic analyses have confirmed the distinctness of animals found off Baja California from animals occurring in U.S. waters north of Point Conception, California and the high seas of the North Pacific (Lux et al. 1997). Based on these genetic data, an area of mixing between the two forms appears to be located off Southern California (Lux et al. 1997). Two types of echolocation have been documented for Pacific white-sided dolphins off Southern California and these have been hypothesized to reflect acoustic differences between the two forms (Soldevilla et al. 2008, 2011; Henderson et al. 2011).

Although there is clear evidence that two forms of Pacific white-sided dolphins occur along the U.S. west coast, there are no known differences in color pattern, and it is not currently possible to distinguish the two stocks reliably during surveys. Geographic stock boundaries appear dynamic and are poorly understood, and therefore cannot be used to differentiate the two forms. Until means of differentiating the two forms for abundance and mortality estimation are developed, these two stocks are managed as a single unit. Pacific white-sided dolphins are not restricted to U.S. territorial waters, but there are no cooperative management agreements with Mexico or Canada for fisheries which may take this species (e.g. gillnet fisheries). For the Marine Mammal Protection Act (MMPA) stock assessment reports, Pacific white-sided dolphins within the Pacific U.S. Exclusive Economic Zone are divided into two discrete, non-contiguous areas: 1) waters off California, Oregon and Washington (this report), and 2) Alaskan waters.

POPULATION SIZE

The distribution of Pacific white-sided dolphins throughout this region is highly variable, apparently in response to oceanographic changes on both seasonal and interannual time scales (Forney and Barlow 1998, Barlow 2016). As oceanographic conditions vary, Pacific white-sided dolphins may spend time outside the U.S. Exclusive Economic Zone, and therefore a multi-year average abundance estimate including California, Oregon and Washington is the most appropriate for management within U.S. waters. The most recent estimate of Pacific white-sided dolphin abundance is the geometric mean of estimates from 2008 and 2014 summer/autumn vessel-based line-transect surveys of California, Oregon, and Washington waters, 26,814 (CV=0.28) animals (Barlow 2016). This estimate includes new correction factors for animals missed during the surveys.

Minimum Population Estimate

The log-normal 20th percentile of the 2008-2014 average abundance estimate is 21,195 Pacific white-sided dolphins.

Current Population Trend

The distribution and abundance of Pacific white-sided dolphins off California, Oregon and Washington varies considerably at both seasonal and interannual time scales (Forney and Barlow 1998, Becker et al. 2012, Barlow 2016), but no long-term trends have been identified.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No information on current or maximum net productivity rates is available for Pacific white-sided dolphins off the U.S. west coast.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (21,195) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.45 (for a species of unknown status with a mortality rate CV between 0.6 and 0.8; Wade and Angliss 1997), resulting in a PBR of 191 Pacific white-sided dolphins per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

A summary of recent fishery mortality and injury information for this stock of Pacific white-sided dolphin is shown in Table 1. More detailed information on these fisheries is provided in Appendix 1. The estimate of mortality and serious injury for Pacific white-sided dolphin in the California drift gillnet fishery for the five most recent years of monitoring, 2010-2014, is 1.1 animals (CV=0.97) per year (Carretta *et al.* 2017). Although some Pacific-white sided dolphins have been incidentally killed in West Coast groundfish fisheries in the past, no takes of this species were observed during 2009-2013 (Jannot et al. 2011, NWFSC unpublished data). Gillnets have been documented to entangle marine mammals off Baja California (Sosa-Nishizaki et al. 1993), but no recent bycatch data from Mexico are available.

Table 1. Summary of available information on the incidental mortality and injury of Pacific white-sided dolphins (California/ Oregon/Washington Stock) in commercial fisheries that might take this species (Carretta *et al.* 2017; Jannot *et al.* 2011). All observed entanglements of Pacific white-sided dolphins resulted in the death of the animal. Coefficients of variation for mortality estimates are provided in parentheses; n/a = not available. Mean annual takes are based on 2010-2014 data unless noted otherwise.

Fishery Name	Data Type	Year(s)	Percent Observer Coverage	Observed Mortality	Estimated Annual Mortality	Mean Annual Takes (CV in parentheses)
CA/OR thresher shark/swordfish drift gillnet fishery	observer	2010	12%	0	1.3 (2.5)	1.1 (0.97)
		2011	20%	0	1.4 (2)	
		2012	19%	0	0.8 (2.2)	
		2013	37%	0	0.9 (1.5)	
		2014	24%	0	0.9 (2)	

Fishery Name	Data Type	Year(s)	Percent Observer Coverage	Observed Mortality	Estimated Annual Mortality	Mean Annual Takes (CV in parentheses)
WA/OR/CA groundfish (bottom trawl)	observer	2009-2013	23% (2009) 18% (2010) 100% (2011-2013)	0	0	0
WA/OR/CA groundfish (midwater trawl - at-sea hake sector)	observer	2009-2013	100%	0	0	0
WA/OR/CA groundfish (midwater trawl - shoreside hake sector)	observer	2011-2013	100%	0	0	0
Minimum total annual takes						1.1 (0.97)

Other removals

Pacific white-sided dolphins have been seriously injured and killed in scientific research trawls for sardines and rockfish. From 2010 through 2014, there were 26 deaths and 2 serious injuries of Pacific white-sided dolphins in scientific research trawls, or an average of 5.6 annually (Carretta *et al*. 2016a). One Pacific white-sided dolphin stranded dead in Washington Inland waters during 2014, and the cause of death was determined to be a vessel strike (Carretta *et al*. 2016a). Human-caused mortality and injury documentation is often based on stranding data, where raw counts are negatively-biased because only a fraction of carcasses are detected. Carretta et al. (2016b) estimated the mean recovery rate of California coastal bottlenose dolphin carcasses to be 25% (95% CI 20% - 33%) and stated that given the extremely coastal habits of coastal bottlenose dolphins, carcass recovery rates for this stock represented a maximum, compared with more pelagic dolphin species in the region. Therefore, in this stock assessment report and others involving dolphins along the U.S. West Coast, human-related deaths and injuries counted from beach strandings along the outer U.S. West Coast are multiplied by a factor of 4 to account for the non-detection of most carcasses (Carretta et al. 2016b). Applying this correction factor to the one stranded Pacific white-sided dolphin yields a minimum estimate of 4 vessel strike-related deaths during 2010-2014, or 0.8 animals annually. The average annual mortality and serious injury of Pacific white-sided dolphin from other anthropogenic activities during 2010-2014 is 5.6 (research takes), plus 0.8 animals (vessel strikes, corrected for undetected carcasses), or 6.4 animals per year.

STATUS OF STOCK

The status of Pacific white-sided dolphins in California, Oregon and Washington relative to OSP is not known, and there is no indication of a trend in abundance for this stock. No habitat issues are known to be of concern for this species. They are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. The average annual human-caused mortality and serious injury from fisheries (1.1 animals), plus other anthropogenic sources (6.4) during 2010-2014 7.5 is estimated to be less than the PBR (191), and therefore this stock of Pacific white-sided dolphins is not classified as a "strategic" stock under the MMPA. The total commercial fishery mortality and serious injury for this stock (1.1/yr) is less than 10% of the calculated PBR and, therefore, is considered to be insignificant and approaching zero.

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Revised 02/9/2017

RISSO'S DOLPHIN (*Grampus griseus*): California/Oregon/Washington Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Risso's dolphins are distributed worldwide in tropical and warm-temperate waters. Off the U.S. West coast, Risso's dolphins are commonly seen on the shelf in the Southern California Bight and in slope and offshore waters of California, Oregon and Washington. Based on sighting patterns from recent aerial and shipboard surveys conducted in these three states during different seasons (Figure 1), animals found off California during the colder water months are thought to shift northward into Oregon and Washington as water temperatures increase in late spring and summer (Green et al. 1992, 1993). The southern end of this population's range is not well-documented, but previous surveys have shown a conspicuous 500 nmi distributional gap between these animals and Risso's dolphins sighted south of Baja California and in the Gulf of California (Mangels and Gerrodette 1994). Thus this population appears distinct from animals found in the eastern tropical Pacific and the Gulf of California. Although Risso's dolphins are not restricted to U.S. waters, cooperative management agreements with Mexico exist only for the tuna purse seine fishery and not for other fisheries which may take this species (e.g. gillnet fisheries). For the Marine Mammal Protection Act (MMPA) stock assessment reports, Risso's dolphins within the Pacific U.S. Exclusive Economic Zone are divided into two discrete, non-contiguous areas: 1) waters off California, Oregon and Washington (this report), and 2) Hawaiian waters.

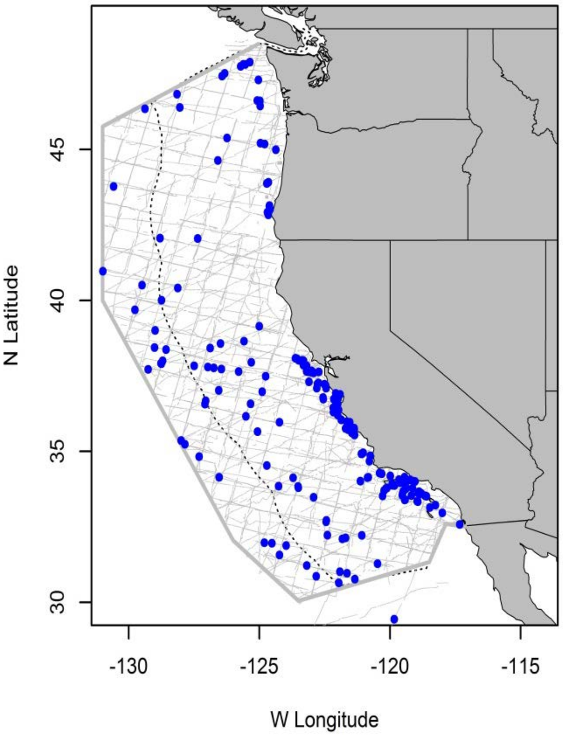

Figure 1. Risso’s dolphin sightings based on shipboard surveys off California, Oregon, and Washington, 1991-2014 (Barlow 2016). Dashed line represents the U.S. EEZ, thin gray lines indicate completed transect effort of all surveys combined.

POPULATION SIZE

The distribution of Risso’s dolphins throughout this region is highly variable, apparently in response to oceanographic changes on both seasonal and interannual time scales (Forney and Barlow 1998). As oceanographic conditions vary, Risso’s dolphins may spend time outside the U.S. Exclusive Economic Zone, and therefore a multi-year average abundance estimate is the most appropriate for management within U.S. waters. The most recent estimate of Risso’s dolphin abundance is the geometric mean of estimates from 2008 and 2014 summer/autumn vessel-based line-transect surveys of California, Oregon, and Washington waters, 6,336 (CV=0.32) animals (Barlow 2016). This estimate includes new correction factors for animals missed during the surveys.

Minimum Population Estimate

The log-normal 20th percentile of the 2008-2014 geometric mean abundance estimate is 4,817 Risso's dolphins.

Current Population Trend

The distribution and abundance of Risso's dolphins off California, Oregon and Washington varies considerably at both seasonal and interannual time scales (Forney and Barlow 1998, Becker *et al*. 2012, Barlow 2016), but no long-term trends have been identified.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No information on current or maximum net productivity rates is available for this stock.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (4,817) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.48 (for a species of unknown status with a mortality rate CV between 0.3 and 0.6; Wade and Angliss 1997), resulting in a PBR of 46 Risso's dolphins per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

A summary of recent fishery mortality and injury information for this stock of Risso's dolphin is shown in Table 1. More detailed information on these fisheries is provided in Appendix 1. The estimate of mortality and serious injury for Risso's dolphin in the California drift gillnet fishery for the five most recent years of monitoring, 2010-2014, is an average of 1.3 per year (Carretta *et al*. 2017, Table 1). Although some Risso's dolphins have been incidentally killed in West Coast groundfish fisheries in the past, no takes of this species were observed during 2009-2013 (Jannot *et al*. 2011, NWFSC unpublished data). Gillnets have been documented to entangle marine mammals off Baja California (Sosa-Nishizaki *et al*. 1993), but no recent bycatch data from Mexico are available.

Historically, Risso's dolphin mortality has been documented in the squid purse seine fishery off Southern California (Heyning et al. 1994). This mortality probably represented animals killed intentionally to protect catch or gear, rather than incidental mortality, and such intentional takes are now illegal under the 1994 Amendment to the MMPA. This fishery has expanded markedly since 1992 (California Department of Fish and Game, unpubl. data). An observer program in the squid purse seine fishery from 2004-2008 observed 377 sets (<10%) without an observed Risso's dolphin interaction.

Human-caused mortality and injury documentation is often based on stranding data, where raw counts are negatively-biased because only a fraction of carcasses are detected (Carretta *et al*. 2016a). Carretta *et al.* (2016b) estimated the mean recovery rate of California coastal bottlenose dolphin carcasses to be 25% (95% CI 20% - 33%) and stated that given the extremely coastal habits of coastal bottlenose dolphins, carcass recovery rates for this stock represented a maximum, compared with more pelagic dolphin species in the region. Therefore, in this stock assessment report and others involving dolphins along the U.S. West Coast, human-related deaths and injuries counted from beach strandings along the outer U.S. West Coast are multiplied by a factor of 4 to account for the non-detection of most carcasses (Carretta *et al*. 2016b). Three Risso's dolphins stranded during 2010-2014 with evidence of fishery interaction (Carretta *et al*. 2016a), yielding a minimum estimate of 12 fishery-related dolphin deaths.

Table 1. Summary of available information on the incidental mortality and serious injury of Risso's dolphin (California/ Oregon/Washington Stock) in commercial fisheries that might take this species (Carretta *et al*. 2016b, 2017; Jannot *et al*. 2011; NWFSC, unpublished data). All observed entanglements of Risso's dolphins resulted in the death of the animal. Human-caused mortality values based on strandings recovered along the outer U.S. West Coast are multiplied by a correction factor of 4 to account for undetected mortality (Carretta *et al*. 2016a). Coefficients of variation for mortality estimates are provided in parentheses; n/a = not available.

Fishery Name	**Data Type**	**Year(s)**	**Percent Observer Coverage**	**Observed Mortality**	**Estimated AnnualMortality (CV)**	**Mean Annual Takes (CV)**
CA/OR thresher shark/swordfish drift gillnet fishery	observer	2010	12%	0	1.5 (2.5)	1.3 (0.93)
		2011	20%	1	2.8 (1.3)	
		2012	19%	0	0.8 (2.8)	
		2013	37%	0	0.9 (1.9)	
		2014	24%	0	0.7 (2.8)	

Fishery Name	**Data Type**	**Year(s)**	**Percent Observer Coverage**	**Observed Mortality**	**Estimated AnnualMortality (CV)**	**Mean Annual Takes (CV)**
CA deep set longline fishery	observer	2005-2008	100%	0	0	0
Market squid purse seine	observer	2004-2008	<10%	0	0	0
Unknown fishery	Stranding	2007-2013	n/a	3	≥ 12	≥2.4 (0.46)[1]
WA/OR/CA groundfish (bottom trawl)[a]	observer	2009-2013	23% (2009) 18% (2010) 100% (2011-2013)	0	0	0
Minimum total annual takes (includes correction for unobserved beach strandings)						≥ 3.7 (0.44)

STATUS OF STOCK

The status of Risso's dolphins off California, Oregon and Washington relative to OSP is not known, and there are insufficient data to evaluate potential trends in abundance. No habitat issues are known to be of concern for this species. They are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. Over the last 5-year period (2010-2014), the average annual human-caused mortality (3.7 animals) is estimated to be less than the PBR (46), and therefore they are not classified as a "strategic" stock under the MMPA. The total fishery mortality and serious injury for this stock (3.7) is less than 10% of the calculated PBR and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate.

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[1] The coefficient of variation (CV) for corrected carcass counts was derived from the results of Carretta *et al*. (2016b), who estimated that 25% (95% CI = 20% - 33%) of all available carcasses were recovered / documented.

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Revised 2/9/2017

COMMON BOTTLENOSE DOLPHIN (*Tursiops truncatus*): California Coastal Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bottlenose dolphins are distributed world-wide in tropical and warm-temperate waters. In many regions, including California, separate coastal and offshore populations are known (Walker 1981; Ross and Cockcroft 1990; Van Waerebeek et al. 1990). The California coastal stock of bottlenose dolphins is distinct from the offshore stock, based on significant differences in genetics and cranial morphology (Perrin et al. 2011, Lowther-Thielking *et al*. 2015). Of 56 haplotypes found among coastal and offshore bottlenose dolphins in the region, only one is shared by both populations (Perrin et al. 2011). California coastal bottlenose dolphins are found within about one kilometer of shore (Hansen, 1990; Carretta et al. 1998; Defran and Weller 1999) from central California south into Mexican waters, at least as far south as San Quintin, Mexico (Figure 1). In southern California, animals are found within 500 m of the shoreline 99% of the time and within 250 m 90% of the time (Hanson and Defran 1993). Oceanographic events appear to influence the distribution of animals along the coasts of California and Baja California, Mexico, as indicated by a change in residency patterns along Southern California and a northward range extension into central California after the 1982-83 El Niño (Hansen and Defran 1990; Wells et al. 1990). Since the 1982-83 El Niño, which increased water temperatures off California, they have been consistently sighted in central California as far north as San Francisco. Photo-identification studies have documented north-south movements of coastal bottlenose dolphins (Hansen 1990; Defran et al. 1999), and monthly counts based on surveys between the U.S./Mexican border and Point Conception are variable (Carretta et al. 1998), indicating that animals are moving into and out of this area. There is little site fidelity of coastal bottlenose dolphins along the California coast; over 80% of the dolphins identified in Santa Barbara, Monterey, and Ensenada have also been identified off San Diego (Defran et al. 1999, Feinholz 1996, Defran *et al.* 2015). The area between Ensenada and San Quintin, Mexico may represent a southern boundary for the California coastal population, as very low rates of photo-ID overlap of individuals (3%) have been found between the two areas, compared to higher overlap rates to the north (Defran *et al.* 2015, Figure 1). Although coastal bottlenose dolphins are not restricted to U.S. waters, cooperative management agreements with Mexico exist only for the tuna purse seine fishery and not for other fisheries which may take this species. Therefore, the management stock includes only animals found within U.S. waters. For the Marine Mammal Protection Act (MMPA) stock assessment reports, bottlenose dolphins within the Pacific U.S. Exclusive Economic Zone are divided into seven stocks: 1) California coastal stock (this report), 2) California, Oregon and Washington offshore stock, and five stocks in Hawaiian waters: 3) Kauai/Niihau, 4) Oahu, 5) 4-Islands (Molokai, Lanai, Maui, Kahoolawe), 6) Hawaii Island and 7) the Hawaiian Pelagic Stock.

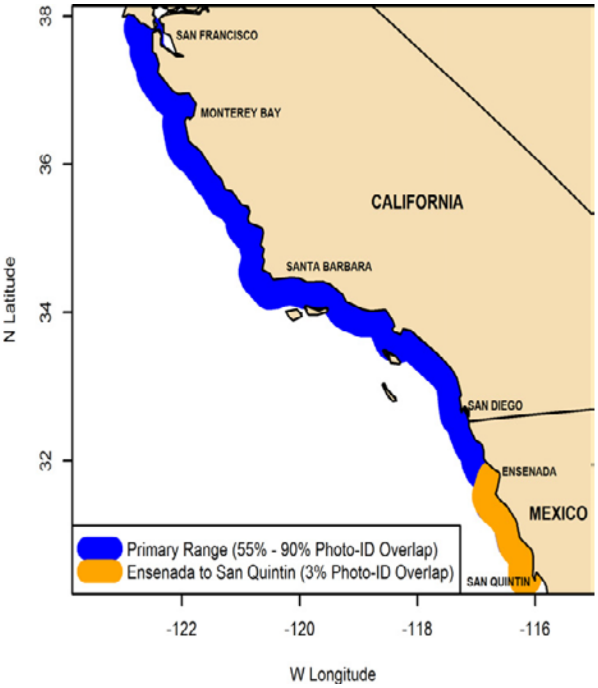

Figure 1. Approximate range of California coastal bottlenose dolphins, based on aerial and boat-based sighting surveys. This population of bottlenose dolphins is found within about 1 km of shore.

POPULATION SIZE

Based on photographic mark-recapture surveys conducted along the San Diego coast from 2009 to 2011 (Weller *et al*. 2016), two separate population size estimates were generated from open and closed mark-recapture models. The best open model generated an estimate of 515 (95% CI = 470–564, CV= 0.05) animals, while the best closed model produced an estimate of 453 (95% CI = 411–524, CV=0.06) animals. These estimates are for *marked animals only* and do not include an estimated ~ 40% of animals that are not individually recognizable (Weller *et al.* 2016). The estimated fraction of unmarked animals is highly uncertain because it is unknown how often unmarked animals are resighted. The new estimates are the largest obtained for this stock, dating back to the 1980s (Defran and Weller 1999, Dudzik 1999, Dudzik *et al.* 2006). For comparison with previous estimates of this stock, the closed population estimate of 453 (CV=0.06) animals is used as the best estimate of abundance.

Minimum Population Estimate

The minimum population size is based on the minimum number of individually identifiable animals documented during surveys in 2009-2011, or 346 animals (Weller *et al.* 2016). This number of individually recognizable dolphins exceeds the number recorded in previous survey periods: 1984-1986 (160 dolphins); 1987-1989 (284); 1996-1998 (260); and 2004-2005 (164) (Weller *et al.* 2016).

Current Population Trend

Based on a comparison of mark-recapture abundance estimates for the periods 1987-89 ($\hat{N}$= 354), 1996-98 ($\hat{N}$= 356), and 2004-05 ($\hat{N}$= 323), Dudzik et al. (2006) stated that the population size had remained stable over this period. New estimates of 450 – 515 animals based on 2009-2011 surveys are the highest to date and include a high proportion (~75%) of previously uncatalogued dolphins (Weller *et al.* 2016). The number of individually-identifiable animals from 2009-2011 surveys (346) is equal to or exceeds previous mark-recapture *abundance estimates* for this stock. This suggests that the population may be growing, although the movement of dolphins north from Mexican waters may also contribute to the observed increase in unique individuals.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No information on current or maximum net productivity rates is available for California coastal bottlenose dolphins.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (346) <u>times</u> one half the default maximum net growth rate for cetaceans (½ of 4%) <u>times</u> a recovery factor of 0.48 (for a species of unknown status with mortality rate CV ≥ 0.3 and ≤ 0.6; Wade and Angliss 1997), resulting in a PBR of 3.3 coastal bottlenose dolphins per year. Not all California coastal bottlenose dolphins are present in U.S. waters at any given moment and approximately 18% of the stock’s range occurs in Mexican waters. Thus, the PBR is prorated by a minimum factor of 0.82 to account for time that animals spend outside of U.S. waters. Without additional data on the residence times of dolphins in Mexican waters, this factor cannot be improved upon. Because this stock spends some of its time outside the U.S. EEZ, the PBR allocation for U.S. waters is 3.3 x 0.82 = 2.7 dolphins per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Due to its exclusive use of coastal habitats, this bottlenose dolphin population is susceptible to fishery-related mortality in coastal gillnet fisheries, such as the halibut and yellowtail set gillnet fishery, which was responsible for one documented coastal bottlenose dolphin death in 2003. Observer coverage in this fishery from 2010-2014 has been 9% (806 observed sets from an estimated 8,654 sets fished), with no observations of coastal bottlenose dolphin entanglements. Between 2010 and 2014, there were two fishery-related deaths of coastal bottlenose dolphins (stock ID confirmed via genetics, Lowther-Thielking *et al.* 2015). Both animals had evidence of entanglement with rope of unknown origin. A summary of information on fishery mortality and injury for this stock of bottlenose dolphin is shown in Table 1. Coastal gillnet fisheries exist in Mexico and may take animals from this population, but no details are available.

Human-caused mortality and injury documentation is often based on stranding data, where raw counts are negatively-biased because only a fraction of carcasses are detected (Williams *et al.* 2011), even for extremely coastal species (Wells *et al.* 2015). Carretta *et al.* (2016b) estimated the mean recovery rate of carcasses of California coastal bottlenose dolphins to be 25% (95% CI 20% - 33%). Given the extremely coastal habits of California coastal bottlenose dolphins, Carretta *et al.* (2016b) argue that carcass recovery rates for this population represent a maximum rate, compared to more pelagic dolphin species in the region. Therefore, in this stock assessment report and others involving dolphins along the U.S. west coast, human-related deaths and injuries counted from beach strandings are multiplied by a factor of 4 to account for the non-detection of most carcasses (Carretta *et al*. 2016b).

Other removals

Seven coastal bottlenose dolphins were collected during the late 1950s in the vicinity of San Diego (Norris and Prescott 1961). Twenty-seven additional bottlenose dolphins were captured off California between 1966 and 1982 (Walker 1975; Reeves and Leatherwood 1984), but based on the locations of capture activities, these animals probably were offshore bottlenose dolphins (Walker 1975). No additional captures of coastal bottlenose dolphins have been documented since 1982, and no live-capture permits are currently active for this species.

In 2012, a coastal bottlenose dolphin (stock ID confirmed via genetics) was found floating under a U.S. Navy marine mammal program dolphin pen enclosure dock and was assumed to have become entangled in the net curtain (Carretta *et al.* 2016a). Another, presumed coastal bottlenose dolphin (based on proximity to shore) became entrapped and drowned in a sea otter research net in 2012. The average annual non-fishery related mortality and serious injury of coastal bottlenose dolphins from 2010-2014 is 0.4 animals (2 animals / 5 years).

Table 1. Summary of available information on the incidental mortality and serious injury of bottlenose dolphins (California Coastal Stock) in commercial fisheries that might take this species. Human-caused mortality values based on strandings recovered on the outer U.S. West Coast are multiplied by a correction factor of 4 to account for undetected mortality (Carretta *et al.* 2016b).

Fishery Name	**Data Type**	**Year(s)**	**Percent Observer Coverage**	**Observed Mortality**	**Estimated Annual Mortality**	**Mean Annual Takes (CV in parentheses)**
CA angel shark/ halibut and other species large mesh (>3.5in) set gillnet fishery	observer	2010-2014	9%	0	0	0
Unknown fishery	stranding	2010-2014	Two strandings with evidence of entanglement in rope or braided material.			≥ 0.4 x 4 (correction factor) = 1.6 (0.46)[1]
Minimum total annual takes (includes correction for unobserved beach strandings)						≥ 1.6 (0.46)

STATUS OF STOCK

The status of coastal bottlenose dolphins in California relative to OSP is not known, and there is no evidence of a trend in abundance. They are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. Coastal bottlenose dolphins are not classified as a "strategic" stock under the MMPA because total annual fishery (1.6) and other anthropogenic mortality (0.4) and serious injury for this stock (≥ 2.0 per year) is less than the PBR (2.7). The total human-caused mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero. Recent population size estimates of 450 to 515 marked individuals are the highest recorded to date (Weller *et al.* 2016), but it is unknown how much of this increase is due to population growth versus immigration.

Habitat Issues

Pollutant levels, especially DDT residues, found in Southern California coastal bottlenose dolphins have been found to be among the highest of any cetacean examined (O'Shea et al. 1980; Schafer et al. 1984). Although the effects of pollutants on cetaceans are not well understood, they may affect reproduction or make the animals more prone to other mortality factors (Britt and Howard 1983; O'Shea et al. 1999). This population of bottlenose dolphins may also be vulnerable to the effects of morbillivirus

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[1] The coefficient of variation (CV) for corrected carcass counts was derived from the results of Carretta *et al.* (2016b), who estimated that 25% (95% CI = 20% - 33%) of all available carcasses were recovered / documented.

outbreaks, which were implicated in the 1987-88 mass mortality of bottlenose dolphins on the U.S. Atlantic coast (Lipscomb et al. 1994).

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Revised 2/7/2017

COMMON BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*): California/Oregon/Washington Offshore Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bottlenose dolphins are distributed world-wide in tropical and warm-temperate waters. In many regions, including California, separate coastal and offshore populations are known (Walker 1981; Ross and Cockcroft 1990; Van Waerebeek et al. 1990; Lowther 2006). On surveys conducted off California, offshore bottlenose dolphins have been found at distances greater than a few kilometers from the mainland and throughout the Southern California Bight. They have also been documented in offshore waters as far north as about 41ºN (Figure 1), and they may range into Oregon and Washington waters during warm-water periods. Sighting records off California and Baja California (Lee 1993; Mangels and Gerrodette 1994) suggest that offshore bottlenose dolphins have a continuous distribution in these two regions. There is no apparent seasonality in distribution (Forney and Barlow 1998). Offshore bottlenose dolphins are not restricted to U.S. waters, but cooperative management agreements with Mexico exist only for the tuna purse seine fishery and not for other fisheries which may take this species (e.g. gillnet fisheries). Therefore, the management stock includes only animals found within U.S. waters. For the Marine Mammal Protection Act (MMPA) stock assessment reports, bottlenose dolphins within the Pacific U.S. Exclusive Economic Zone are divided into seven stocks: 1) California coastal stock, 2) California, Oregon and Washington offshore stock (this report), and five stocks in Hawaiian waters: 3) Kauai/Niihau, 4) Oahu, 5) 4-Islands (Molokai, Lanai, Maui, Kahoolawe), 6) Hawaii Island and 7) the Hawaiian Pelagic Stock.

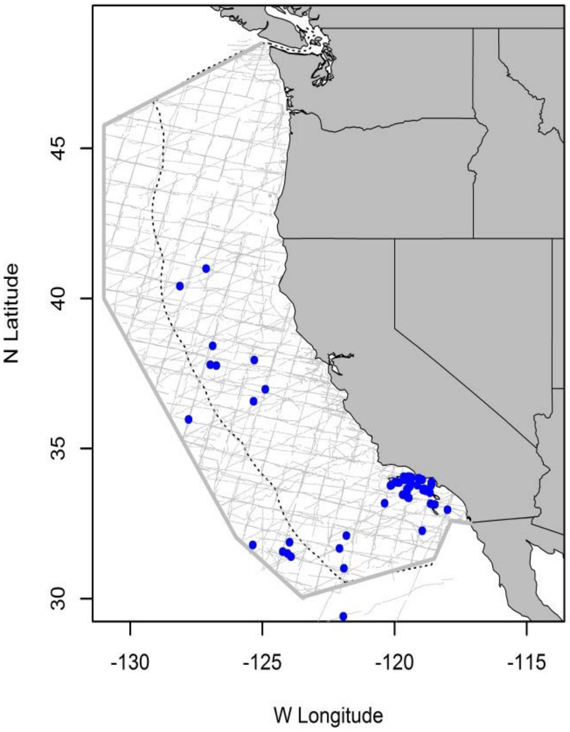

Figure 1. Offshore bottlenose dolphin sightings based on shipboard surveys off California, Oregon, and Washington, 1991-2014 (Barlow 2016). Dashed line represents the U.S. EEZ, thin gray lines indicate completed transect effort of all surveys combined.

POPULATION SIZE

The most recent estimate of bottlenose dolphin abundance is the geometric mean of estimates from 2008 and 2014 summer/autumn vessel-based line-transect surveys of California, Oregon, and Washington waters, 1,924 (CV=0.54) animals (Barlow 2016). This estimate includes new correction factors for animals missed during the surveys.

Minimum Population Estimate

The log-normal 20th percentile of the 2008-2014 geometric mean abundance estimate is 1,255 offshore bottlenose dolphins.

Current Population Trend

Trend analyses for this stock have not been performed to date, while other stocks with more urgent conservation concerns are analyzed (e.g., Moore and Barlow 2011, 2013).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No information on current or maximum net productivity rates is available for this population of offshore bottlenose dolphins.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (1,255) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.45 (for a species of unknown status with fishery mortality CV between 0.6 and 0.8; Wade and Angliss 1997), resulting in a PBR of 11 offshore bottlenose dolphins per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

A summary of known fishery mortality and serious injury for this stock of bottlenose dolphin is shown in Table 1. The estimate of mortality and serious injury for bottlenose dolphin in the California drift gillnet fishery for the five most recent years of monitoring, 2010-2014, is 6.9 (CV=0.74) individuals, or an average of 1.4 per year (CV=0.74) (Carretta *et al*. 2017). One bottlenose dolphin was seriously injured in the limited entry fixed gear sablefish fishery during 2009, but no other deaths or injuries were reported in West Coast groundfish fisheries for the period 2009-2013 (Jannot *et al*. 2011). Gillnets have been documented to entangle marine mammals off Baja California (Sosa-Nishizaki *et al*. 1993), but no recent bycatch data from Mexico are available. Gillnets have been documented to entangle marine mammals off Baja California (Sosa-Nishizaki et al. 1993), but no recent bycatch data from Mexico are available.

Table 1. Summary of available information on the incidental mortality and serious injury of bottlenose dolphins (California/ Oregon/Washington Offshore Stock) in commercial fisheries that might take this species (Carretta *et al*. 2016, 2017; Jannot *et al*. 2011). Coefficients of variation for mortality estimates are provided in parentheses; n/a = not available.

Fishery Name	Data Type	Year(s)	Percent Observer Coverage	Observed Mortality (and Serious Injury)	Estimated Mortality and Serious Injury (CV)	Mean Annual Takes (CV in parentheses)
CA/OR thresher shark/swordfish drift gillnet fishery	observer	2010 2011 2012 2013 2014	12% 20% 19% 37% 24%	1 0 0 0 0	6.8 (0.75) 0.1 (7.6) 0 (n/a) 0 (n/a) 0 (n/a)	1.4 (0.74)
CA halibut / white seabass and other species set gillnet fishery	observer	2010-2014	9%	0 0 0 0	0	0
California yellowtail, barracuda, and white seabass drift gillnet fishery	observer	2010-2012	~4%	0	0	0
CA lobster trap/pot	At-sea disentanglement	2008	n/a	0 (1)	1 (n/a)	0.2 (n/a)
Limited entry fixed gear (longline) sablefish fishery	At-sea disentanglement	2005 2006 2007 2008 2009	0.5% 1.5% 3.4% 1.5% 2.4%	0 (1)	1 (n/a)*	0.2 (n/a)
Minimum total annual takes						≥1.6 (0.74)

*No estimate of bycatch was derived from the one observation of a bottlenose dolphin released injured from sablefish gear (Jannot *et al*. 2011).

STATUS OF STOCK

The status of offshore bottlenose dolphins in California relative to OSP is not known, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this species. They are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. Because average annual fishery takes (1.6 /yr) are less than the calculated PBR (11), offshore bottlenose dolphins are not classified as a "strategic" stock under the MMPA. The total fishery mortality and serious injury for this stock is less than 10% of the PBR and, therefore, can be considered to be insignificant and approaching zero.

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Revised 02/09/2017

STRIPED DOLPHIN (*Stenella coeruleoalba*): California/Oregon/Washington Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Striped dolphins are distributed world-wide in tropical and warm-temperate pelagic waters. Striped dolphins are commonly encountered in warm offshore waters of California, and a few sightings have been made off Oregon (Figure 1, Barlow 2016). Striped dolphins are also commonly found in the central North Pacific, but sampling between this region and California has been insufficient to determine whether the distribution is continuous. Based on sighting records off California and Mexico, striped dolphins appear to have a continuous distribution in offshore waters of these two regions (Perrin et al. 1985; Mangels and Gerrodette 1994). No information on possible seasonality in distribution is available, because the California surveys which extended 300 nmi offshore were conducted only during the summer/fall period. Although striped dolphins are not restricted to U.S. waters, cooperative management agreements with Mexico exist only for the tuna purse seine fishery and not for other fisheries which may take this species (e.g. gillnet fisheries). Therefore, the management stock includes only animals found within U.S. waters. For the Marine Mammal Protection Act (MMPA) stock assessment reports, striped dolphins within the Pacific U.S. Exclusive Economic Zone are divided into two discrete, non-contiguous areas: 1) waters off California, Oregon and Washington (this report), and 2) waters around Hawaii.

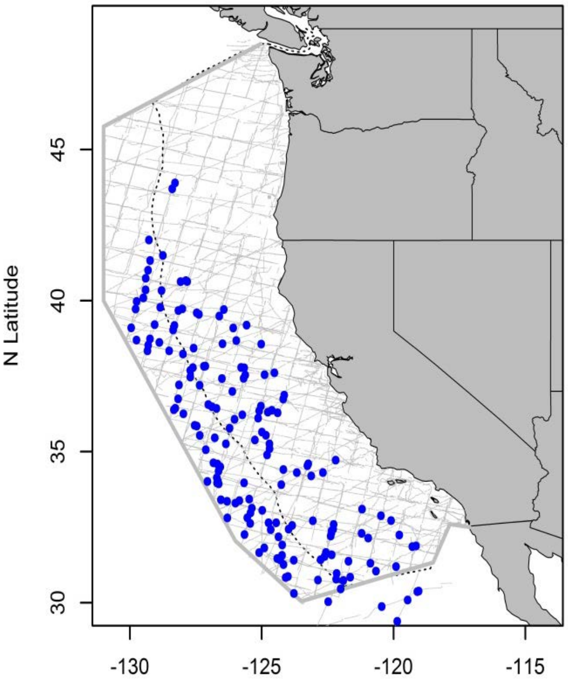

Figure 1. Striped dolphin sightings based on shipboard surveys off California, Oregon, and Washington, 1991-2014 (Barlow 2016). Dashed line represents the U.S. EEZ, thin gray lines indicate the completed transect effort of all surveys combined.

POPULATION SIZE

The abundance of striped dolphins in this region appears to be variable between years and may be affected by oceanographic conditions, as with other odontocete species (Forney 1997, Becker et al. 2012, Barlow 2016). Because animals may spend time outside the U.S. Exclusive Economic Zone as oceanographic conditions change, a multi-year average abundance estimate is the most appropriate for management within U.S. waters. The most recent estimate of striped dolphin abundance is the geometric mean of estimates from 2008 and 2014 summer/autumn vessel-based line-transect surveys of California, Oregon, and Washington waters, 29,211 (CV=0.20) animals (Barlow 2016). This estimate includes new correction factors for animals missed during the surveys.

Minimum Population Estimate

The log-normal 20th percentile of the 2008-2014 average abundance estimate is 24,782 striped dolphins.

Current Population Trend

The distribution and abundance of striped dolphins off California, Oregon and Washington varies interannually (Becker et al. 2012, Barlow 2016), but no long-term trends have been identified.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No information on current or maximum net productivity rates is available for striped dolphins off California.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (24,782) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.48 (for a species of unknown status with fishery mortality CV > 0.3 and < 0.6; Wade and Angliss 1997), resulting in a PBR of 238 striped dolphins per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

A summary of recent fishery mortality and injury for this stock of striped dolphin is shown in Table 1. More detailed information on these fisheries is provided in Appendix 1. The estimate of mortality and serious injury for striped dolphin in the California drift gillnet fishery for the five most recent years of monitoring, 2010-2014, is zero animals per year (Carretta et al. 2017). Human-caused mortality and injury documentation is often based on stranding data, where raw counts are negatively-biased because only a fraction of carcasses are detected. Carretta *et al*. (2016a) estimated the mean recovery rate of California coastal bottlenose dolphin carcasses to be 25% (95% CI 20% - 33%) and stated that given the extremely coastal habits of coastal bottlenose dolphins, carcass recovery rates for this stock represented a maximum, compared with more pelagic dolphin species in the region. Therefore, in this stock assessment report and others involving dolphins along the U.S. West Coast, human-related deaths and injuries counted from beach strandings along the outer U.S. West Coast are multiplied by a factor of 4 to account for the non-detection of most carcasses (Carretta *et al*. 2016a). One striped dolphin stranded during 2010-2014 with evidence of fishery interaction (Carretta *et al*. 2016b), yielding a minimum estimate of four fishery-related dolphin deaths. Gillnets have been documented to entangle marine mammals off Baja California (Sosa-Nishizaki et al. 1993), but no recent bycatch data from Mexico are available.

Table 1. Summary of available information on the incidental mortality and serious injury of striped dolphins (California/ Oregon/Washington Stock) in commercial fisheries that might take this species (Carretta *et al*. 2016a, 2016b, 2017.). Human-caused mortality values based on strandings recovered along the outer U.S. West Coast are multiplied by a correction factor of 4 to account for undetected mortality (Carretta *et al*. 2016a). Coefficients of variation for mortality estimates are provided in parentheses.

Fishery Name	Data Type	Year(s)	Percent Observer Coverage	Observed Mortality	Estimated Mortality	Mean Annual Takes (CV in parentheses)
CA/OR thresher shark/swordfish drift gillnet fishery	observer	2010 2011 2012 2013 2014	12% 20% 19% 37% 24%	0 0 0 0 0	0 (n/a)	0 (n/a)
Unidentified fishery	Stranding	2010-2014	-	1	≥ 4	≥ 0.8 (0.46)[1]
Minimum total annual takes (includes correction for unobserved beach strandings)						≥ 0.8 (0.46)

STATUS OF STOCK

The status of striped dolphins in California relative to OSP is not known, and there are insufficient data to evaluate potential trends in abundance. No habitat issues are known to be of concern for this species. They are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. Because recent fishery and human-caused mortality (≥0.80) is less than 10% of the PBR (238), striped dolphins are not classified as a "strategic" stock under the MMPA, and the total fishery mortality and serious injury for this stock can be considered to be insignificant and approaching zero.

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[1] The coefficient of variation (CV) for corrected carcass counts was derived from the results of Carretta *et al*. (2016a), who estimated that 25% (95% CI = 20% - 33%) of all available carcasses were recovered / documented.

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Revised 02/07/2017

SHORT-BEAKED COMMON DOLPHIN (*Delphinus delphis*): California/Oregon/Washington Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

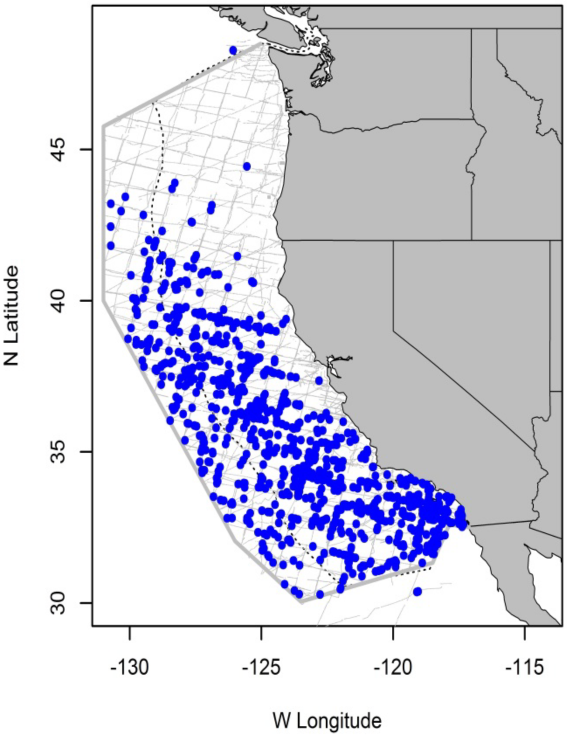

Figure 1. Short-beaked common dolphin sightings based on shipboard surveys off California, Oregon, and Washington, 1991-2014 (Barlow 2016). Dashed line represents the U.S. EEZ, thin gray lines indicate completed transect effort of all surveys combined.

Short-beaked common dolphins are the most abundant cetacean off California, and are widely distributed between the coast and at least 300 nmi distance from shore (Figure 1). The abundance of this species off California has been shown to change on both seasonal and inter-annual time scales (Dohl *et al.* 1986; Forney and Barlow 1998; Barlow 2016). Significant seasonal shifts in the abundance and distribution of common dolphins have been identified based on winter/spring 1991-92 and summer/fall 1991 surveys (Forney and Barlow 1998). The distribution of short-beaked common dolphins is continuous southward into Mexican waters to about 13ºN (Perrin *et al.* 1985; Wade and Gerrodette 1993; Mangels and Gerrodette 1994), and short-beaked common dolphins off California may be an extension of the "northern common dolphin" stock defined for management of eastern tropical Pacific tuna fisheries (Perrin *et al.* 1985). However, preliminary data on variation in dorsal fin color patterns suggest there may be multiple stocks in this region, including at least two possible stocks in California (Farley 1995). Although short-beaked common dolphins are not restricted to U.S. waters, cooperative management agreements with Mexico exist only for the tuna purse seine fishery and not for other fisheries which may take this species. Under the Marine Mammal Protection Act (MMPA), short-beaked common dolphins involved in tuna purse seine fisheries in international waters of the eastern tropical Pacific are managed separately, and they are not included in the assessment reports. For the MMPA stock assessment reports, there is a single Pacific management stock including only animals found within the U.S. Exclusive Economic Zone of California, Oregon and Washington.

POPULATION SIZE

The distribution of short-beaked common dolphins throughout this region is highly variable, apparently in response to oceanographic changes on both seasonal and interannual time scales (Heyning and Perrin 1994; Forney 1997; Forney and Barlow 1998). As oceanographic conditions vary, short-beaked common dolphins may spend time outside the U.S. Exclusive Economic Zone, and therefore a multi-year average abundance estimate is the most appropriate for management within U.S. waters. The most recent estimate of short-beaked common dolphin abundance is the geometric mean of estimates from 2008 and 2014 summer/autumn vessel-based line-transect surveys of California, Oregon, and Washington waters, 969,861 (CV = 0.17) animals (Barlow 2016). This estimate includes new correction factors for animals missed during the surveys.

Minimum Population Estimate

The log-normal 20th percentile of the 2008-2014 average abundance estimate is 839,325 short-beaked common dolphins.

Current Population Trend

Short-beaked common dolphin abundance off the U.S. West Coast is known to increase during warm-water periods (Dohl *et al.* 1986, Forney and Barlow 1998, Barlow 2016). The most recent 2014 survey was conducted during extremely warm ocean conditions (Bond *et al*. 2015) and resulted in the largest abundance estimate since large-scale surveys began in 1991. The increase in short-beaked common dolphin abundance is likely a result of northward movement of this transboundary stock from waters off Mexico (Barlow 2016).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

There are no estimates of current or maximum net productivity rates for short-beaked common dolphins.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (839,325) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a species of unknown status with a mortality rate CV< 0.30; Wade and Angliss 1997), resulting in a PBR of 8,393 short-beaked common dolphins per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

A summary of recent fishery mortality and injury for short-beaked common dolphins is shown in Table 1. The summed estimate of mortality and serious injury for short-beaked common dolphin in the California drift gillnet fishery for the five most recent years of monitoring, 2010-2014, is approximately 100 individuals, or an average of 20 (CV=0.18) per year (Carretta *et al.* 2017) (Table 1). No takes were documented by observers during the most recent five years of monitoring for other gillnet and purse seine fisheries that have interacted with short-beaked common dolphins in the past. However, two short-beaked common dolphins stranded with evidence of fishery interaction with an unidentified gillnet fishery. Human-caused mortality and injury documentation is often based on stranding data, where raw counts are negatively-biased because only a fraction of carcasses are detected. Carretta *et al*. (2016a) estimated the mean recovery rate of California coastal bottlenose dolphin carcasses to be 25% (95% CI 20% - 33%) and stated that given the extremely coastal habits of coastal bottlenose dolphins, carcass recovery rates for this stock represented a maximum, compared with more pelagic dolphin species in the region. Therefore, in this stock assessment report and others involving dolphins along the U.S. West Coast, human-related deaths and injuries counted from beach strandings along the outer U.S. West Coast are multiplied by a factor of 4 to account for the non-detection of most carcasses (Carretta *et al*. 2016a). Applying this correction factor to the two stranded short-beaked common dolphins yields a minimum estimate of 8 fishery-related dolphin deaths.

Table 1. Summary of available information on the incidental mortality and injury of short-beaked common dolphins (California/Oregon/Washington Stock) in commercial fisheries that might take this species (Carretta *et al*. 2016b, 2017). All entanglements resulted in the death of the animal. Coefficients of variation for mortality estimates are provided in parentheses; n/a = not available. Human-caused mortality values based on strandings recovered along the outer U.S. West Coast are multiplied by a correction factor of 4 to account for undetected mortality (Carretta *et al.* 2016a).

Fishery Name	Data Type	Year	Percent Observer Coverage	Observed Mortality (and Serious Injury)	Estimated Mortality and Serious Injury	Mean Annual Takes (CV in parentheses)
CA/OR thresher shark/swordfish drift gillnet fishery	observer	2010	12%	3	21.2 (0.53)	20 (0.18)
		2011	20%	2	15.2 (0.46)	
		2012	19%	5	21.3 (0.41)	
		2013	37%	6	16.5 (0.25)	
		2014	24%	6	23.5 (0.31)	

Fishery Name	Data Type	Year	Percent Observer Coverage	Observed Mortality (and Serious Injury)	Estimated Mortality and Serious Injury	Mean Annual Takes (CV in parentheses)
CA squid purse seine	observer	2004 2005 2006 2007 2008	unknown 1.1% unknown <5% <5%	0 1 0 (1) 0 0	0 87 (0.98) ≥ 1 (n/a)0 0	18 (0.98)
CA halibut / white seabass and other species set gillnet fishery	observer	2010-2014	9%	0	0	0 (n/a)
Hawaii Shallow Set Longline fishery	observer	2010-2014	100%	0 0 (1) 0 0 0 (1)	0 (2)	0.4 (n/a)
Unidentified gillnet fishery	Stranding	2010-2014	-	2	≥8	≥1.6 (0.46)[1]
Minimum total annual takes (includes correction for unobserved beach strandings)						≥ 40 (0.45)

The California squid purse seine fishery has not been observed since 2008. Between 2004 and 2008, there were 377 sets observed in the squid purse seine fishery and one short-beaked common dolphin mortality was observed in 2005, with a resulting mortality estimate of 87 (CV=0.98) animals (Carretta and Enriquez 2006). It is likely, due to the low observer coverage that year (~1%), combined with a relatively rare entanglement event, that this estimate is positively-biased (Carretta and Moore 2014). In addition, there was one squid purse seine set in 2006 where 8 unidentified dolphins were encircled. Seven were released alive and the eighth was seriously injured. For purposes of this stock assessment report, it is assumed that the unidentified seriously injured dolphin was a short-beaked common dolphin, due to its high abundance within the fishing area and a previous record of this species having been killed in the fishery.

Two short-beaked common dolphins were reported released injured from the Hawaii shallow set longline fishery (one each in 2011 and 2014 with 100% observer coverage, Table 1). These interactions occurred outside of the U.S. EEZ just west of the California Current and likely involved dolphins from the CA/OR/WA stock of short-beaked common dolphins (NOAA Pacific Islands Regional Office 2017).

Other Mortality

In the eastern tropical Pacific, 'northern common dolphins' have been incidentally killed in international tuna purse-seine fisheries since the late 1950's and are managed separately under a section of the MMPA written specifically for the management of dolphins involved in eastern tropical Pacific tuna fisheries. Cooperative international management programs have dramatically reduced overall dolphin mortality in these fisheries in recent decades (IATTC 2015). Between 2007 and 2014, annual fishing mortality of northern common dolphins (potentially including both short-beaked and long-beaked common dolphins) ranged between 35 and 124 animals, with an average of 75 (IATTC, 2015). Although it is unclear whether these animals are part of the same population as short-beaked common dolphins found off California, the distributions of both of the species that comprise the 'northern common dolphins' appear to shift into U.S. waters during certain oceanographic conditions (IATTC 2006).

STATUS OF STOCK

The status of short-beaked common dolphins in Californian waters relative to OSP is not known. The observed increase in abundance of this species off California probably reflects a distributional shift

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[1] The coefficient of variation (CV) for corrected carcass counts was derived from the results of Carretta *et al*. (2016a), who estimated that 25% (95% CI = 20% - 33%) of all available carcasses were recovered / documented.

(Anganuzzi *et al.* 1993; Forney and Barlow 1998, Barlow 2016), rather than an overall population increase due to growth. No habitat issues are known to be of concern for this species. They are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. The average annual human-caused mortality in 2010-2014 (40 animals) is estimated to be less than the PBR (8,393), and therefore they are not classified as a "strategic" stock under the MMPA. The total estimated fishery mortality and injury for short-beaked common dolphins is less than 10% of the calculated PBR and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate.

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Revised 2/10/2017

LONG-BEAKED COMMON DOLPHIN (*Delphinus capensis*): California Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Long-beaked common dolphins were recognized as a distinct species in the 1990s (Heyning and Perrin 1994; Rosel *et al.* 1994). Along the U.S. west coast, their distribution overlaps with that of the short-beaked common dolphin. Long-beaked common dolphins are commonly found within about 50 nmi of the coast, from Baja California (including the Gulf of California) northward to about central California (Figure 1). Along the west coast of Baja California, long-beaked common dolphins primarily occur inshore of the 250 m isobath, with very few sightings (<15%) in waters deeper than 500 meters (Gerrodette and Eguchi 2011). Stranding and sighting records indicate that the abundance of this species off California changes both seasonally and inter-annually (Heyning and Perrin 1994, Forney and Barlow 1998, Barlow 2016). Although long-beaked common dolphins are not restricted to U.S. waters, cooperative management agreements with Mexico exist only for the tuna purse seine fishery and not for other fisheries which may take this species (e.g. gillnet fisheries). For the MMPA stock assessment reports, there is a single Pacific management stock including only animals found within the U.S. Exclusive Economic Zone off California.

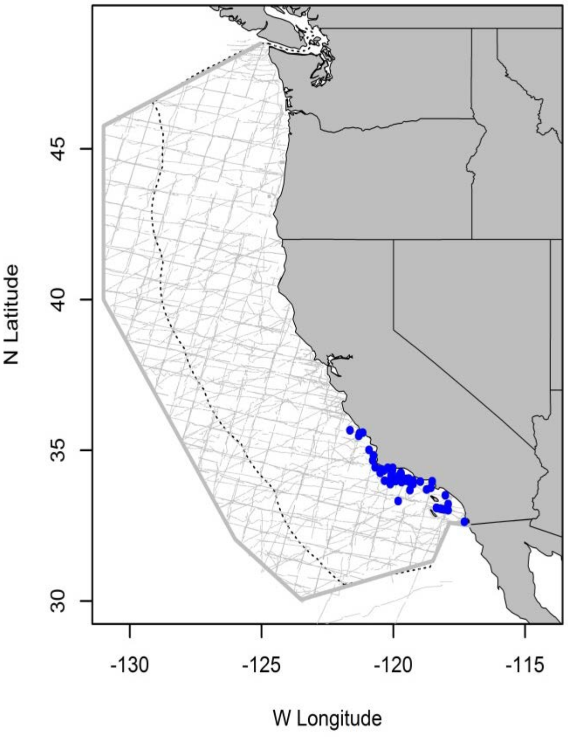

Figure 1. Long-beaked common dolphin sightings based on shipboard surveys off California, Oregon, and Washington, 1991- 2014 (Barlow 2016). Dashed line represents the U.S. EEZ, thin gray lines indicate completed transect effort of all surveys combined.

POPULATION SIZE

The distribution and abundance of long-beaked common dolphins off California varies inter-annually and seasonally (Heyning and Perrin 1994). As oceanographic conditions change, long-beaked common dolphins may move between Mexican and U.S. waters, and therefore a multi-year average abundance estimate is the most appropriate for management within the U.S. waters. The geometric mean abundance estimate for California, Oregon and Washington waters based on two ship surveys conducted in 2008 and 2014 (Barlow 2016) is 101,305 (0.49) long-beaked common dolphins. This estimate includes new correction factors for animals missed during the surveys. Although Carretta *et al*. (2011) also estimated abundance of this stock from a 2009 survey, that estimate did not include the correction factors and had high imprecision for one of the geographic strata, so it is not included in the multi-year average.

Minimum Population Estimate

The log-normal 20th percentile of the weighted 2008-2014 abundance estimate is 68,432 long-beaked common dolphins.

Current Population Trend

California waters represent the northern limit for this stock and animals likely move between U.S. and Mexican waters. While no formal statistical trend analysis exists for this stock of long-beaked common dolphin, abundance estimates for California waters from vessel-based line-transect surveys have been greater in recent years as water conditions have been warmer (Barlow 2016). The ratio of strandings of long-beaked to short-beaked common dolphin in southern California has varied, suggesting that the proportions of each species present change as ocean conditions vary (Heyning and Perrin 1994, Danil *et al.* 2010). During a 2009 ship-based survey of California and Baja California waters, the ratio of long-beaked to short-beaked common dolphin sightings was nearly 1:1, whereas during previous surveys conducted from 1986 to 2008 in the same geographic strata, the ratio was approximately 1:3.5 (Carretta *et al.* 2011). There appears to be an increasing trend of long-beaked common dolphins in California waters over the last 30 years, but a trend analysis for this stock has not been performed to date, while other stocks with more urgent conservation concerns are analyzed (e.g., Moore and Barlow 2011, 2013).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

There are no estimates of current or maximum net productivity rates for long-beaked common dolphins.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (68,432) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.48 (for a species of unknown status with a mortality rate CV of 0.3 to 0.6 ; Wade and Angliss 1997), resulting in a PBR of 657 long-beaked common dolphins per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

A summary of recent fishery mortality and injury for long-beaked common dolphins is shown in Table 1. More detailed information on these fisheries is provided in Appendix 1. The estimate of mortality and serious injury for long-beaked common dolphin in the California drift gillnet fishery for the five most recent years of monitoring, 2010-2014, averages 2.0 (CV=0.99) per year (Carretta *et al.* 2017). One interaction with the halibut set gillnet fishery was observed during 2010-2014, resulting in an estimate of 7 (CV=1.17) dolphins (Carretta and Enriquez 2012). No mortality or serious injury has been documented by observers during the most recent five years of monitoring for the small mesh gillnet fishery, which has interacted with long-beaked common dolphins in the past. However, 36 long-beaked common dolphins stranded with evidence of interaction with unidentified fisheries. Human-caused mortality and injury documentation is often based on stranding data, where raw counts are negatively-biased because only a fraction of carcasses are detected. Carretta *et al.* (2016a) estimated the mean recovery rate of California coastal bottlenose dolphin carcasses to be 25% (95% CI 20% - 33%) and stated that given the extremely coastal habits of coastal bottlenose dolphins, carcass recovery rates for this stock represented a maximum, compared with more pelagic dolphin species in the region. Therefore, in this stock assessment report and others involving dolphins along the U.S. West Coast, human-related deaths and injuries counted from beach strandings along the outer U.S. West Coast are multiplied by a factor of 4 to account for the non-detection of most carcasses (Carretta *et al.* 2016a). Applying this correction factor to the 36 stranded long-beaked common dolphins yields a minimum estimate of 144 fishery-related dolphin deaths, or an average of 29 per year. Gillnets have been documented to entangle marine mammals off Baja California (Sosa-Nishizaki *et al.* 1993), but no recent bycatch data from Mexico are available.

Table 1. Summary of available information on the incidental mortality and serious injury of long-beaked common dolphins (California Stock) in commercial fisheries that might take this species (Carretta *et al.* 2016b, 2017). All observed entanglements resulted in the death of the animal. Coefficients of variation for mortality estimates are provided in parentheses, when available. n/a = information not available. Human-caused mortality values based on strandings recovered along the outer U.S. West Coast are multiplied by a correction factor of 4 to account for undetected mortality (Carretta *et al.* 2016a).

Fishery Name	Data Type	Year(s)	Percent Observer Coverage	Observed (or self-reported)	Estimated Annual Mortality (CV)	Mean Annual Takes (CV

Fishery Name	Data Type	Year(s)	Percent Observer Coverage	Observed (or self-reported)	Estimated Annual Mortality (CV)	Mean Annual Takes (CV
CA thresher shark/swordfish drift gillnet fishery	observer	2010 2011 2012 2013 2014	12% 20% 19% 37% 24%	1 1 0 0 0	1.9 (1.1) 5.1 (1.3) 0 (n/a) 0.2 (2.2) 2.8 (1.4)	2.0 (0.99)
CA small mesh drift gillnet fishery for white seabass, yellowtail, barracuda, and tuna	observer	2010-2012	~4%	0	0	0 (n/a)
CA halibut/white seabass and other species set gillnet fishery	observer	2010-2014	9%	1	7 (1.17)	1.4 (1.17)
Unidentified fishery interaction	Strandings	2010-2014	-	36	≥144	≥29 (0.46)[1]
Minimum total annual takes (includes correction for unobserved beach strandings)						≥32 (0.42)

Other Mortality

Three long-beaked common dolphins died near San Diego in 2011 as the result of blast trauma associated with underwater detonations conducted by the U.S. Navy. Three days later, a fourth animal stranded approximately 70 km north of that location with similar injuries (Danil and St. Leger 2011). One long-beaked common dolphin was incidentally killed during fishery research during 2013 (Carretta *et al.* 2016b). Stranding records from 2010-2014 include three additional human-related long-beaked common dolphin deaths, including one animal that was struck by a vessel, one animal that had ingested marine debris, and one animal that had been cut in half (Carretta *et al.* 2016b). Applying the minimum correction factor to account for undetected mortality (Carretta *et al.* 2016a), this yields an estimated 12 human-caused long-beaked common dolphin deaths. From all sources combined, this results in a total of 17 non-fishery human-caused deaths between 2010 and 2014, or an average of 3.4 dolphins per year.

'Unusual mortality events' of long-beaked common dolphins off California due to domoic acid toxicity have been documented by NMFS as recently as 2007. One study suggests that increasing anthropogenic CO_2 levels and ocean acidification may increase the toxicity of the diatom responsible for these mortality events (Tatters *et al.* 2012).

In the eastern tropical Pacific, 'northern common dolphins' have been incidentally killed in international tuna purse-seine fisheries since the late 1950's and are managed separately under a section of the MMPA written specifically for the management of dolphins involved in eastern tropical Pacific tuna fisheries. Cooperative international management programs have dramatically reduced overall dolphin mortality in these fisheries (Joseph 1994). Between 2007 and 2014, annual fishing mortality of northern common dolphins (potentially including both short-beaked and long-beaked common dolphins) ranged between 35 and 124 animals, with an average of 75 (IATTC 2015). The distributions of both of the species that comprise the 'northern common dolphins' appear to shift into U.S. waters during certain oceanographic conditions (IATTC 2006).

STATUS OF STOCK

The status of long-beaked common dolphins in California waters relative to OSP is not known, and there are insufficient data to evaluate potential trends in abundance. Exposure to blast trauma resulting from underwater detonations is a local concern for this stock, but population level impacts from such activities are unclear. In response to the 2011 event, the U.S. Navy has implemented new training protocols to reduce the probability of blast trauma events occurring (Danil and St. Leger 2011). Long-

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[1] The coefficient of variation (CV) for corrected carcass counts was derived from the results of Carretta *et al.* (2016a), who estimated that 25% (95% CI = 20% - 33%) of all available carcasses were recovered / documented.

beaked common dolphins are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. The average annual human-caused mortality from commercial fisheries (≥32 dolphins /year) and other sources (3.4 dolphins/year) is 35.4 long-beaked common dolphins. This does not exceed the PBR (657), and therefore they are not classified as a "strategic" stock under the MMPA. The average total fishery mortality and injury for long-beaked common dolphins (32/yr) is less than 10% of the PBR and therefore, is considered to be insignificant and approaching zero mortality and serious injury rate.

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NORTHERN RIGHT-WHALE DOLPHIN (*Lissodelphis borealis*): California/Oregon/Washington Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

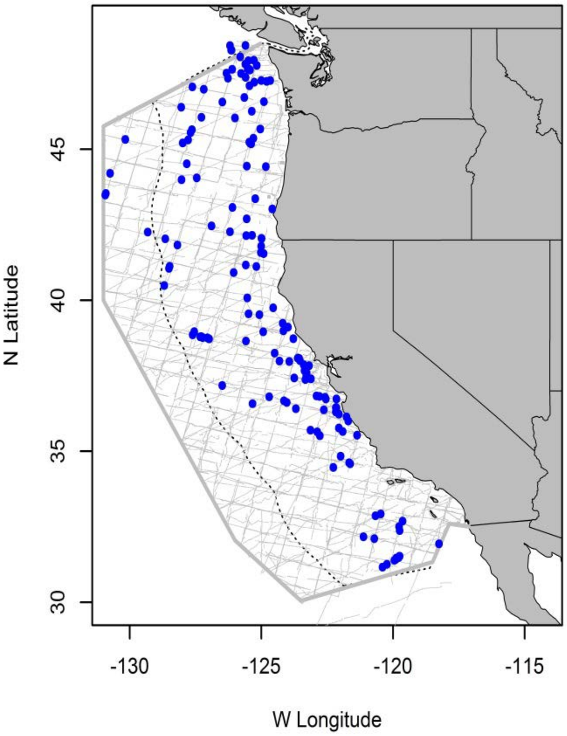

Figure 1. Northern right whale dolphin sightings based on shipboard surveys off California, Oregon, and Washington, 1991-2014 (Barlow 2016). Dashed line represents the U.S. EEZ, thin gray lines indicate completed transect effort of all surveys combined.

Northern right-whale dolphins are endemic to temperate waters of the North Pacific Ocean. Off the U.S. west coast, they have been seen primarily in shelf and slope waters (Figure 1), with seasonal movements into the Southern California Bight (Leatherwood and Walker 1979; Dohl et al. 1980; 1983). Sighting patterns from recent aerial and shipboard surveys conducted in California, Oregon and Washington during different seasons (Green et al. 1992; 1993; Forney and Barlow 1998; Barlow 2016) suggest seasonal north-south movements, with animals found primarily off California during the colder water months and shifting northward into Oregon and Washington as water temperatures increase in late spring and summer. The southern end of this population's range is not well-documented, but during cold-water periods, they probably range into Mexican waters off northern Baja California. Genetic analyses have not found statistically significant differences between northern right-whale dolphins from the U.S. West coast and other areas of the North Pacific (Dizon et al. 1994); however, power analyses indicate that the ability to detect stock differences for this species is poor, given traditional statistical error levels (Dizon et al. 1995). Although northern right-whale dolphins are not restricted to U.S. territorial waters, there are currently no international agreements for cooperative management. For the Marine Mammal Protection Act (MMPA) stock assessment reports, there is a single management stock including only animals found within the U.S. Exclusive Economic Zone of California, Oregon and Washington.

POPULATION SIZE

The distribution of northern right-whale dolphins throughout this region is highly variable, apparently in response to oceanographic changes on both seasonal and interannual time scales (Forney and Barlow 1998, Barlow 2016). As oceanographic conditions vary, northern right-whale dolphins may spend time outside the U.S. Exclusive Economic Zone, and therefore a multi-year average abundance estimate is the most appropriate for management within U.S. waters. The most recent estimate of northern right whale dolphin abundance is the geometric mean of estimates from 2008 and 2014 summer/autumn vessel-based line-transect surveys of California, Oregon, and Washington waters, 26,556 (CV=0.44) animals (Barlow 2016). This estimate includes new correction factors for animals missed during the surveys.

Minimum Population Estimate

The log-normal 20th percentile of the 2008-2014 average abundance estimate is 18,608 northern right-whale dolphins.

Current Population Trend

The distribution and abundance of northern right whale dolphins off California, Oregon and Washington varies considerably at both seasonal and interannual time scales (Forney and Barlow 1998, Becker *et al*. 2012, Barlow 2016), but no long term trends have been identified.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No information on current or maximum net productivity rates is available for northern right-whale dolphins off the U.S. west coast.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (18,608) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.48 (for a species of unknown status with a mortality rate CV between 0.3 and 0.6; Wade and Angliss 1997), resulting in a PBR of 179 northern right-whale dolphins per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

A summary of recent fishery mortality and injury information for this stock of northern right-whale dolphin is shown in Table 1. More detailed information on these fisheries is provided in Appendix 1. The estimate of mortality and serious injury for northern right whale dolphin in the California drift gillnet fishery for the five most recent years of monitoring, 2010-2014, is 17.6 (CV=0.36) individuals, or an average of 3.5 per year (Carretta *et al*. 2016). Gillnets have been documented to entangle marine mammals off Baja California (Sosa-Nishizaki *et al*. 1993), but no recent bycatch data from Mexico are available.

Table 1. Summary of available information on the incidental mortality and serious injury of northern right-whale dolphins (California/Oregon/Washington Stock) in commercial fisheries that might take this species (Carretta *et al*. 2017). All observed entanglements of northern right-whale dolphins resulted in the death of the animal. Coefficients of variation for mortality estimates are provided in parentheses.

Fishery Name	Data Type	Year(s)	Percent Observer Coverage	Observed Mortality	Estimated Annual Mortality (CV)	Mean Annual Takes (CV)
CA/OR thresher shark/swordfish drift gillnet fishery	observer data	2010 2011 2012 2013 2014	12% 20% 19% 37% 24%	1 1 1 2 1	3.9 (1) 5.5 (0.85) 3.7 (0.95) 3.3 (0.45) 2.5 (0.83)	3.8 (0.40)
Minimum total annual takes						3.8 (0.40)

STATUS OF STOCK

The status of northern right-whale dolphins in California, Oregon and Washington relative to OSP is not known, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this species. They are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. The average annual human-caused mortality in 2010-2014 (3.8 animals) is estimated to be less than the PBR (179), and therefore they are not classified as a "strategic" stock under the MMPA. The total fishery mortality and serious injury for northern right-whale dolphins does not exceed 10% of the calculated PBR and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate.

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Revised 01/15/2011

KILLER WHALE (*Orcinus orca*): Eastern North Pacific Offshore Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Killer whales have been observed in all oceans and seas of the world (Leatherwood and Dahlheim 1978). Although reported from tropical and offshore waters, killer whales prefer the colder waters of both hemispheres, with greatest abundances found within 800 km of major continents (Mitchell 1975). Along the west coast of North America, killer whales occur along the entire Alaskan coast (Braham and Dahlheim 1982), in British Columbia and Washington inland waterways (Bigg et al. 1990), and along the outer coasts of Washington, Oregon and California (Green et al. 1992; Barlow 1995, 1997; Forney et al. 1995; Barlow and Forney 2007). Seasonal and year-round occurrence have been noted for killer whales throughout Alaska (Braham and Dahlheim 1982) and in the intracoastal waterways of British Columbia and Washington, where pods have been labeled as 'resident', 'transient' and ‘offshore’ (Bigg et al. 1990, Ford et al. 1994) based on aspects of morphology, ecology, genetics and behavior (Ford and Fisher 1982; Baird and Stacey 1988; Baird et al. 1992, Hoelzel et al. 1998). Through examination of photographs of recognizable individuals and pods, movements of whales between geographical areas have been documented. For example, whales identified in Prince William Sound have been observed near Kodiak Island (Heise et al. 1991) and whales identified in Southeast Alaska have been observed in Prince William Sound, British Columbia, and Puget Sound (Leatherwood et al. 1990, Dahlheim et al. 1997). Movements of killer whales between the waters of Southeast Alaska and central California have also been documented (Goley and Straley 1994).

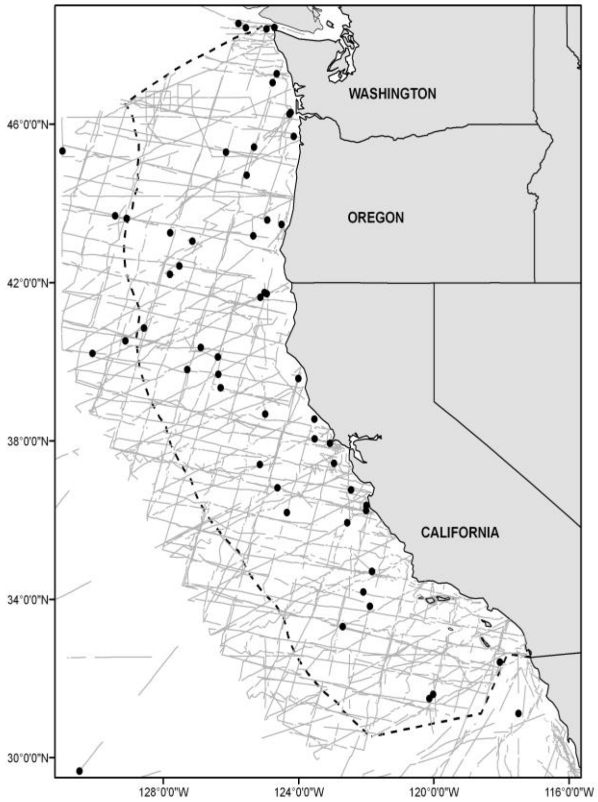

Figure 1. Killer whale sightings based on shipboard surveys off California, Oregon and Washington, 1991-2008 (see Appendix 2 for data sources and information on timing and location of survey effort). Sightings include killer whales from all stocks found in this region. Dashed line represents the U.S. EEZ, thin lines indicate completed transect effort of all surveys combined.

Offshore killer whales have more recently also been identified off the coasts of California, Oregon, and rarely, in Southeast Alaska (Ford et al. 1994, Black et al. 1997, Dahlheim et al. 1997). They apparently do not mix with the transient and resident killer whale stocks found in these regions (Ford et al. 1994, Black et al. 1997). Studies indicate the ‘offshore’ type, although distinct from the other types (‘resident’ and ‘transient’), appears to be more closely related genetically, morphologically, behaviorally, and vocally to the ‘resident’ type killer whales (Black et al. 1997, Hoelzel et al. 1998; J. Ford, pers. comm.; L. Barrett-Lennard, pers. comm.). Based on data regarding association patterns, acoustics, movements, genetic differences and potential fishery interactions, eight killer whale stocks are recognized within the Pacific U.S. EEZ: 1) the Eastern North Pacific Alaska Resident stock - occurring from Southeast Alaska to the Bering Sea, 2) the Eastern North Pacific Northern Resident stock - occurring from British Columbia through Alaska, 3) the Eastern North Pacific Southern Resident stock - occurring mainly within the inland waters of Washington State and southern British Columbia but extending from central California into southern Southeast Alaska, 4) the West Coast Transient stock - occurring from Alaska through California, 5) the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock - occurring from southeast Alaska to the Bering Sea, 6) the AT1 Stock – found only in Prince William Sound, 7) the Eastern North Pacific Offshore stock - occurring from Southeast Alaska through California, 8) the Hawaiian stock. The Stock Assessment Reports for the Alaska Region contain information concerning the Eastern North Pacific Alaska Resident, Eastern North Pacific Northern Resident and the Gulf of Alaska, Aleutian Islands, and Bering Sea, AT1, and West Coast Transient stocks.

POPULATION SIZE

Off British Columbia, approximately 200 offshore killer whales were identified between 1989 and 1993 (Ford et al. 1994), and 20 of these individuals have also been seen off California (Black et al. 1997). Using only good quality photographs that clearly show characteristics of the dorsal fin and saddle patch region, an additional 11 offshore killer whales that were not previously known have been identified off the California coast, bringing the total number of known individuals in this population to 211. This is certainly an underestimate of the total population size, because not all animals in this population have been photographed. In the future, it may be possible estimate the total abundance of this transboundary stock using mark-recapture analyses based on individual photographs. Based on summer/fall shipboard line-transect surveys in 2005 (Forney 2007) and 2008 (Barlow 2010), the total number of killer whales within 300 nmi of the coasts of California, Oregon and Washington is estimated to be 691 animals (CV=0.49). There is currently no way to reliably distinguish the different stocks of killer whales from sightings at sea, but photographs of individual animals can provide a rough estimate of the proportion of whales in each stock. A total of 161 individual killer whales photographed off California and Oregon have been determined to belong to the transient (105 whales) and offshore (56 whales) stocks (Black et al. 1997). Using these proportions to prorate the line transect abundance estimate yields an estimate of 56/161 * 691 = 240 offshore killer whales along the U.S. west coast. This is expected to be a conservative estimate of the number of offshore killer whales, because offshore whales apparently are less frequently seen near the coast (Black et al. 1997), and therefore photographic sampling may be biased towards transient whales. For stock assessment purposes, this combined value is currently the best available estimate of abundance for offshore killer whales off the coasts of California, Oregon and Washington.

Minimum Population Estimate

The total number of known offshore killer whales along the U.S. West coast, Canada and Alaska is 211 animals, but it is not known what proportion of time this transboundary stock spends in U.S. waters, and therefore this number is difficult to work with for PBR calculations. A minimum abundance estimate for all killer whales along the coasts of California, Oregon and Washington can be estimated from the 2005-2008 line-transect surveys as the 20th percentile of the geometric mean 2005-2008 abundance estimate, or 466 killer whales. Using the same prorating as above, a minimum of 56/161 * 466 = 162 offshore killer whales are estimated to be in U.S. waters off California, Oregon and Washington.

Current Population Trend

No information is available regarding trends in abundance of Eastern North Pacific offshore killer whales.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No information on current or maximum net productivity rates is available for killer whales in this region.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (162) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no known fishery mortality; Wade and Angliss 1997), resulting in a PBR of 1.6 offshore killer whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

A summary of information on fisheries that may take animals from this killer whale stock is shown in Table 1 (Carretta et al. 2005, Carretta and Enriquez 2006, 2007, 2009a, 2009b). More detailed information on these fisheries is provided in Appendix 1. In the California drift gillnet fishery, no offshore killer whales have been observed entangled (Julian 1997; Julian and Beeson 1998; Cameron and Forney 1999, 2000; Carretta and Chivers 2004, Carretta et al. 2005a, 2005b, Carretta and Enriquez 2006, 2007, 2009a, 2009b), but one killer whale from the Eastern North Pacific Transient Stock was observed taken in 1995, and offshore killer whales may also occasionally be entangled. Additional potential sources of killer whale mortality are set gillnets and longlines. In California, an observer program between July 1990 and December 1994 and additional observations between 2000 and 2008 monitored 5-15% of all sets in the large mesh (>3.5") set gillnet fishery for halibut , and no killer whales were observed taken. Based on observations for longline fisheries in other regions (i.e. Alaska; Yano and Dahlheim 1995), fishery interactions may also occur with U.S. West coast pelagic longline fisheries, but no such interactions have been documented to date.

Table 1. Summary of available information on the incidental mortality and injury of killer whales (Eastern North Pacific Offshore Stock) in commercial fisheries that might take this species. Mean annual takes are based on 2004-2008 data unless noted otherwise.

Fishery Name	Data Type	Year(s)	Percent Observer Coverage	Observed Mortality	Estimated Annual Mortality	Mean Annual Takes (CV in parentheses)
CA/OR thresher shark/swordfish drift gillnet fishery	observer data	2004 2005 2006 2007 2008	20.6% 20.9% 18.5% 16.4% 13.5%	0 0 0 0 0	0 0 0 0 0	0
Minimum total annual takes						0

Drift gillnet fisheries for swordfish and sharks exist along the entire Pacific coast of Baja California, Mexico and may take animals from this population. Quantitative data are available only for the Mexican swordfish drift gillnet fishery, which uses vessels, gear, and operational procedures similar to those in the U.S. drift gillnet fishery, although nets may be up to 4.5 km long (Holts and Sosa-Nishizaki 1998). The fleet increased from two vessels in 1986 to 31 vessels in 1993 (Holts and Sosa-Nishizaki 1998). The total number of sets in this fishery in 1992 can be estimated from data provided by these authors to be approximately 2700, with an observed rate of marine mammal bycatch of 0.13 animals per set (10 marine mammals in 77 observed sets; Sosa-Nishizaki et al. 1993). This overall mortality rate is similar to that observed in California driftnet fisheries during 1990-95 (0.14 marine mammals per set; Julian and Beeson, 1998), but species-specific information is not available for the Mexican fisheries. Previous efforts to convert the Mexican swordfish driftnet fishery to a longline fishery have resulted in a mixed-fishery, with 20 vessels alternately using longlines or driftnets, 23 using driftnets only, 22 using longlines only, and seven with unknown gear type (Berdegué 2002).

STATUS OF STOCK

The status of killer whales in California in relation to OSP is unknown, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this stock. They are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. There has been no documented human-caused mortality of this stock, and therefore they are not classified as a "strategic" stock under the MMPA. The total fishery mortality and serious injury for offshore killer whales is zero and can be considered to be insignificant and approaching zero mortality and serious injury rate.

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KILLER WHALE (*Orcinus orca*): Eastern North Pacific Southern Resident Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Killer whales have a cosmopolitan distribution, ranging from equatorial to polar waters, with highest densities found in coastal temperate waters (Forney and Wade 2006). Along the west coast of North America, killer whales occur along the entire Alaskan coast as far north as Barrow (George *et al.* 1994, Lowry *et al.* 1987, Clarke *et al.* 2013), in British Columbia and Washington inland waterways (Bigg *et al.* 1990), and along the outer coasts of Washington, Oregon, and California (Barlow and Forney 2007). Seasonal and year-round occurrence has been noted for killer whales throughout Alaska (Braham and Dahlheim 1982) and in the intra-coastal waterways of British Columbia and Washington State, where pods have been labeled as 'resident,' 'transient,' and 'offshore' (Bigg *et al.* 1990, Ford *et al.* 1994) based on aspects of morphology, ecology, genetics, and behavior (Ford and Fisher 1982, Baird and Stacey 1988, Baird *et al.* 1992, Hoelzel *et al.* 1998). Through examination of photographs of recognizable individuals and pods, movements of whales between Prince William Sound and Kodiak Island have been observed (Matkin *et al.* 1999) and whales identified in Southeast Alaska have been observed in Prince William Sound, British Columbia, and Puget Sound (Leatherwood *et al.* 1990, Dahlheim *et al.* 1997).

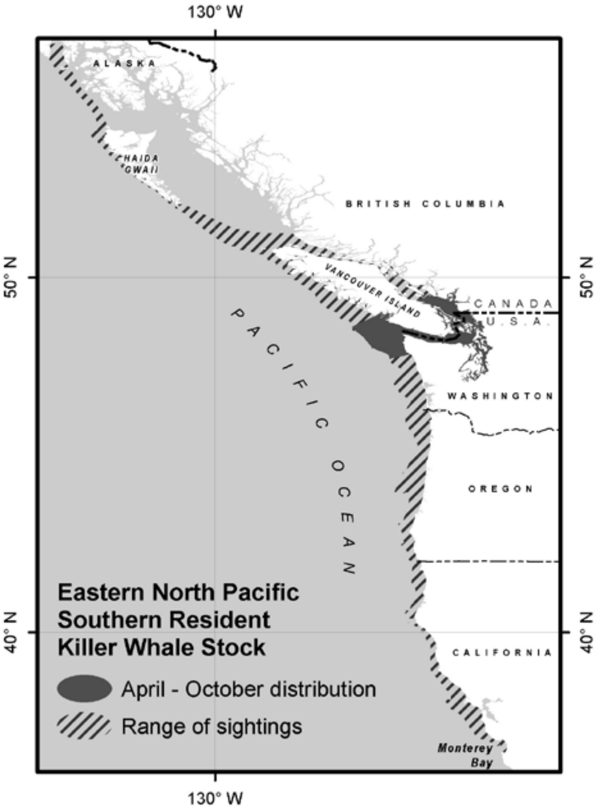

Figure 1. Approximate April - October distribution of the Eastern North Pacific Southern Resident killer whale stock (shaded area) and range of sightings (diagonal lines).

Genetic studies provide evidence that the 'resident' and 'transient' types are distinct (Stevens *et al.* 1989, Hoelzel 1991, Hoelzel and Dover 1991, Hoelzel *et al.* 1998, Morin *et al.* 2010). Analyses of complete mitochondrial genomes indicates that transient killer whales should be recognized as a separate species, and that, pending additional data, resident killer whales should be recognized as a separate subspecies (Morin *et al.* 2010). The genetic data results support previous lines of evidence for separation of the transient and resident ecotypes, including differences in 1) acoustic dialects; 2) skull features; 3) morphology; 4) feeding specializations; and 5) a lack of interbreeding between the two sympatric ecotypes (Krahn *et al.* 2004).

Most sightings of the Eastern North Pacific Southern Resident stock of killer whales have occurred in the summer in inland waters of Washington and southern British Columbia. However, pods belonging to this stock have also been sighted in coastal waters off southern Vancouver Island and Washington (Bigg *et al.* 1990, Ford *et al.* 2000, NWFSC unpubl. data). The complete winter range of this stock is uncertain. Of the three pods comprising this stock, one (J1) is commonly sighted in inshore waters in winter, while the other two (K1 and L1) apparently spend more time offshore (Ford *et al.* 2000). These latter two pods have been sighted as far south as Monterey Bay and central California in recent years. They sometimes have also been seen entering the inland waters of Vancouver Island through Johnstone Strait in the spring (Ford *et al.* 2000), suggesting that they may spend time along the outer coast of Vancouver Island during the winter. In June 2007, whales from L-pod were sighted off Chatham Strait, Alaska, the farthest north they have ever been documented (J. Ford, pers. comm.). Passive autonomous acoustic recorders have recently provided more information on the seasonal occurrence of these pods along the west coast of the U.S. (Hanson *et al.* 2013). In addition, satellite-linked tags were recently deployed in winter months on members of J, K, and L pods. Results were consistent with previous data, but provided much greater detail, showing wide-ranging use of inland waters by J Pod whales and extensive movements in U.S. coastal waters by K and L Pods.

Based on data regarding association patterns, acoustics, movements, genetic differences and potential fishery interactions, eight killer whale stocks are recognized within the Pacific U.S. EEZ: 1) the Eastern North Pacific Alaska Resident stock - occurring from Southeast Alaska to the Bering Sea, 2) the Eastern North Pacific Northern Resident stock - occurring from British Columbia through Alaska, 3) the Eastern North Pacific Southern Resident stock - occurring mainly within the inland waters of Washington State and southern British Columbia but extending from central California into southern Southeast Alaska (see Fig. 1), 4) the West Coast Transient stock - occurring from Alaska through California, 5) the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock - occurring from southeast Alaska to the Bering Sea, 6) the AT1 Stock – found only in Prince William Sound, 7) the Eastern North Pacific Offshore stock - occurring from Southeast Alaska through California, 8) the Hawaiian stock. The Stock Assessment Reports for the Alaska Region contain information concerning the Eastern North Pacific Alaska Resident, Eastern North Pacific Northern Resident and the Gulf of Alaska, Aleutian Islands, and Bering Sea, AT1, and Eastern North Pacific Transient stocks.

POPULATION SIZE

The Eastern North Pacific Southern Resident stock is a trans-boundary stock including killer whales in inland Washington and southern British Columbia waters. Photo-identification of individual whales through the years has advanced knowledge of this stock's structure, behaviors, and movements. In 1993, the three pods comprising this stock totaled 96 killer whales (Ford *et al.* 1994). The population increased to 99 whales in 1995, then declined to 79 whales in 2001, and most recently numbered 81 whales in 2015 (Fig. 2; Ford *et al.* 2000; Center for Whale Research 2016). The 2001-2005 counts included a whale born in 1999 (L-98) that was listed as missing during the annual census in May and June 2001 but was subsequently discovered alone in an inlet off the west coast of Vancouver Island. L-98 remained separate from L pod until 10 March 2006 when he died due to injuries associated with a vessel interaction in Nootka Sound. L-98 has been subtracted from the official 2006 and subsequent population censuses. The most recent census spanning 1 July 2014 through 1 July 2015 includes 5 new calves (3 presumed male, one female) and the deaths of one reproductive age adult female (that was pregnant with a female neonate), and a calf of unknown sex. This does not include 5 additional calves born between September 2015 and January 2016. In addition, a young adult female was observed pushing a dead neonate (not one of the recently born calves) in January 2016.

Minimum Population Estimate

The abundance estimate for this stock of killer whales is a direct count of individually identifiable animals. It is thought that the entire population is censused every year. This estimate therefore serves as both a best estimate of abundance and a minimum estimate of abundance. Thus, the minimum population estimate (N_{min}) for the Eastern North Pacific Southern Resident stock of killer whales is 81 animals.

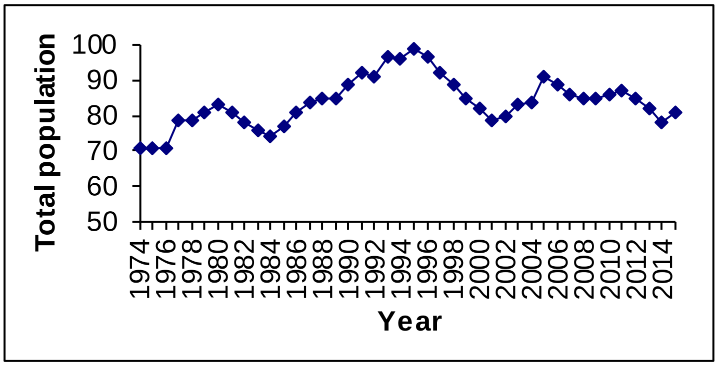

Figure 2. Population of Eastern North Pacific Southern Resident stock of killer whales, 1974-2015. Each year's count includes animals first seen and first missed; a whale is considered first missed the year after it was last seen alive (Ford *et al.* 2000; Center for Whale Research 2015).

Current Population Trend

During the live-capture fishery that existed from 1967 to 1973, it is estimated that 47 killer whales, mostly immature, were taken out of this stock (Ford *et al.* 1994). Since the first complete census of this stock in 1974 when 71 animals were identified, the number of southern resident killer whales has fluctuated annually. Between 1974 and the mid-1990s, the Southern Resident stock increased approximately 35% (Ford *et al.* 1994), representing a net annual growth rate of 1.8% during those years. Following the peak census count of 99 animals in 1995, the population size has declined and currently stands at 81 animals as of the 2015 census (Ford *et al.* 2000; Center for Whale Research 2015).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for this stock of killer whales. Matkin *et al.* (2014) estimated a maximum population annual growth rate of 1.035 for southern Alaska resident killer whales. The authors noted that the 3.5% annual rate estimated for southern Alaska residents is higher than previously measured rates for British Columbia northern residents (2.9%, Olesiuk *et al.* 1990) and "probably represents a population at r-max (maximum rate of growth)." In the absence of published estimates of R_{max} for southern resident killer whales, the maximum annual rate of 3.5% found for southern Alaska residents is used for this stock of southern resident killer whales. This reflects more information about the known life history of resident killer whales than the default R_{max} of 4% and results in a more conservative estimate of potential biological removal (PBR).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (81) times one-half the maximum net growth rate for *Alaska* resident killer whales (½ of 3.5%) times a recovery factor of 0.1 (for an endangered stock, Wade and Angliss 1997), resulting in a PBR of 0.14 whales per year, or approximately 1 animal every 7 years.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Salmon drift gillnet fisheries in Washington inland waters were last observed in 1993 and 1994 and no killer whale entanglements were documented, though observer coverage levels were less than 10% (Erstad *et al.* 1996, Pierce *et al.* 1994, Pierce *et al.* 1996, NWIFC 1995). Fishing effort in the inland waters drift gillnet fishery has declined considerably since 1994 because far fewer vessels participate today (NOAA West Coast Region). Past marine mammal entanglements in this fishery included harbor porpoise, Dall's porpoise, and harbor seals. Coastal marine tribal set gillnets also occur along the outer Washington coast and no killer whale interactions have been reported in this fishery since the inception of the observer program in 1988, though the fishery is not active every year (Gearin *et al.* 1994, Gearin *et al.* 2000, Makah Fisheries Management,).

An additional source of information on killer whale mortality and injury incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. No self-report records of killer whale mortality have been reported.

Due to a lack of observer programs, there are few data concerning the mortality of marine mammals incidental to Canadian commercial fisheries. Since 1990, there have been no reported fishery-related strandings of killer whales in Canadian waters. However, in 1994 one killer whale was reported to have contacted a salmon gillnet but did not entangle (Guenther *et al.* 1995). Data regarding the level of killer whale mortality related to commercial fisheries in Canadian waters are not available.

The known total fishery mortality and serious injury for this stock is zero.

Other Mortality

No human-caused killer whale mortality or serious injuries were reported from non-fisheries sources in 2010-2014 (Carretta *et al.* 2016). In 2012, a moderately decomposed juvenile female southern resident killer whale (L-112) was found dead near Long Beach, WA. A full necropsy was performed and the cause of death was determined to be blunt force trauma to the head, however the source of the trauma (vessel strike, intraspecific aggression, or other unknown source) could not be established (NOAA 2014). There was documentation of a whale-boat collision in Haro Strait in 2005 which resulted in a minor injury to a whale. In 2006, whale L98 was killed during a vessel interaction. It is important to note that L98 had become habituated to regularly interacting with vessels during its isolation in Nootka Sound. The annual known level of non-fishery human-caused mortality for this stock over the past five years (2010-2014) is zero animals per year.

STATUS OF STOCK

Total annual fishery mortality and serious injury for this stock (0) is not known to exceed 10% of the calculated PBR (0.14) and, therefore, appears to be insignificant and approaching zero mortality and serious injury rate. The estimated annual level of human-caused mortality and serious injury of zero animals per year does not exceed the PBR (0.14). Southern Resident killer whales were formally listed as "endangered" under the ESA in 2005 and consequently the stock is automatically considered as a "strategic" stock under the MMPA. This stock was considered "depleted" prior to its 2005 listing under the ESA.

Habitat Issues

Several potential risk factors identified for this population have habitat implications. The summer range of this population, the inland waters of Washington and British Columbia, are home to a large commercial whale watch industry, and high levels of recreational boating and commercial shipping. Potential for acoustic masking effects on the whales' communication and foraging due to vessel traffic remains a concern (Erbe 2002, Clark *et al.* 2009). In 2011 vessel approach regulations were implemented to restrict vessels from approaching closer than 200m. Oil tankers also regularly transit these inland waters and as such the risk of oil spills to this population is of concern. This population appears to be Chinook salmon specialists (Ford and Ellis 2006, Hanson *et al.* 2010), although other species, such as chum, pink, and coho salmon also appear to be important elements of the diet (Ford *et al.* 1998). There is evidence that changes in Chinook abundance have affected this population (Ford *et al.* 2009, Ward *et al.* 2009). In addition, the high trophic level and longevity of the animals has predisposed them to accumulate levels of contaminants that are high enough to cause potential health impacts. In particular, there is recent evidence of extremely high levels of flame retardants in young animals (Krahn *et al.* 2007, 2009). The recovery plan for southern resident killer whales highlights risk factors related to high PCB levels found in southern resident killer whales, including possible immune suppression and reproductive impairment (NOAA 2008).

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Revised 02/06/2017

SHORT-FINNED PILOT WHALE (*Globicephala macrorhynchus*): California/Oregon/Washington Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Two genetically and morphologically distinct short-finned pilot whale types are described in the Pacific (‘Shiho’ and ‘Naisa’) by Van Cise *et al*. (2016), which correspond to the northern and southern types (respectively) described off Japan (Kasuya *et al.* 1988; Wada 1988; Miyazaki and Amano 1994). Shiho type animals are largely confined to the California Current and eastern tropical Pacific, while Naisa type pilot whales occur in the central Pacific and Japan. Differences in body size, head shape, coloration, and number of teeth characterize Shiho and Naisa morphotypes, with the larger eastern Pacific Shiho type characterized by a rounder melon and distinct light saddle patch. Short-finned pilot whales were once common off Southern California, with an apparently resident population around Santa Catalina Island, as well as seasonal migrants (Dohl et al. 1980). After a strong El Niño event in 1982-83, short-finned pilot whales virtually disappeared from this region, and despite increased survey effort along the entire U.S. west coast, sightings and fishery takes are rare and have primarily occurred during warm-water years (Julian and Beeson 1998, Carretta *et al*. 2004, Barlow 2016). Figure 1 summarizes the sightings of short-finned pilot whales off the U.S. west coast from 1991-2014. Pilot whales in the California Current and eastern tropical Pacific likely represent a single population, based on a lack of differentiation in mtDNA (Van Cise *et al.* 2016), while animals in Hawaiian waters are characterized by unique haplotypes that are absent from eastern and southern Pacific samples, despite relatively large sample sizes from Hawaiian waters. For the Marine Mammal Protection Act (MMPA) stock assessment reports, short-finned pilot whales within the Pacific U.S. Exclusive Economic Zone are divided into two discrete, non-contiguous areas: 1) waters off California, Oregon and Washington (this report), and 2) Hawaiian waters. Shiho-type short-finned pilot whales comprise the California, Oregon and Washington stock, and are covered in this report. Naisa-type short-finned pilot whales comprise the Hawaiian stock.

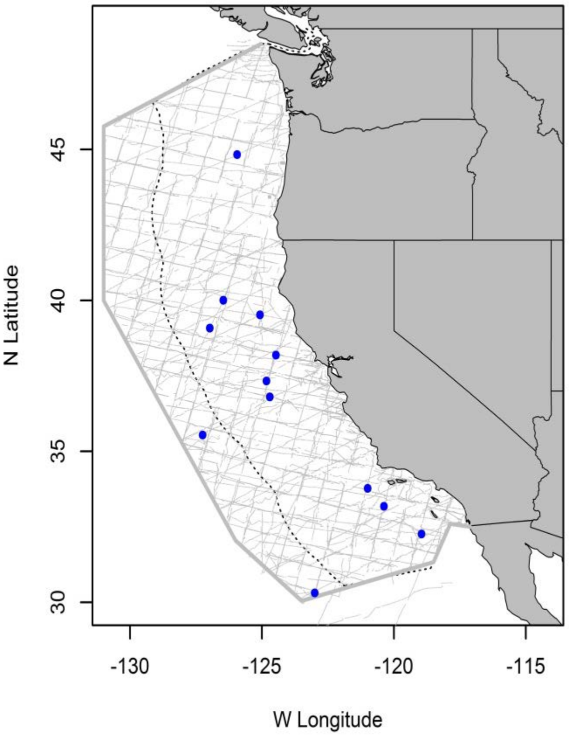

Figure 1. Short-finned pilot whale sightings made during shipboard surveys conducted off California, Oregon, and Washington, 1991-2014 (Barlow 2016). Dashed line represents the U.S. EEZ, thin gray lines indicate completed transect effort of all surveys combined.

POPULATION SIZE

The abundance of short-finned pilot whales in this region is variable and may be influenced by prevailing oceanographic conditions (Forney 1997, Forney and Barlow 1998, Barlow 2016). Because animals may spend time outside the U.S. Exclusive Economic Zone as oceanographic conditions change, a multi-year average abundance estimate is the most appropriate for management within U.S. waters. The most recent estimate of short-finned pilot whale abundance is the geometric mean of estimates from 2008 and 2014 summer/autumn vessel-based line-transect surveys of California, Oregon, and Washington waters, or 836 (CV=0.79) animals (Barlow 2016). This estimate includes new correction factors for animals missed during the surveys.

Minimum Population Estimate

The log-normal 20th percentile of the 2008-2014 geometric mean abundance estimate is 466 short-finned pilot whales.

Current Population Trend

Following the virtual disappearance of short-finned pilot whales from California after the 1982-83 El Niño, they have been encountered infrequently and primarily during warm-water years, such as 1991, 1993, 1997, 2014, and 2015 (e.g., Carretta et al. 1995, Julian and Beeson 1998, Carretta et al. 2004, Barlow 2016). These patterns likely reflect large-scale, long-term movements of this species in response to changing oceanographic conditions. It is not known whether the animals sighted more recently are part of the same population that was documented off Southern California before the mid-1980s or a different wide-ranging pelagic population. Therefore, no inferences can be drawn regarding trends in abundance of short-finned pilot whales off California, Oregon and Washington.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No information on current or maximum net productivity rates is available for short-finned pilot whales off California, Oregon and Washington.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (466) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.48 (for a species of unknown status with bycatch mortality rate CV between 0.3 and 0.6; Wade and Angliss 1997), resulting in a PBR of 4.5 short-finned pilot whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

A summary of known fishery mortality and injury for this stock of short-finned pilot whale is shown in Table 1. More detailed information on these fisheries is provided in Appendix 1. The estimate of mortality and serious injury for short-finned pilot whale in the California drift gillnet fishery for the five most recent years of monitoring, 2010-2014, is 6 (CV= 0.39) individuals, or an average of 1.2 per year (Carretta *et al*. 2017). Bycatch of short-finned pilot whales in the drift gillnet fishery is rarely-observed (14 animals in 8,711 observed sets), but high multivariate El Niño index values associated with warm-water years (Wolter and Timlin 2011) were identified as a significant predictor of bycatch in a recent analysis (Carretta et al. 2017).

Historically, short-finned pilot whales were also killed in squid purse seine operations off Southern California (Miller et al. 1983; Heyning et al. 1994), but these deaths occurred when pilot whales were still common in the region. An observer program in the squid purse seine fishery was initiated in 2004 and a total of 377 sets (<10% of effort) were observed through 2008 without a pilot whale interaction. Gillnets have been documented to entangle marine mammals off Baja California (Sosa-Nishizaki et al. 1993), but no recent bycatch data from Mexico are available.

Table 1. Summary of available information on the incidental mortality and serious injury of short-finned pilot whales (California/Oregon/Washington Stock) in commercial fisheries that might take this species (Carretta *et al*. 2017). Coefficients of variation for mortality estimates are provided in parentheses; n/a = not available.

Fishery Name	Data Type	Year(s)	Percent Observer Coverage	Observed Mortality	Estimated Mortality	Mean Annual Takes (CV in parentheses)

Fishery Name	Data Type	Year(s)	Percent Observer Coverage	Observed Mortality	Estimated Mortality	Mean Annual Takes (CV in parentheses)
CA/OR thresher shark/swordfish drift gillnet fishery	observer	2010 2011 2012 2013 2014	12% 20% 19% 37% 24%	0 0 0 0 2	0 0 0 0 6 (0.39)	1.2 (0.39)
Market squid purse seine	observer	2004-2008	<10%	0	0	0
Minimum total annual takes						1.2 (0.39)

STATUS OF STOCK

The status of short-finned pilot whales off California, Oregon and Washington in relation to OSP is unknown. They have declined in abundance in the Southern California Bight, since the 1982-83 El Niño, but the nature of these changes and potential habitat issues are not adequately understood. Short-finned pilot whales are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. The average annual human-caused mortality, 1.2 animals, is less than the PBR of 4.5, and therefore they are not classified as a "strategic" stock under the MMPA. Total annual human-caused mortality and serious injury for this stock is greater than 10 % of PBR; therefore, mortality and serious injury cannot be considered to be approaching a zero mortality and serious injury rate.

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Revised 6/4/2014

BAIRD'S BEAKED WHALE (*Berardius bairdii*): California/Oregon/Washington Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Baird's beaked whales are distributed throughout deep waters and along the continental slopes of the North Pacific Ocean (Balcomb 1989, Macleod et al. 2006). They have been harvested and studied in Japanese waters, but little is known about this species elsewhere (Balcomb 1989). Along the U.S. west coast, Baird's beaked whales have been seen primarily along the continental slope (Figure 1) from late spring to early fall. They have been seen less frequently and are presumed to be farther offshore during the colder water months of November through April. For the Marine Mammal Protection Act (MMPA) stock assessment reports, Baird's beaked whales within the Pacific U.S. Exclusive Economic Zone are divided into two discrete, non-contiguous areas: 1) waters off California, Oregon and Washington (this report), and 2) Alaskan waters.

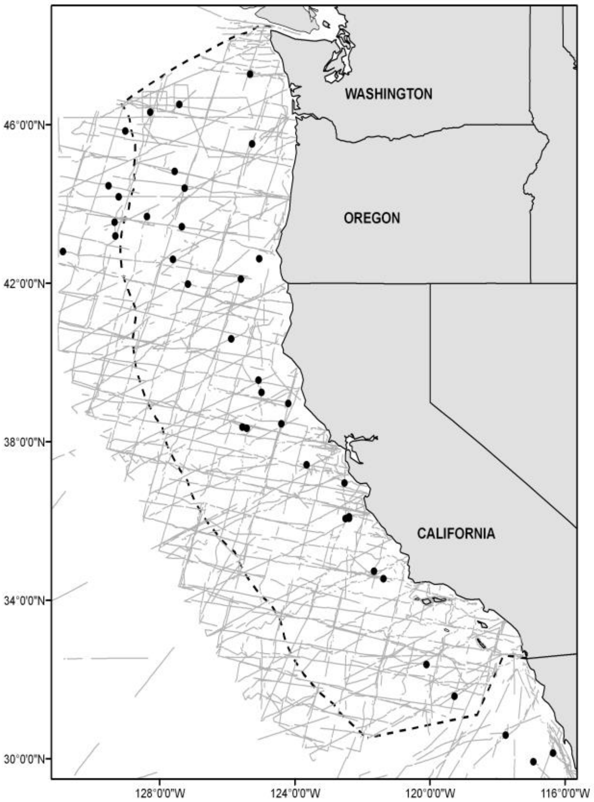

Figure 1. Baird’s beaked whale sightings based on shipboard surveys off California, Oregon and Washington, 1991-2008 (see Appendix 2 for data sources and information on timing and location of survey effort). Dashed line represents the U.S. EEZ, thin lines indicate completed transect effort of all surveys combined.

POPULATION SIZE

Two summer/fall shipboard surveys were conducted within 300 nmi of the coasts of California, Oregon and Washington 2005 (Forney 2007) and 2008 (Barlow 2010). Because the distribution of Baird’s beaked whale varies and animals probably spend time outside the U.S. Exclusive Economic Zone, a multi-year average abundance estimate is the most appropriate for management within U.S. waters. A geometric mean abundance estimate for California, Oregon and Washington waters based on ship surveys from 2005 and 2008 was 907 (CV=0.49) Baird’s beaked whales (Forney 2007, Barlow 2010). This abundance estimate included correction factors for the proportion of animals missed, based on a model of their diving behavior, detection distances, and the searching behavior of observers (Barlow 1999). About 96% of all trackline groups are estimated to be seen. A trend-based analysis of line-transect data from surveys conducted between 1991 and 2008 yielded new estimates of abundance (Moore and Barlow 2013). Based on this analysis and a lack of a detected trend in abundance, a multi-year average of the 2005 and 2008 trend estimates is the most appropriate estimate for this stock. The geometric mean of the best (50th percentile) estimates of abundance for Baird’s beaked whales in 2005 (767, CV=1.29) and 2008 (937, CV=1.34) in waters off California, Oregon and Washington is 847 (CV=0.81).

Minimum Population Estimate

The log-normal 20th percentile of the 2005-2008 geometric mean abundance estimate is 466 Baird's beaked whales.

Current Population Trend

The analysis by Moore and Barlow (2013) did not suggest evidence of an abundance trend during 1991–2008 for Baird's beaked whale in waters off the U.S. west coast (Figure 2).

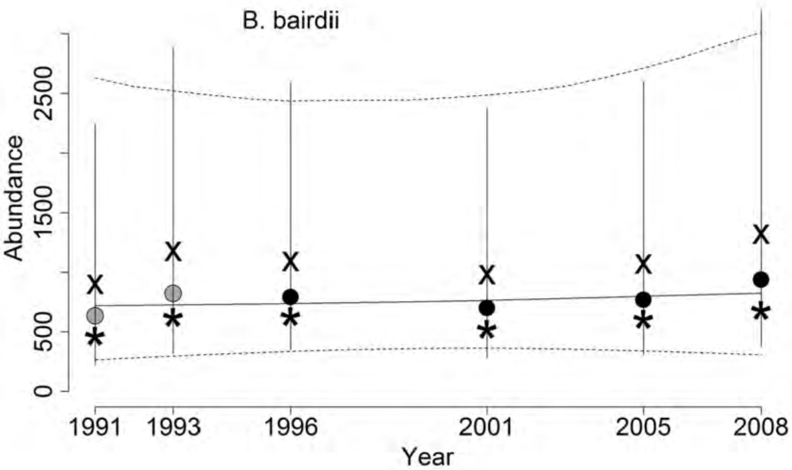

Figure 2. Abundance and trend estimates for Baird's beaked whales in the California Current, 1991-2008 (Moore and Barlow 2013). For each year, the Bayesian posterior median (●), mean (x) and mode (*) abundance estimates are shown, along with 90% CRIs.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No information on current or maximum net productivity rates is available for this species.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (466) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no fishery mortality; Wade and Angliss 1997), resulting in a PBR of 4.7 Baird's beaked whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

The California large mesh drift gillnet fishery has been the only fishery known to interact with this stock. One Baird's beaked whale was incidentally killed in this fishery in 1994 (Julian and Beeson 1998), before acoustic pingers were first used in the fishery in 1996 (Barlow and Cameron 2003). Since 1996, no beaked whale of *any* species have been observed entangled or killed in this fishery (Carretta et al. 2008, Carretta and Enriquez 2009a, 2009b, Carretta and Barlow 2011, Carretta and Enriquez 2012a, 2012b). Mean annual takes in Table 1 are based on 2007-2011 data. This results in an average estimated annual mortality of zero Baird's beaked whales. Gillnets have been documented to entangle marine mammals off Baja California (Sosa-Nishizaki et al. 1993), but no recent bycatch data from Mexico are available.

Table 1. Summary of available information on the incidental mortality and injury of Baird's beaked whales (California/Oregon/Washington Stock) in commercial fisheries that might take this species. The single observed entanglement resulted in the death of the animal. Coefficients of variation for mortality estimates are provided in parentheses. Mean annual takes are based on 2007-2011 data unless noted otherwise.

Fishery Name	Data Type	Year(s)	Percent Observer Coverage	Observed Mortality	Estimated Annual Mortality	Mean Annual Takes (CV in parentheses)
CA/OR thresher shark/swordfish drift gillnet fishery	observer data	2007 2008 2009 2010 2011	16.4% 13.5% 13.3% 11.9% 19.5%	0 0 0 0 0	0 0 0 0 0	0

Fishery Name	Data Type	Year(s)	Percent Observer Coverage	Observed Mortality	Estimated Annual Mortality	Mean Annual Takes (CV in parentheses)
Minimum total annual takes						0

Other mortality

California coastal whaling operations killed 15 Baird's beaked whales between 1956 and 1970, and 29 additional Baird's beaked whales were taken by whalers in British Columbian waters (Rice 1974). One Baird’s beaked whale stranded in Washington state in 2003 and the cause of death was attributed to a ship strike. No other human-caused mortality has been reported for this stock for the period 2007-2011.

Anthropogenic sound sources, such as military sonar and seismic testing have been implicated in the mass strandings of beaked whales, including atypical events involving multiple beaked whale species (Simmonds and Lopez-Jurado 1991, Frantiz 1998, Anon. 2001, Jepson et al. 2003, Cox et al. 2006). While D’Amico et al. (2009) note that most mass strandings of beaked whales are unassociated with documented sonar activities, lethal or sub-lethal effects of such activities would rarely be documented, due to the remote nature of such activities and the low probability that an injured or dead beaked whale would strand. Filadelpho et al. (2009) reported statistically significant correlations between military sonar use and mass strandings of beaked whales in the Mediterranean and Caribbean Seas, but not in Japanese and Southern California waters, and hypothesized that regions with steep bathymetry adjacent to coastlines are more conducive to stranding events in the presence of sonar use. In Hawaiian waters, Faerber & Baird (2010) suggest that the probability of stranding is lower than in some other regions due to nearshore currents carrying animals away from beaches, and that stranded animals are less likely to be detected due to low human population density near many of Hawaii’s beaches. Actual and simulated sonar are known to interrupt the foraging dives and echolocation activities of tagged beaked whales (Tyack et al. 2011). Blainville’s beaked whale presence was monitored on hydrophone arrays before, during, and after sonar activities on a Caribbean military range, with evidence of avoidance behavior: whales were detected throughout the range prior to sonar exposure, not detected in the center of the range coincident with highest sonar use, and gradually returned to the range center after the cessation of sonar activity (Tyack et al. 2011). Fernández et al. (2013) report that there have been no mass strandings of beaked whales in the Canary Islands following a 2004 ban on sonar activities in that region. The absence of beaked whale bycatch in California drift gillnets following the introduction of acoustic pingers into the fishery implies additional sensitivity of beaked whales to anthropogenic sound (Carretta et al. 2008, Carretta and Barlow 2011).

STATUS OF STOCK

The status of Baird's beaked whales in California, Oregon and Washington waters relative to OSP is not known, and no abundance trend is evident. They are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. The average annual human-caused mortality during 2007-2011 is zero animals/year. Because recent fishery and human-caused mortality is less than the PBR (4.7), Baird’s beaked whales are not classified as a "strategic" stock under the MMPA. The total fishery mortality and serious injury for this stock is zero and can be considered to be insignificant and approaching zero. The impacts of anthropogenic sound on beaked whales remains a concern (Barlow and Gisiner 2006, Cox et al. 2006, Hildebrand et al. 2005, Weilgart 2007).

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Revised 6/4/2014

MESOPLODONT BEAKED WHALES (*Mesoplodon* spp.): California/Oregon/Washington Stocks

STOCK DEFINITION AND GEOGRAPHIC RANGE

Mesoplodont beaked whales are distributed throughout deep waters and along the continental slopes of the North Pacific Ocean. The six species known to occur in this region are: Blainville's beaked whale (*M. densirostris*), Perrin's beaked whale (*M. perrini*), Lesser beaked whale (*M. peruvianus*), Stejneger's beaked whale (*M. stejnegeri*), Gingko-toothed beaked whale (*M. gingkodens*), and Hubbs' beaked whale (*M. carlhubbsi*) (Mead 1989, Henshaw *et al.* 1997, Dalebout *et al.* 2002, MacLeod et al. 2006). Based on bycatch and stranding records in this region, it appears that Hubb's beaked whale is most commonly encountered (Carretta et al. 2008, Moore and Barlow 2013). Insufficient sighting records exist off the U.S. west coast (Figure 1) to determine any possible spatial or seasonal patterns in the distribution of mesoplodont beaked whales.

Until methods of distinguishing these six species at-sea are developed, the management unit must be defined to include all *Mesoplodon* stocks in this region. However, in the future, species-level management is desirable, and a high priority should be placed on finding means to obtain species-specific abundance information. For the Marine Mammal Protection Act (MMPA) stock assessment reports, three *Mesoplodon* stocks are defined: 1) all *Mesoplodon* species off California, Oregon and Washington (this report), 2) *M. stejnegeri* in Alaskan waters, and 3) *M. densirostris* in Hawaiian waters.

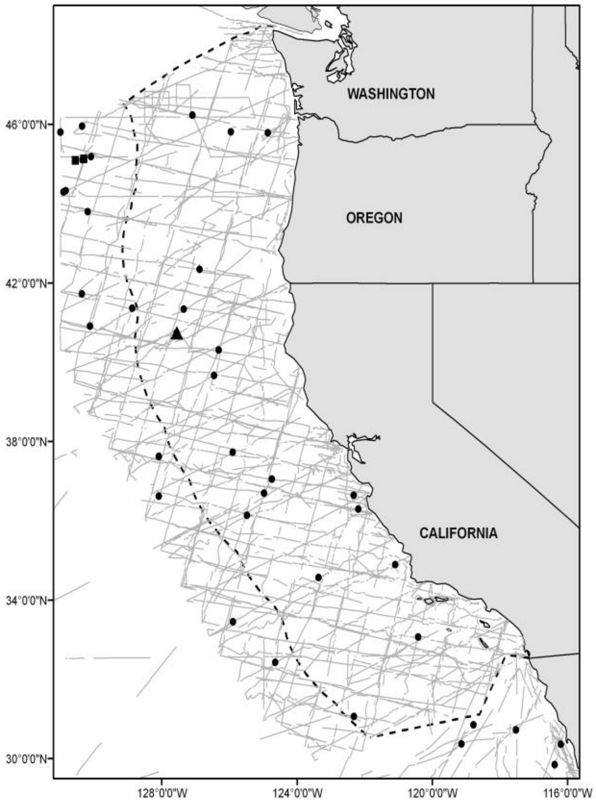

Figure 1. *Mesoplodon* beaked whale sightings based on shipboard surveys off California, Oregon and Washington, 1991-2008 (see Appendix 2 for data sources and information on timing and location of survey effort). Key: ● = *Mesoplodon* spp.; ▲= identified *Mesoplodon densirostris*; ■ = identified *Mesoplodon carlhubbsi*. Dashed line represents the U.S. EEZ, thin lines indicate completed transect effort of all surveys combined.

POPULATION SIZE

Although mesoplodont beaked whales have been sighted along the U.S. west coast on several line transect surveys utilizing both aerial and shipboard platforms, the rarity of sightings has historically precluded reliable population estimates. Early abundance estimates are imprecise and biased low by an unknown amount because of the large proportion of time this species spends submerged, and because the ship surveys before 1996 covered only California waters, and thus did not include animals off Oregon/Washington. Furthermore, survey data include a large number of unidentified beaked whale sightings that are probably either *Mesoplodon* sp. or Cuvier's beaked whales (*Ziphius cavirostris*). An abundance estimate of 1,024 (CV = 0.77) for all species of *Mesoplodon* beaked whales in the California Current was obtained based on combining data from the two most recent surveys (2005, 2008) conducted within 300 nmi of the coasts of California, Oregon and Washington (Forney 2007, Barlow and Forney 2007, Barlow 2010). This estimate was based in part on a correction factor to account for the proportion of animals on the survey trackline that were likely to missed by observers (0.55), calculated from a model of beaked whale diving behavior, detection distances and searching behavior by the observers (Barlow 1999). Of the 5 sightings of *Mesoplodon* made during 2005-2008 surveys [all 5 sightings were made during the 2005 survey] two were identified to the ‘probable’ species level (one *Mesoplodon densirostris* and one *Mesoplodon carlhubbsi*). An estimate of Blainville’s beaked whale abundance (603, CV = 1.16) was based on this one probable sighting, while the Hubb’s beaked whale sighting was not recorded during standard survey effort, and thus there is no estimate of abundance. The abundance estimate for mesoplodont beaked whales of unknown species, based on the same 2005-2008 surveys was 421 (CV=0.88). A trend-based analysis of line-transect data from surveys conducted between 1991 and 2008 yielded new estimates of *Mesoplodon* species abundance (Moore and Barlow 2013). The new estimate accounts for the proportion of unidentified beaked whale sightings likely to be *Mesoplodon* beaked whales and uses a correction factor for missed animals adjusted to account for the fact that the proportion of animals on the trackline missed by observers increases in rough observing conditions. The trend-model analysis incorporates information from the entire 1991-2008 time series for each annual estimate of abundance, and given the strong evidence of a decreasing abundance trend over that time (Moore and Barlow 2013), the best estimate of abundance is represented by the model-averaged estimate for 2008. Based on this analysis, the best (50th percentile) estimate of abundance for all species of *Mesoplodon* species combined in 2008 in waters off California, Oregon and Washington is 694 (CV=0.65).

Minimum Population Estimate

The minimum population estimate (defined as the log-normal 20th percentile of the abundance estimate) for mesoplodont beaked whales in California, Oregon, and Washington is 389 animals.

Current Population Trend

There is strong evidence, based on line-transect survey data and the historical stranding record off the U.S. west coast, that the abundance of *Mesoplodon* beaked whales has recently declined in waters off California, Oregon and Washington (Moore and Barlow 2013, Figure 2). Statistical analysis of line-transect survey data from 1991 - 2008 indicates a 0.96 probability of decline during this period, with the mean annual rate of population change estimated to have been −7.0% per year (95% CRI: −16.7% to +1.0%). Patterns in the historical stranding record alone provide limited information about beaked whale abundance trends, but the stranding record appears generally consistent rather than at-odds with results of the line-transect survey analysis. Regional stranding networks along the Pacific coast of the U.S. and Canada originated during the 1980s, and beach coverage and reporting rates are thought to have increased throughout the 1990s and in to the early 2000s. Therefore, for a stable or increasing population, an overall increasing trend in stranding reports between the 1980s and 2000s would be expected. In contrast, reported strandings for *M. carlhubbsi* and *M. stejnegeri* in the California Current region have declined monotonically since the 1980s.

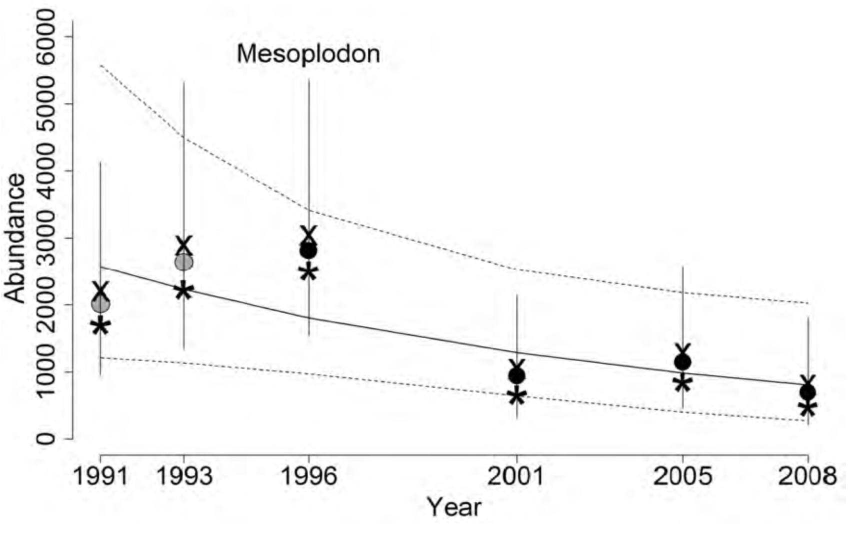

Figure 2. Abundance and trend estimates for mesoplodont beaked whales in the California Current, 1991-2008 (Moore and Barlow 2013). For each year, the Bayesian posterior median (●), mean (x) and mode (*) abundance estimates are shown, along with 90% CRIs.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No information on current or maximum net productivity rates is available for mesoplodont beaked whales.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (389) <u>times</u> one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no known recent fishery mortality; Wade and Angliss 1997), resulting in a PBR of 3.9 mesoplodont beaked whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

The California large mesh drift gillnet fishery has been the only fishery historically known to interact with *Mesoplodon* beaked whales in this region. Between 1990 and 1995, a total of eight *Mesoplodon* beaked whales (5 Hubb's beaked whales (*Mesoplodon carlhubbsi*), one Stejneger's beaked whale (*Mesoplodon stejnegeri*), and two unidentified whales of the genus *Mesoplodon* were observed entangled in approximately 3,300 sets (Julian and Beeson 1998, Carretta *et al*. 2008). Following the introduction of acoustic pingers into this fishery (Barlow and Cameron 2003), no beaked whales of any species have been observed entangled in over 4,000 observed sets (Carretta *et al*. 2008, Carretta and Enriquez 2009a, 2009b, 2010, 2012a, 2012b, Carretta and Barlow 2011). Mean annual takes in Table 1 are based on 2007-2011 data. This results in an average estimated annual mortality of zero mesoplodont beaked whales.

Gillnets have been documented to entangle marine mammals off Baja California (Sosa-Nishizaki et al. 1993), but no recent bycatch data from Mexico are available.

Table 1. Summary of available information on the incidental mortality and injury of *Mesoplodon* beaked whales (California/Oregon/Washington Stocks) in commercial fisheries that might take these species. Mean annual takes are based on 2007-2011 data unless noted otherwise.

Fishery Name	Data Type	Year	Percent Observer Coverage	Observed Mortality	Estimated Annual Mortality	Mean Annual Takes (CV in parentheses)
CA/OR thresher shark/swordfish drift gillnet fishery	observer	2007 2008 2009 2010 2011	16.4% 13.5% 13.3% 11.9% 19.5%	0 0 0 0 0	0 0 0 0 0	0
Minimum total annual takes of *Mesoplodon* beaked whales						0

Other mortality

Anthropogenic sound sources, such as military sonar and seismic testing have been implicated in the mass strandings of beaked whales, including atypical events involving multiple beaked whale species (Simmonds and Lopez-Jurado 1991, Frantiz 1998, Anon. 2001, Jepson et al. 2003, Cox et al. 2006). While D'Amico et al. (2009) note that most mass strandings of beaked whales are unassociated with documented sonar activities, lethal or sub-lethal effects of such activities would rarely be documented, due to the remote nature of such activities and the low probability that an injured or dead beaked whale would strand. Filadelpho et al. (2009) reported statistically significant correlations between military sonar use and mass strandings of beaked whales in the Mediterranean and Caribbean Seas, but not in Japanese and Southern California waters, and hypothesized that regions with steep bathymetry adjacent to coastlines are more conducive to stranding events in the presence of sonar use. In Hawaiian waters, Faerber & Baird (2010) suggest that the probability of stranding is lower than in some other regions due to nearshore currents carrying animals away from beaches, and that stranded animals are less likely to be detected due to low human population density near many of Hawaii's beaches. Actual and simulated sonar are known to interrupt the foraging dives and echolocation activities of tagged beaked whales (Tyack et al. 2011, DeRuiter et al. 2013). Cuvier's beaked whales tagged and tracked during simulated mid-frequency sonar exposure showed avoidance reactions, including prolonged diving, cessation of echolocation click production associated with foraging, and directional travel away from the simulated sonar source (DeRuiter et al. 2013). Blainville's beaked whale presence was monitored on hydrophone arrays before, during, and after sonar activities on a Caribbean military range, with evidence of avoidance behavior: whales were detected throughout the range prior to sonar exposure, not detected in the center of the range coincident with highest sonar use, and gradually returned to the range center after the cessation of sonar activity (Tyack et al. 2011). Fernández et al. (2013) report that there have been no mass strandings of beaked whales in the Canary Islands following a 2004 ban on sonar activities in that region. The absence of beaked whale bycatch in California drift gillnets following the introduction of acoustic pingers into the fishery implies additional sensitivity of beaked whales to anthropogenic sound (Carretta et al. 2008, Carretta and Barlow 2011).

STATUS OF STOCKS

The status of mesoplodont beaked whales in California, Oregon and Washington waters relative to OSP is not known, but evidence suggests a high likelihood of population decline in the California Current since the early 1990s, at a mean rate of −7.0% per year, which corresponds to trend-fitted abundance levels in 2008 (most recent survey) being at approximately 30% of 1991 levels. Moore and Barlow (2013) ruled out bycatch as a cause of the decline in mesoplodont beaked whale abundance and suggest that impacts from anthropogenic sound such as naval sonar and deepwater ecosystem changes within the California Current are plausible hypotheses warranting further investigation. None of the six species is listed as "threatened" or "endangered" under the Endangered Species Act, but given the long-term decline in mesoplodont beaked whale abundance in the California Current reported by Moore and Barlow (2013), these stocks are considered strategic. The degree of decline (trend-fitted 2008 abundance at approximately 30% of 1991 levels) also suggests that these stocks are likely well below their carrying capacity and may be depleted. The average annual known human-caused fishery mortality between 2007 and 2011 is zero. It is likely that the difficulty in identifying these animals in the field will remain a critical obstacle to obtaining species-specific abundance estimates and stock assessments in the future. The impacts of anthropogenic sound on beaked whales remains a concern (Barlow and Gisiner 2006, Cox et al. 2006, Hildebrand et al. 2005, Weilgart 2007).

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CUVIER'S BEAKED WHALE (*Ziphius cavirostris*): California/Oregon/Washington Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Cuvier's beaked whales are distributed widely throughout deep waters of all oceans (MacLeod et al. 2006). Off the U.S. west coast, this species is the most commonly encountered beaked whale (Figure 1). No seasonal changes in distribution are apparent from stranding records, and morphological evidence is consistent with the existence of a single eastern North Pacific population from Alaska to Baja California, Mexico (Mitchell 1968). For the Marine Mammal Protection Act (MMPA) stock assessment reports, Cuvier's beaked whales within the Pacific U.S. Exclusive Economic Zone are divided into three discrete, non-contiguous areas: 1) waters off California, Oregon and Washington (this report), 2) Alaskan waters, and 3) Hawaiian waters.

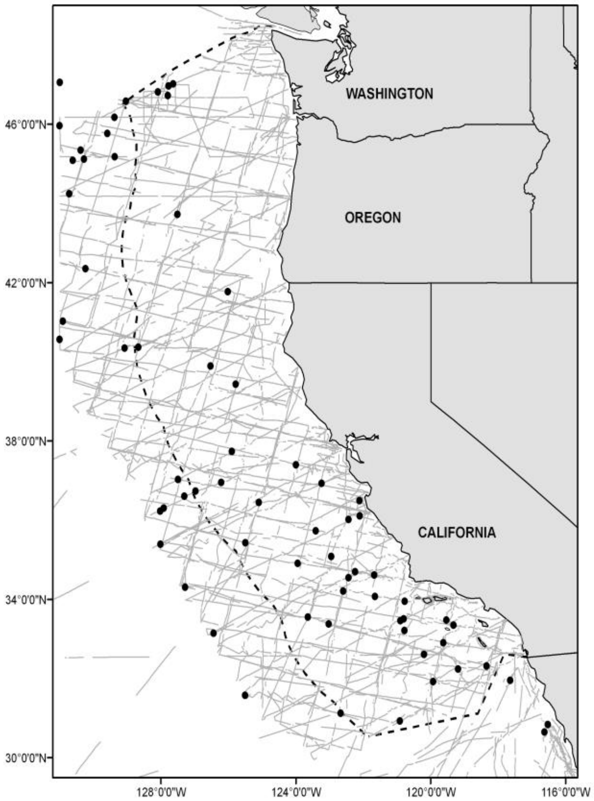

Figure 1. Cuvier’s beaked whale sightings based on shipboard surveys off California, Oregon and Washington, 1991-2008 (see Appendix 2, for data sources and information on timing and location of survey effort). Dashed line represents the U.S. EEZ, thin lines indicate completed transect effort of all surveys combined.

POPULATION SIZE

Although Cuvier's beaked whales have been sighted along the U.S. west coast on several line transect surveys utilizing both aerial and shipboard platforms, the rarity of sightings has historically precluded reliable population estimates. Early abundance estimates were imprecise and biased low by an unknown amount because of the large proportion of time this species spends submerged, and because ship surveys before 1996 covered only California waters, and thus did not include animals off Oregon/Washington. Furthermore, survey data include a large number of unidentified beaked whale sightings that are probably either *Mesoplodon* sp. or Cuvier's beaked whales (*Ziphius cavirostris*). An abundance estimate of 2,143 (CV = 0.65) was obtained based on combining data from the two most recent surveys (2005, 2008) conducted within 300 nmi of the coasts of California, Oregon and Washington (Forney 2007, Barlow and Forney 2007, Barlow 2010). This estimate was based in part on a correction factor to account for the proportion of animals on the survey trackline that were likely to missed by observers (0.67), calculated from a model of Cuvier’s beaked whale diving behavior, detection distances and searching behavior by the observers (Barlow 1999). A trend-based analysis of line-transect data from surveys conducted between 1991 and 2008 yielded new estimates of Cuvier’s beaked whale abundance (Moore and Barlow 2013). The new estimate is substantially higher than previous estimates in part because it accounts for the proportion of unidentified beaked whale sightings likely to be Cuvier’s beaked whales and because the correction factor for missed animals was adjusted to account for the fact that the proportion of animals on the trackline missed by observers increases in rough observing conditions. The trend-model analysis incorporates information from the entire

1991-2008 time series for each annual estimate of abundance, and given the strong evidence of a decreasing abundance trend over that time (Moore and Barlow 2013), the best estimate of abundance is represented by the model-averaged estimate for 2008. Based on this analysis, the best (50th percentile) estimate of abundance for Cuvier's beaked whales in 2008 in waters off California, Oregon and Washington was 6,590 (CV=0.55).

Minimum Population Estimate

Based on the analysis by Moore and Barlow (2013), the minimum population estimate (defined as the log-normal 20th percentile of the abundance estimate) for Cuvier's beaked whales in California, Oregon, and Washington is 4,481 animals.

Current Population Trend

There is substantial evidence, based on line-transect survey data and the historical stranding record off the U.S. west coast, that the abundance of Cuvier's beaked whales has recently declined in waters off California, Oregon and Washington (Moore and Barlow 2013, Figure 2). Statistical analysis of line-transect survey data from 1991 - 2008 indicates a 0.84 probability of decline during this period, with the mean annual rate of population change estimated to have been −2.9% per year (95% CRI: −8.8% to +3.3%). Patterns in the historical stranding record alone provide limited information about beaked whale abundance trends, but the stranding record appears generally consistent rather than at-odds with results of the line-transect survey analysis. Regional stranding networks along the Pacific coast of the U.S. and Canada originated during the 1980s, and beach coverage and reporting rates are thought to have increased throughout the 1990s and in to the early 2000s. Therefore, for a stable or increasing population, an overall increasing trend in stranding reports between the 1980s and 2000s would be expected. Patterns of Cuvier's beaked whale strandings data are highly variable across stranding network regions, but an overall increasing trend from the 1980s through 2000s is not evident within the California Current area, contrary to patterns for Baird's beaked whales (Moore and Barlow 2013) and for cetaceans in general (e.g., Norman et al. 2004, Danil et al. 2010).

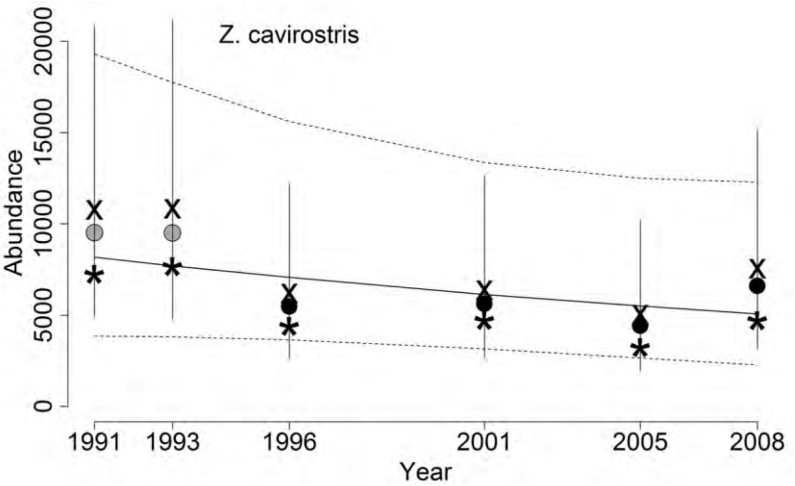

Figure 2. Abundance and trend estimates for Cuvier's beaked whales in the California Current, 1991-2008 (Moore and Barlow 2013). For each year, the Bayesian posterior median (●), mean (x) and mode (*) abundance estimates are shown, along with 90% CRIs.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No information on current or maximum net productivity rates is available for this species.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (4,481) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no known fishery mortality; Wade and Angliss 1997), resulting in a PBR of 45 Cuvier's beaked whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

A summary of recent fishery mortality and injury for Cuvier's beaked whales in this region is shown in Table 1. The California large mesh drift gillnet fishery has been the only fishery historically known to interact with this stock. There have been no Cuvier's beaked whales observed entangled in over 4,000 drift gillnet fishery sets since acoustic pingers were first used in this fishery in 1996 (Barlow and Cameron 2003, Carretta et al. 2008, Carretta and Enriquez 2009a, 2009b, 2010, 2012a, 2012b, Carretta and Barlow 2011). Prior to 1996, there were a total of 21 Cuvier's beaked whales entangled in approximately 3,300 drift gillnet fishery sets: 1992 (six animals), 1993 (three), 1994 (six) and 1995 (six) (Julian and Beeson 1998). Mean annual takes in Table 1 are based only on 2007-2011 data. This results in an average estimated annual mortality of zero Cuvier's beaked whales.

Table 1. Summary of available information on the incidental mortality and injury of Cuvier's beaked whales (California/ Oregon/Washington Stock) in commercial fisheries that might take this species. Mean annual takes are based on 2007-2011 data unless noted otherwise.

Fishery Name	Data Type	Year(s)	Percent Observer Coverage	Observed Mortality + ReleasedAlive	Estimated Annual Mortality / Mortality + Entanglements	Mean Annual Takes (CV in parentheses)
CA/OR thresher shark/swordfish drift gillnet fishery	observer data	2007 2008 2009 2010 2011	16.4% 13.5% 13.3% 11.9% 19.5%	0 0 0 0 0	0 0 0 0 0	0
Minimum total annual takes						0

Gillnets have been documented to entangle marine mammals off Baja California (Sosa-Nishizaki et al. 1993), but no recent bycatch data from Mexico are available.

Other mortality

Anthropogenic sound sources, such as military sonar and seismic testing have been implicated in the mass strandings of beaked whales, including atypical events involving multiple beaked whale species (Simmonds and Lopez-Jurado 1991, Frantiz 1998, Anon. 2001, Jepson et al. 2003, Cox et al. 2006). While D'Amico et al. (2009) note that most mass strandings of beaked whales are unassociated with documented sonar activities, lethal or sub-lethal effects of such activities would rarely be documented, due to the remote nature of such activities and the low probability that an injured or dead beaked whale would strand. Filadelpho et al. (2009) reported statistically significant correlations between military sonar use and mass strandings of beaked whales in the Mediterranean and Caribbean Seas, but not in Japanese and Southern California waters, and hypothesized that regions with steep bathymetry adjacent to coastlines are more conducive to stranding events in the presence of sonar use. In Hawaiian waters, Faerber & Baird (2010) suggest that the probability of stranding is lower than in some other regions due to nearshore currents carrying animals away from beaches, and that stranded animals are less likely to be detected due to low human population density near many of Hawaii's beaches. Actual and simulated sonar are known to interrupt the foraging dives and echolocation activities of tagged beaked whales (Tyack et al. 2011, DeRuiter et al. 2013). Cuvier's beaked whales tagged and tracked during simulated mid-frequency sonar exposure showed avoidance reactions, including prolonged diving, cessation of echolocation click production associated with foraging, and directional travel away from the simulated sonar source (DeRuiter et al. 2013). Blainville's beaked whale presence was monitored on hydrophone arrays before, during, and after sonar activities on a Caribbean military range, with evidence of avoidance behavior: whales were detected throughout the range prior to sonar exposure, not detected in the center of the range coincident with highest sonar use, and gradually returned to the range center after the cessation of sonar activity (Tyack et al. 2011). Fernández et al. (2013) report that there have been no mass strandings of beaked whales in the Canary Islands following a 2004 ban on sonar activities in that region. The absence of beaked whale bycatch in California drift gillnets following the introduction of acoustic pingers into the fishery implies additional sensitivity of beaked whales to anthropogenic sound (Carretta et al. 2008, Carretta and Barlow 2011).

STATUS OF STOCK

The status of Cuvier's beaked whales in California, Oregon and Washington waters relative to OSP is not known, but evidence suggests a substantial likelihood of population decline in the California

Current since the early 1990s, at a mean rate of -2.9% per year, which corresponds to trend-fitted abundance levels in 2008 (most recent survey) being at 61% of 1991 levels. They are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA, but given the long-term decline in Cuvier's beaked whale abundance in the California Current reported by Moore and Barlow (2013), this stock is considered strategic. The degree of decline (trend-fitted 2008 abundance at approximately 61% of 1991 levels) also suggests that this stock is likely below its carrying capacity and may be depleted. Moore and Barlow (2013) ruled out bycatch as a cause of the decline in Cuvier's beaked whale abundance and suggest that impacts from anthropogenic sounds such as naval sonar and deepwater ecosystem changes within the California Current are plausible hypotheses warranting further investigation. The average annual known human-caused mortality between 2007 and 2011 is zero. The total fishery mortality and serious injury for this stock is less than 10% of the PBR and thus can be considered to be insignificant and approaching zero. The impacts of anthropogenic sound on beaked whales remains a concern (Barlow and Gisiner 2006, Cox et al. 2006, Hildebrand et al. 2005, Weilgart 2007).

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Revised 2/10/2017

PYGMY SPERM WHALE (*Kogia breviceps*): California/Oregon/Washington Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Pygmy sperm whales are distributed throughout deep waters and along the continental slopes of the North Pacific and other ocean basins (Ross 1984; Caldwell and Caldwell 1989). Along the U.S. west coast, sightings of this species and of animals identified only as *Kogia* sp. have been rare (Figure 1). However, this probably reflects their pelagic distribution, small body size and cryptic behavior, rather than a measure of rarity. Strandings of pygmy sperm whales in this region are known from California, Oregon and Washington (Roest 1970; Caldwell and Caldwell 1989; NMFS, Northwest Region, unpublished data; NMFS, Southwest Region, unpublished data), while strandings of dwarf sperm whales (*Kogia sima*) are rare in this region. At-sea sightings in this region have all been either of pygmy sperm whales or unidentified *Kogia* sp. Available data are insufficient to identify any seasonality in the distribution of pygmy sperm whales, or to delineate possible stock boundaries. For the Marine Mammal Protection Act (MMPA) stock assessment reports, pygmy sperm whales within the Pacific U.S. Exclusive Economic Zone are divided into two discrete, non-contiguous areas: 1) waters off California, Oregon and Washington (this report), and 2) Hawaiian waters.

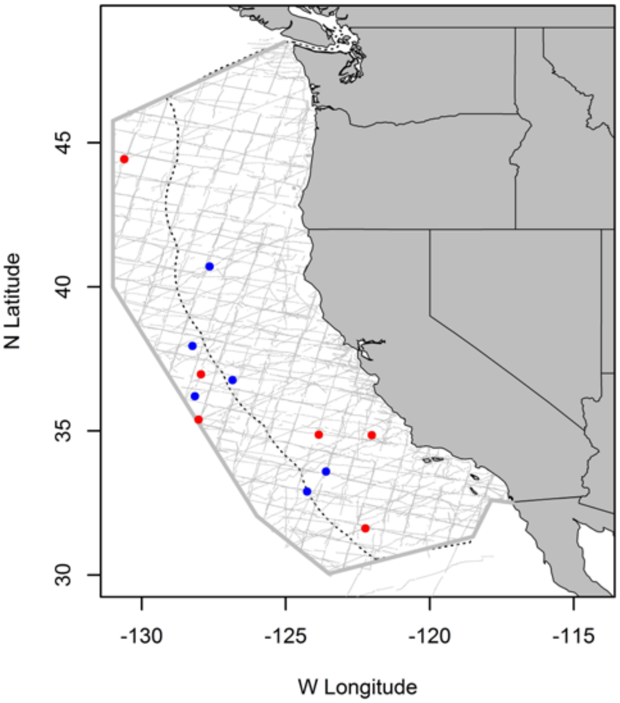

Figure 1. *Kogia* sightings based on shipboard surveys off California, Oregon and Washington, 1991-2014. Key: ● = *Kogia breviceps*, ● = *Kogia* spp. Dashed line represents the U.S. EEZ, thin lines indicate completed transect effort of all surveys combined.

POPULATION SIZE

Most sightings of *Kogia* in the California Current are only identified to genus due to their cryptic nature, but based on positively-identified sightings from previous surveys and historical stranding data, most of these sightings were probably pygmy sperm whales; *K. breviceps*. The rarity of sightings likely reflects the cryptic nature of this species (they are detected almost exclusively in extremely calm sea conditions), rather than an absence of animals in the region. The best estimate of abundance for this stock is the geometric mean of 2008 and 2014 shipboard line-transect surveys, or 4,111 (CV=1.12) animals. This estimate is considerably higher than previous abundance estimates for the genus *Kogia* and results from a new and lower estimate of *g(0)*, the trackline detection probability (Barlow 2015). Only 3% of *Kogia* groups were estimated to have been detected on the trackline during 1991-2014 surveys (Barlow 2016).

Minimum Population Estimate

The minimum population estimate is taken as the log-normal 20th percentile of the 2008 and 2014 average abundance estimate for California, Oregon, and Washington waters, or 1,924 animals.

Current Population Trend

Due to the rarity of sightings of this species on surveys along the U.S. West coast, no information exists regarding trends in abundance of this population.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No information on current or maximum net productivity rates is available for this species.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (1,924) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no known fishery mortality during the last five years; Wade and Angliss 1997), resulting in a PBR of 19 pygmy sperm whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

A summary of recent fishery mortality and injury for pygmy sperm whales and unidentified *Kogia*, which may have been pygmy sperm whales, is shown in Table 1. In the California swordfish drift gillnet fishery (the only U.S. west coast fishery likely to interact with *Kogia*), no mortality of pygmy sperm whales or unidentified *Kogia* was observed during the most recent five years of monitoring (Carretta *et al*. 2017). Over 8,600 fishing sets have been monitored in the California swordfish drift gillnet fishery between 1990 and 2014 and only 2 pygmy sperm whales were observed entangled (Carretta et al. 2017). Both animals were entangled in years that predated the use of acoustic pingers in the fishery to reduce bycatch (Barlow and Cameron 2003), but the small sample size of *Kogia breviceps* bycatch in the fishery precludes any conclusions regarding the effectiveness of acoustic pingers in reducing bycatch of this species (Carretta and Barlow 2011). Mean annual takes in Table 1 are based on 2010-2014 data. This results in an average estimated annual mortality of zero pygmy sperm whales.

One pygmy sperm whale stranded in California in 2002 with evidence that it died as a result of a shooting (positive metal detector scan). Due to the cryptic and pelagic nature of this species, it is likely that the shooting resulted from an interaction with an unknown entangling net fishery. Although there are no records of fishery-related strandings of pygmy sperm whales along the U.S. west coast in recent years (Carretta *et al*. 2013, 2014, 2015, 2016a), compared with other more coastal cetaceans, the probability of a pygmy sperm whale carcass coming ashore and being detected would be quite low (Carretta *et al*. 2016b).

Other mortality

Unknown levels of injuries and mortality of pygmy sperm whales may occur as a result of anthropogenic sound, such as military sonars. Atypical multispecies mass strandings, sometimes involving pygmy and/or dwarf sperm whales have been associated with military sonar use. One 1988 event from the Canary Islands included 2 pygmy sperm whales and the species *Ziphius cavirostris* and *Hyperoodon ampullatus* (reviewed in D'Amico *et al*. 2009). Another mass stranding and unusual mortality event (UME) in North Carolina, USA in 2005 included 2 dwarf sperm whales, in addition to 33 short-finned pilot whales and a minke whale (Hohn *et al*. 2006). This UME coincided in time and space with military activity using mid-frequency active sonar, although the authors note that a definitive association between the UME and sonar use is lacking (Hohn *et al*. 2006). Such injuries or mortality to pygmy sperm whales would rarely be documented, due to the remote nature of many of these activities and the low probability that an injured or dead pygmy sperm whale would strand.

STATUS OF STOCK

The status of pygmy sperm whales in California, Oregon and Washington waters relative to OSP is not known, and there are insufficient data to evaluate potential trends in abundance. Although the impacts of anthropogenic sounds such as sonar are often focused on beaked whales (Barlow and Gisiner 2006), the impacts of such sounds on deep-diving pygmy beaked whales also warrants concern. They are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. Given the rarity of sightings and lack of recent documented fishery interactions in U.S. west coast waters, pygmy sperm whales are not classified as a "strategic" stock under the MMPA.

Table 1. Summary of available information on the incidental mortality and injury of pygmy sperm whales and unidentified *Kogia* sp. (California/Oregon/Washington Stock) in commercial fisheries that might take this species. Coefficients of variation for mortality estimates are provided in parentheses. Mean annual takes are based on 2010-2014 data unless noted otherwise (Carretta *et al.* 2017).

Fishery Name	**Data Type**	**Year(s)**	**Percent Observer Coverage**	**Observed Mortality *K. breviceps* /*Kogia* sp.**	***Estimated Annual Mortality of K. breviceps/Kogia* sp.**	***Mean Annual Takes (CV in parentheses)***

Fishery Name	**Data Type**	**Year(s)**	**Percent Observer Coverage**	**Observed Mortality *K. breviceps /Kogia* sp.**	***Estimated Annual Mortality of K. breviceps/Kogia* sp.**	***Mean Annual Takes (CV in parentheses)***
CA/OR thresher shark/swordfish drift gillnet fishery	observer data	2010 2011 2012 2013 2014	12% 20% 19% 37% 24%	0 0 0 0 0	0	0
Minimum total annual takes						0

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Revised 2/10/2017

DWARF SPERM WHALE (*Kogia sima*): California/Oregon/Washington Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Dwarf sperm whales are distributed throughout deep waters and along the continental slopes of the North Pacific and other ocean basins (Caldwell and Caldwell 1989; Ross 1984). This species was only recognized as being distinct from the pygmy sperm whale in 1966 (Handley, 1966), and early records for the two species are confounded. Along the U.S. west coast, no at-sea sightings of this species have been reported; however, this may be partially a reflection of their pelagic distribution, small body size and cryptic behavior. A few sightings of animals identified only as *Kogia* sp. have been reported (Figure 1), and some of these may have been dwarf sperm whales. At least five dwarf sperm whales stranded in California between 1967 and 2000 (Roest 1970; Jones 1981; J. Heyning, pers. comm.; NMFS, Southwest Region, unpublished data), and one stranding is reported for western Canada (Nagorsen and Stewart 1983). It is unclear whether records of dwarf sperm whales are so rare because they are not regular inhabitants of this region, or merely because of their cryptic habits and offshore distribution. Available data are insufficient to identify any seasonality in the distribution of dwarf sperm whales, or to delineate possible stock boundaries. For the Marine Mammal Protection Act (MMPA) stock assessment reports, dwarf sperm whales within the Pacific U.S. Exclusive Economic Zone are divided into two discrete, non-contiguous areas: 1) waters off California, Oregon and Washington (this report), and 2) Hawaiian waters.

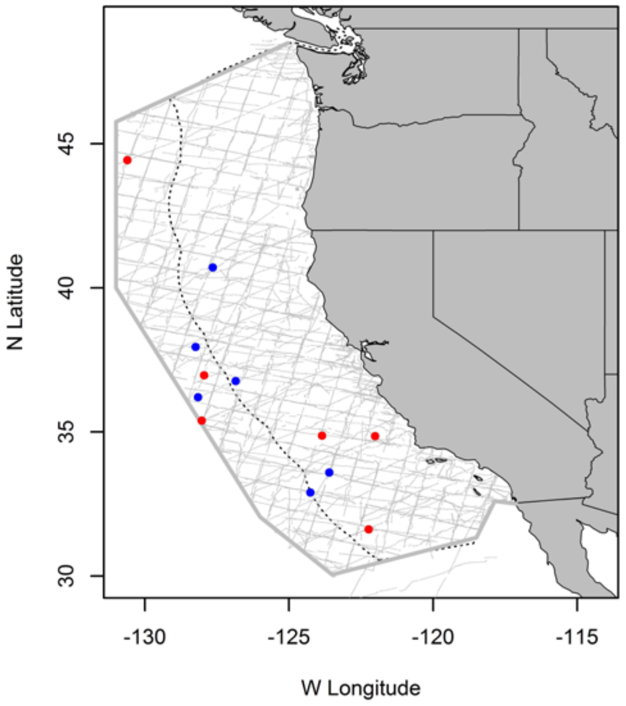

Figure 1. *Kogia* sightings based on shipboard surveys off California, Oregon and Washington, 1991-2014. Key: ● = *Kogia breviceps*; ● = *Kogia* spp. Dashed line represents the U.S. EEZ, thin lines indicate completed transect effort of all surveys combined.

POPULATION SIZE

No information is available to estimate the population size of dwarf sperm whales off the U.S. west coast, as no sightings of this species have been documented despite numerous vessel surveys of this region (Barlow 1995; Barlow and Gerrodette 1996; Barlow and Forney 2007; Forney 2007; Barlow 2010, Barlow 2016). Based on previous sighting surveys and historical stranding data, it is likely that recent ship survey sightings were of pygmy sperm whales; *K. breviceps.*

Minimum Population Estimate

No information is available to obtain a minimum population estimate for dwarf sperm whales.

Current Population Trend

Due to the rarity of records for this species along the U.S. West coast, no information exists regarding trends in abundance of this population.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No information on current or maximum net productivity rates is available for this species.

POTENTIAL BIOLOGICAL REMOVAL

Based on this stock's unknown status and growth rate, the recovery factor (F_r) is 0.5, and ½R_{max} is the default value of 0.02. However, due to the lack of abundance estimates for this species, no potential biological removal (PBR) can be calculated.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

The fishery most likely to interact with dwarf sperm whales in the California Current is the swordfish drift gillnet fishery. There have been no observed dwarf sperm whale entanglements in over 8,600 monitored fishing sets from 1990 to 2014 (Carretta *et al.* 2017). Although there are no records of fishery-related strandings of dwarf sperm whales along the U.S. west coast in recent years (Carretta *et al.* 2013, 2014, 2015, 2016a), compared with other more coastal cetaceans, the probability of a dwarf sperm whale carcass coming ashore and being detected would be quite low (Carretta *et al*. 2016b).

Table 1. Summary of available information on the incidental mortality and injury of dwarf sperm whales and unidentified *Kogia* sp. (California/Oregon/Washington Stock) in commercial fisheries that might take this species. Coefficients of variation for mortality estimates are provided in parentheses. Mean annual takes are based on 2010-2014 data.

Fishery Name	**Data Type**	**Year(s)**	**Percent Observer Coverage**	**Observed Mortality *K. breviceps /Kogia* sp.**	***Estimated Annual Mortality of K. breviceps/Kogia* sp.**	***Mean Annual Takes (CV in parentheses)***
CA/OR thresher shark/swordfish drift gillnet fishery	observer data	2010-2014	12% to 37%	0	0	0
Minimum total annual takes						0

Other Mortality

Unknown levels of injuries and mortality of dwarf sperm whales may occur as a result of anthropogenic sound, such as military sonars. Atypical multispecies mass strandings, sometimes involving dwarf and/or pygmy sperm whales have been associated with military sonar use. One 1988 event from the Canary Islands included 2 pygmy sperm whales and the species *Ziphius cavirostris* and *Hyperoodon ampullatus* (reviewed in D'Amico *et al.* 2009). Another mass stranding and unusual mortality event (UME) in North Carolina, USA in 2005 included 2 dwarf sperm whales, in addition to 33 short-finned pilot whales and a minke whale (Hohn *et al.* 2006). This UME coincided in time and space with military activity using mid-frequency active sonar, although the authors note that a definitive association between the UME and sonar use is lacking (Hohn *et al*. 2006). Such injuries or mortality would rarely be documented, due to the remote nature of many of these activities and the low probability that an injured or dead dwarf sperm whale would strand.

STATUS OF STOCK

The status of dwarf sperm whales in California, Oregon and Washington waters relative to OSP is not known, and there are insufficient data to evaluate potential trends in abundance. Although the impacts of anthropogenic sounds such as sonar are often focused on beaked whales (Barlow and Gisiner 2006), the impacts of such sounds on deep-diving dwarf beaked whales also warrants concern. They are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. Given that this species rarely occurs off the U.S. west coast and a lack of recent documented fishery mortality, dwarf sperm whales off California, Oregon and Washington are not classified as a "strategic" stock under the MMPA.

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SPERM WHALE (*Physeter macrocephalus*): California/Oregon/Washington Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

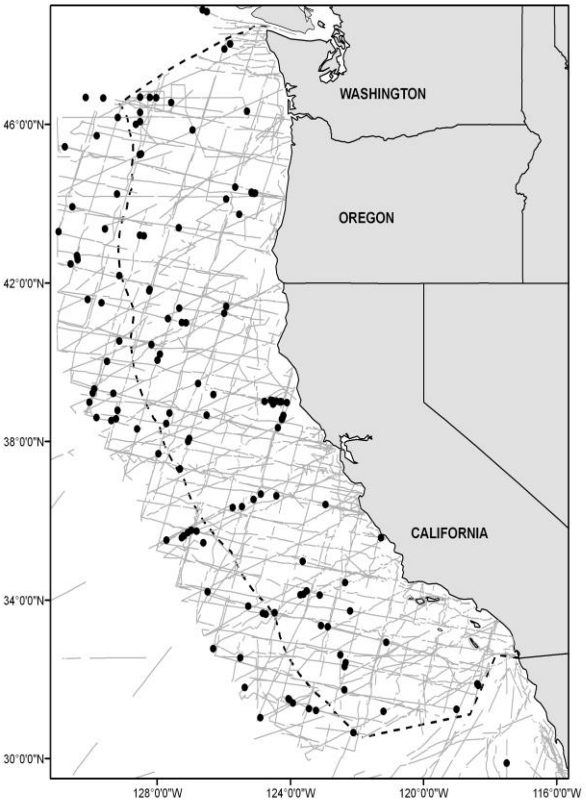

Figure 1. Sperm whale sighting locations from shipboard surveys off California, Oregon, and Washington, 1991-2008. Dashed line represents the U.S. EEZ, thin lines indicate completed transect effort of all surveys combined. See Appendix 2 for data sources and information on timing and location of survey effort.

Sperm whales are distributed across the entire North Pacific and into the southern Bering Sea in summer, but the majority are thought to be south of 40^{o}N in winter (Rice 1974; Rice 1989; Gosho et al. 1984; Miyashita et al. 1995). The International Whaling Commission (IWC) historically divided the North Pacific into two management regions (Donovan 1991) defined by a zig-zag line which starts at 150^{o}W at the equator, is 160^{o}W between 40-50^{o}N, and ends up at 180^{o}W north of 50^{o}N; however, the IWC has not reviewed this stock boundary recently (Donovan 1991). Sperm whales are found year-round in California waters (Dohl et al. 1983; Barlow 1995; Forney et al. 1995), but they reach peak abundance from April through mid-June and from the end of August through mid-November (Rice 1974). Sperm whales are seen off Washington and Oregon in every season except winter (Green et al. 1992). Of 176 sperm whales that were marked with Discovery tags off southern California in winter 1962-70, only three were recovered by whalers: one off northern California in June, one off Washington in June, and another far off British Columbia in April (Rice 1974). Recent summer/fall surveys in the eastern tropical Pacific (Wade and Gerrodette 1993) show that although sperm whales are widely distributed in the tropics, their relative abundance declines westward towards the middle of the tropical Pacific (near the IWC stock boundary at 150^{o}W) and declines northward towards the tip of Baja California. Sperm whale population structure in the eastern tropical Pacific is unknown, but the only photographic matches of known individuals from this area have been between the Galapagos Islands and coastal waters of South America (Dufault and Whitehead 1995) and between the Galapagos Islands and the southern Gulf of California (Jaquet et al. 2003), suggesting that eastern tropical Pacific animals constitute a distinct stock. No apparent distributional hiatus was found between the U.S. EEZ off California and Hawaii during a survey designed specifically to investigate stock structure and abundance of sperm whales in the northeastern temperate Pacific (Barlow and Taylor 2005). Sperm whales in the California Current have been identified as demographically independent from animals in Hawaii and the Eastern Tropical Pacific, based on genetic analyses of single-nucleotide polymorphisms (SNPs), microsatellites, and mtDNA (Mesnick *et al.* 2011). For the Marine Mammal Protection Act (MMPA) stock assessment reports, sperm whales within the Pacific U.S. EEZ are divided into three discrete, non-contiguous areas: 1) California, Oregon and Washington waters (this report), 2) waters around Hawaii, and 3) Alaska waters.

POPULATION SIZE

Previous estimates of sperm whale abundance from 2005 (3,140, CV=0.40, Forney 2007) and 2008 (300, CV=0.51, Barlow 2010) show a ten-fold difference that cannot be attributed to human-caused or natural population declines and likely reflect inter-annual variability in movement of animals into and out of the study area. New estimates of sperm whale abundance in California, Oregon, and Washington waters out to 300 nmi are available from a trend-model analysis of line-transect data collected from six surveys conducted from 1991 to 2008 (Moore and Barlow 2014), using methods similar to previous abundance trend analyses for fin whales (Moore and Barlow 2011) and beaked whales (Moore and Barlow 2013). Abundance trend models incorporate information from the entire 1991-2008 time series to obtain each annual abundance estimate, yielding estimates with less inter-annual variability. The trend model also uses improved estimates of group size and trackline detection probability (Moore and Barlow 2014). Sperm whale abundance estimates based on the trend-model ranged between 2,000 and 3,000 animals for the 1991-2008 time series (Moore and Barlow 2014). The best estimate of sperm whale abundance in the California Current is the trend-based estimate corresponding to the most recent survey (2008), or 2,106 animals (CV=0.58). This estimate is corrected for diving animals not seen during surveys.

Minimum Population Estimate

The minimum population estimate for sperm whales is taken as the lower 20th percentile of the posterior distribution of abundance estimated from 2008 or 1,332 whales (Moore and Barlow 2014).

Current Population Trend

Moore and Barlow (2014) report that sperm whale abundance appeared stable from 1991 to 2008 (Figure 2), but that reliable conclusions on population trends could not be made because the precision of estimated growth rates was poor. However, they also reported that trends in the detection of single animals (presumably large, solitary males) apparently doubled over this time period. The authors could not determine if the apparent increase in sightings of single animals reflected an increase in the number of adult male sperm whales in the population or merely increased use of the U.S. west coast waters by adult males in recent years.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

There are no published estimates of the growth rate for any sperm whale population (Best 1993).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (1,332) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.1 (for an endangered stock with N_{min} <1,500; Taylor et al. 2003), resulting in a PBR of 2.7 animals per year.

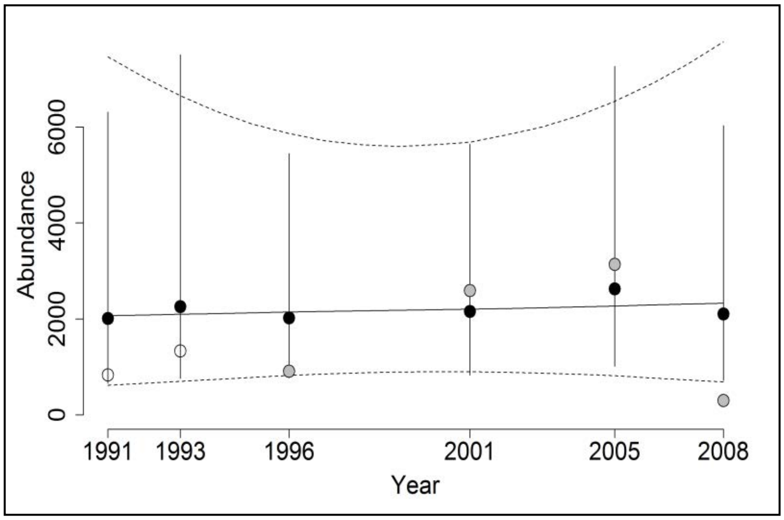

Figure 2. Trend-based estimates of sperm whale abundance in the California Current, 1991-2008 (Moore and Barlow 2014). Abundance estimates (posterior medians [●] and 95% CRIs) from the trend model, with fitted trend line and 95% CRIs for trend. For comparison, open and gray circles depict earlier published estimates from Barlow and Forney (2007) and Barlow (2010), with those for 1991 and 1993 [○] being for a smaller surveyed area.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Serious Injury Guidelines

NMFS uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to distinguis serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "injury that is more likely than not to result in mortality".

Fishery Information

The fishery most likely to directly take sperm whales from this stock is the California thresher shark/swordfish drift gillnet fishery (Julian and Beeson 1998, Carretta and Enriquez 2012). Observed serious injury and mortality has been rarely documented in the gillnet fishery (10 animals observed during ~8,500 observed sets between 1990 and 2014). Given the historic long-term average observer coverage of ~15% for this fishery (Carretta and Barlow 2011), annual estimates of bycatch will always be either zero (if no sperm bycatch is observed) or at least 7 (if ≥ 1 observed), for estimates made using within-year ratio methods [*e.g.,* estimated bycatch = observed bycatch/percent observer coverage]. If the true average annual mortality and serious injury is > 0, but less than a few animals per year, and if observer coverage generally remains low, then multiple years of data need to be pooled to for unbiased estimation of a mean annual bycatch rates (Carretta and Moore, 2014). Pooling more years reduces bias (estimates of mean annual bycatch approaches the true rate) and provides increased precision of bycatch estimates to better estimate long-term annual mortality and serious injury. Most marine mammal stock assessment reports utilize a 5-year time period for pooling bycatch estimates (NMFS 2005), but in the case of rare events, this 5-year time frame will yield biased estimates (systematic over- or underestimation of true bycatch) with insufficient precision (Carretta and Moore 2014, Moore and Merrick 2011). Since 2001, the drift gillnet fishery has been subject to a time/area closure that restricts most fishing to south of Point Conception, California, in waters generally shallower than 2,000 m, where bycatch risk to sperm whales is lower. The post-2000 time period best represents the current spatial state of the fishery and is used to calculate mean annual bycatch for sperm whales. Between 2001 and 2013, two sperm whales (one death and one serious injury in the same set) were entangled during 2,392 observed sets, resulting in a mean bycatch rate of 0.84 per 1,000 sets. Annual bycatch estimates for the 12-year period of 2001-2012 are presented for the drift gillnet fishery in Table 1 and are based on previously published estimates (Carretta et al. 2004, 2014a, Carretta and Chivers 2004, Carretta et al. 2005, Carretta and Enriquez 2006, 2007, 2009a, 2009b, 2010, 2012).

Although acoustic pingers are known to reduce the entanglement of cetaceans in the California drift gillnet swordfish fishery (Barlow and Cameron 2003, Carretta et al. 2008, Carretta and Barlow 2011), it is unknown whether pingers have any effect on sperm whale entanglement in this fishery due to low sample sizes. Sperm whales have been observed entangled 10 times in approximately 8,500 observed drift gillnet sets since 1990 (Carretta and Enriquez 2012). Six entanglements occurred prior to pinger use in this fishery. Two entanglements (1996 and 1998) occurred in sets that did not use a full complement of pingers, and two animals were entangled in 2010 in a single net where a full complement of 40 pingers was used (Carretta and Enriquez 2012).

Other fisheries may injure or kill sperm whales through entanglement or ingestion of marine debris. Three separate sperm whale strandings in 2008 showed evidence of fishery interactions (Jacobsen et al. 2010; NMFS, unpublished stranding data). Two whales died from gastric impaction as a result of ingesting multiple types of floating polyethylene netting (Jacobsen *et al*. 2010). The variability in size and age of the ingested net material suggests that it was ingested as surface debris and was not the result of fishery depredation (Jacobsen *et al*. 2010). Net types recovered from the whales' stomachs included portions of gillnet, bait nets, and fish/shrimp trawl nets. A third whale in 2008 showed evidence of entanglement scars (NMFS, unpublished stranding data). Two sperm whales also died in 2004 as a result of marine debris ingestion (NMFS, unpublished data): one animal had monofilament gillnet in its stomach and the second animal had nets of differing types in its stomach. Mean annual takes for all fisheries (Table 1) are based on 2001-2012 observer and stranding data (Carretta and Enriquez 2006, 2007, 2009a, 2009b, 2010, 2012, Carretta et al. 2005, Carretta and Chivers 2004, Carretta et al. 2004, 2014a, Jacobsen et al. 2010, NMFS unpublished stranding data). Including estimates from fishery observer programs (16 animals/12 years = 1.3/yr) and strandings data (5 animals/12 years = 0.4/yr), results in an average estimate of 1.7 sperm whale deaths per year due to fishery-related causes for the period 2001 to 2012. The mean annual mortality from strandings represents a minimum value, as not all carcasses come ashore or are detected.

Table 1. Summary of available information on the incidental mortality and injury of sperm whales (CA/OR/WA stock) for commercial fisheries that might take this species. n/a indicates that data are not available. Mean annual takes are based on 2001-2012 data unless noted otherwise.

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed mortality (and serious injury in parentheses)	Estimated mortality and serious injury (CV in parentheses)	Mean annual takes (CV in parentheses)
CA thresher shark/swordfish drift gillnet fishery	2001	observer	20.4%	0	0	1.3 (0.95)
	2002		22.1%	0	0	
	2003		20.0%	0	0	
	2004		21.0%	0	0	
	2005		21.0%	0	0	
	2006		18.5%	0	0	
	2007		16.4%	0	0	
	2008		13.5%	0	0	
	2009		13.3%	0	0	
	2010		11.9%	1 (1)	16 (0.95)	
	2011		19.5%	0	0	
	2012		18.7%	0	0	
Unknown fishery	2001-2012	stranding	n/a	5	≥5	≥ 0.4
Total annual takes						≥ 1.7 (0.95)

Sperm whales from the North Pacific stock are known to depredate on longline sablefish catch in the Gulf of Alaska and sometimes incur serious injuries from becoming entangled in gear (Sigler et al. 2008, Allen and Angliss 2011). An unknown number of whales from the CA/OR/WA stock probably venture into waters where Alaska longline fisheries operate, but the amount of temporal and spatial overlap is unknown. Thus, the risk of serious injury to CA/OR/WA stock sperm whales resulting from longline fisheries cannot be quantified.

Ship Strikes

One sperm whale died as the result of a ship strike in Oregon in 2007 (NMFS Northwest Regional Stranding data, unpublished). Another sperm whale was struck by a 58-foot sablefish longline vessel in 2007 while at idle speed (Jannot et al. 2011). The observer noted no apparent injuries to the whale. Based on the size and speed of the vessel relative to the size of a sperm whale, this incident was categorized as a non-serious injury (Carretta et al. 2013). For the most recent 5-year period of 2008 to 2012 for which data are available, no ship strikes of sperm whales were documented (Carretta et al. 2014b) and the mean annual average mortality and serious injury is zero whales. Ship strikes are assessed over the most recent 5-year period to reflect the degree of shipping risk to large whales since ship traffic routes changed in response to new ship pollution rules implemented in 2009 (McKenna *et al.* 2012, Redfern *et al.* 2013).

STATUS OF STOCK

The only estimate of the status of North Pacific sperm whales in relation to carrying capacity (Gosho et al. 1984) is based on a CPUE method which is no longer accepted as valid. Whaling removed at least 436,000 sperm whales from the North Pacific between 1800 and the end of legal commercial whaling for this species in 1987 (Best 1976; Ohsumi 1980; Brownell 1998; Kasuya 1998). Of this total, an estimated 33,842 were taken by Soviet and Japanese pelagic whaling operations in the eastern North Pacific from the longitude of Hawaii to the U.S. West coast, between 1961 and 1976 (Allen 1980), and approximately 1,000 were reported taken in land-based U.S. West coast whaling operations between 1919 and 1971 (Ohsumi 1980; Clapham et al. 1997). There has been a prohibition on taking sperm whales in the North Pacific since 1988, but large-scale pelagic whaling stopped in 1980. Sperm whales are formally listed as "endangered" under the Endangered Species Act (ESA), and consequently the California to Washington stock is automatically considered as a "depleted" and "strategic" stock under the MMPA. The status of sperm whales with respect to carrying capacity and optimum sustainable population (OSP) is unknown. Including both fishery and ship-strike mortality, the annual rate of kill and serious injury (1.7 per year) is less than the calculated PBR for this stock (2.7). Total human-caused mortality is greater than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. Increasing levels of anthropogenic sound in the world's oceans has been suggested to be a habitat concern for whales, particularly for deep-diving whales like sperm whales that feed in the ocean's "sound channel".

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GRAY WHALE (*Eschrichtius robustus*): Eastern North Pacific Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Once common throughout the Northern Hemisphere, the gray whale was extinct in the Atlantic by the early 1700s (Fraser 1970; Mead and Mitchell 1984), though one anomalous sighting occurred in the Mediterranean Sea in 2010 (Scheinin *et al.* 2011) and another off Namibia in 2013 (Elwen and Gridley 2013). Gray whales are now only commonly found in the North Pacific. Genetic comparisons indicate there are distinct "Eastern North Pacific" (ENP) and "Western North Pacific" (WNP) population stocks, with differentiation in both mtDNA haplotype and microsatellite allele frequencies (LeDuc et al. 2002; Lang et al. 2011a; Weller et al. 2013).

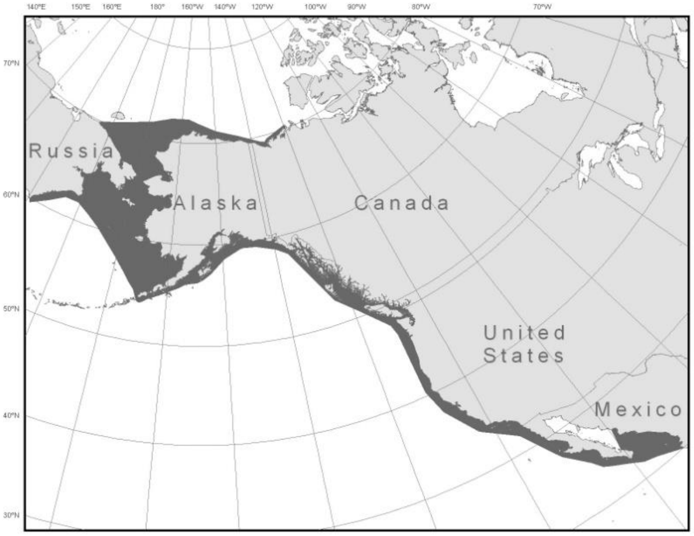

Figure 1. Approximate distribution of the Eastern North Pacific stock of gray whales (shaded area).

During summer and fall, most whales in the ENP population feed in the Chukchi, Beaufort and northwestern Bering Seas (Fig. 1). An exception to this is the relatively small number of whales (approximately 200) that summer and feed along the Pacific coast between Kodiak Island, Alaska and northern California (Darling 1984, Gosho *et al.* 2011, Calambokidis *et al.* 2012), referred to as the "Pacific Coast Feeding Group" (PCFG). Three primary wintering lagoons in Baja California, Mexico are utilized, and some females are known to make repeated returns to specific lagoons (Jones 1990). Genetic substructure on the wintering grounds is indicated by significant differences in mtDNA haplotype frequencies between females (mothers with calves) using two of the primary calving lagoons and females sampled in other areas (Goerlitz *et al*. 2003). Other research identified a small, but significant departure from panmixia between two of the lagoons using nuclear data, although no significant differences were identified using mtDNA (Alter *et al.* 2009).

Tagging, photo-identification and genetic studies show that some whales identified in the WNP off Russia have been observed in the ENP, including coastal waters of Canada, the U.S. and Mexico (Lang 2010; Mate et al. 2011; Weller et al. 2012; Urbán et al. 2013, Mate et al. 2015). In combination, these studies have recorded a total of 27 gray whales observed in both the WNP and ENP. Despite this overlap, significant mtDNA and nDNA differences are found between whales in the WNP and those summering in the ENP (Lang *et al*. 2011a).

In 2010, the IWC Standing Working Group on Aboriginal Whaling Management Procedure noted that different names had been used to refer to gray whales feeding along the Pacific coast, and agreed to designate animals that spend the summer and autumn feeding in coastal waters of the Pacific coast of North America from California to southeast Alaska as the "Pacific Coast Feeding Group" or PCFG (IWC 2012). This definition was further refined for purposes of abundance estimation, limiting the geographic range to the area from northern California to northern British Columbia (from 41°N to 52°N), limiting the temporal range to the period from June 1 to November 30, and counting only those whales seen in more than one year within this geographic and temporal range (IWC 2012). The IWC adopted this definition in 2011, but noted that "not all whales seen within the PCFG area at this time will be PCFG whales and some PCFG whales will be found outside of the PCFG area at various times during the year." (IWC 2012).

Photo-identification studies between northern California and northern British Columbia provide data on the abundance and population structure of PCFG whales (Calambokidis *et al*. 2012). Gray whales using the study area in summer and autumn include two components: **1)** whales that frequently return to the area, display a high degree of intra-seasonal " fidelity" and account for a majority of the sightings between 1 June and 30 November. Despite movement and interchange among sub-regions of the study area, some whales are more likely to return to the same sub-region where they were observed in previous years; **2)**"visitors" from the northbound migration that are sighted only in one year, tend to be seen for shorter time periods in that year, and are encountered in more limited areas. Photo-identification (Gosho *et al.* 2011; Calambokidis *et al.* 2012) and satellite tagging (Mate *et al.* 2010; Ford *et al.*

2012) studies have documented some PCFG whales off Kodiak Island, the Gulf of Alaska and Barrow, Alaska, well to the north of the pre-defined 41°N to 52°N boundaries used in some PCFG-related analyses (e.g. abundance estimation).

Frasier *et al.* (2011) found significant differences in mtDNA haplotype distributions between PCFG and ENP gray whale sequences, in addition to differences in long-term effective population size, and concluded that the PCFG qualifies as a separate management unit under the criteria of Moritz (1994) and Palsbøll *et al.* (2007). The authors noted that PCFG whales probably mate with the rest of the ENP population and that their findings were the result of maternally-directed site fidelity of whales to different feeding grounds.

Lang *et al.* (2011b) assessed stock structure of ENP whales from different feeding grounds using both mtDNA and eight microsatellite markers. Significant mtDNA differentiation was found when samples from individuals (n=71) sighted over two or more years within the seasonal range of the PCFG were compared to samples from whales feeding north of the Aleutians (n=103), and when PCFG samples were compared to samples collected off Chukotka, Russia (n=71). No significant differences were found when these same comparisons were made using microsatellite data. The authors concluded that (1) the significant differences in mtDNA haplotype frequencies between the PCFG and whales sampled in northern areas indicates that use of some feeding areas is being influenced by internal recruitment (e.g., matrilineal fidelity), and (2) the lack of significance in nuclear comparisons suggests that individuals from different feeding grounds may interbreed. The level of mtDNA differentiation identified, while statistically significant, was low and the mtDNA haplotype diversity found within the PCFG was similar to that found in the northern strata. Lang *et al.* (2011b) suggested this could indicate recent colonization of the PCFG but could also be consistent with external recruitment into the PCFG. An additional comparison of whales sampled off Vancouver Island, British Columbia (representing the PCFG) and whales sampled at the calving lagoon at San Ignacio also found no significant differences in microsatellite allele frequencies, providing further support for interbreeding between the PCFG and the rest of the ENP stock (D'Intino et al. 2012). Lang and Martien (2012) investigated potential immigration levels into the PCFG using simulations and produced results consistent with the empirical (mtDNA) analyses of Lang et al. (2011b). Simulations indicated that immigration of >1 and <10 animals per year into the PCFG was plausible, and that annual immigration of 4 animals/year produced results most consistent with the empirical study.

While the PCFG is recognized as a distinct feeding aggregation (Calambokidis et al. 2012; Mate et al. 2010; Frasier et al. 2011; Lang et al. 2011b; IWC 2012), the status of the PCFG as a population stock remains unresolved (Weller et al. 2013). A NMFS gray whale stock identification workshop held in 2012 included a review of available photo-identification, genetic, and satellite tag data. The report of the workshop states "there remains a substantial level of uncertainty in the strength of the lines of evidence supporting demographic independence of the PCFG." (Weller et al. 2013). The NMFS task force, charged with evaluating stock status of the PCFG, noted that "both the photo-identification and genetics data indicate that the levels of internal versus external recruitment are comparable, but these are not quantified well enough to determine if the population dynamics of the PCFG are more a consequence of births and deaths within the group (internal dynamics) rather than related to immigration and/or emigration (external dynamics)." Further, given the lack of significant differences found in nuclear DNA markers between PCFG whales and other ENP whales, the task force found no evidence to suggest that PCFG whales breed exclusively or primarily with each other, but interbreed with ENP whales, including potentially other PCFG whales. Additional research is needed to better identify recruitment levels into the PCFG and further assess the stock status of PCFG whales (Weller et al. 2013). In contrast, the task force noted that WNP gray whales should be recognized as a population stock under the MMPA, and NMFS prepared a separate report for WNP gray whales in 2014. Because the PCFG appears to be a distinct feeding aggregation and may warrant consideration as a distinct stock in the future, separate PBRs are calculated for the PCFG to assess whether levels of human-caused mortality are likely to cause local depletion.

POPULATION SIZE

Systematic counts of gray whales migrating south along the central California coast have been conducted by shore-based observers at Granite Canyon most years since 1967 (Fig. 2). The most recent estimate of abundance for the ENP population is from the 2010/2011 southbound survey and is 20,990 (CV=0.05) whales (Durban *et al.* 2013) (Fig. 2).

Photographic mark-recapture abundance estimates for PCFG gray whales between 1998 and 2012, including estimates for a number of smaller geographic areas within the IWC-defined PCFG region (41°N to 52°N), are reported in Calambokidis *et al.* (2014). The 2012 abundance estimate for the defined range of the PCFG between 41°N to 52°N is 209 (SE=15.4; CV= 0.07).

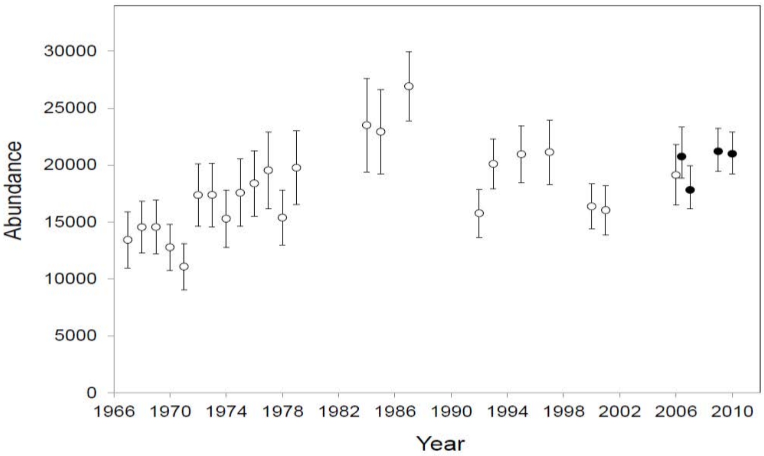

Figure 2. Estimated abundance of Eastern North Pacific gray whales from NMFS counts of migrating whales past Granite Canyon, California. Open circles represent abundance estimates and 95% confidence intervals reported by Laake et al. (2012). Closed circles represent estimates and 95% posterior highest density intervals reported by Durban et al. (2013) for the 2006/7, 2007/8, 2009/10, and 2010/11 migration seasons.

Eastern North Pacific gray whales experienced an unusual mortality event (UME) in 1999 and 2000, when large numbers of emaciated animals stranded along the west coast of North America (Moore *et al*., 2001; Gulland *et al*., 2005). Over 60% of the dead whales were adults, compared with previous years when calf strandings were more common. Several factors following this UME suggest that the high mortality rate observed was a short-term, acute event and not a chronic situation or trend: 1) in 2001 and 2002, strandings decreased to levels below UME levels (Gulland *et al*., 2005); 2) average calf production returned to levels seen before 1999; and 3) in 2001, living whales no longer appeared emaciated. Oceanographic factors that limited food availability for gray whales were identified as likely causes of the UME (LeBouef et al. 2000; Moore et al. 2001; Minobe 2002; Gulland et al. 2005), with resulting declines in survival rates of adults during this period (Punt and Wade 2012). The population has recovered to levels seen prior to the UME of 1999-2000 (Fig. 2).

Gray whale calves have been counted from Piedras Blancas, a shore site in central California, in 1980-81 (Poole 1984a) and each year from 1994 to 2012 (Perryman *et al*. 2002; Perryman and Weller 2012). In 1980 and 1981, calves comprised 4.7% to 5.2% of the population (Poole 1984b). Calf production indices, as calculated by dividing northbound calf estimates by estimates of population abundance (Laake *et al*. 2012), ranged between 1.3 - 8.8% (mean=4.2%) during 1994-2012. Annual indices of calf production include impacts of early postnatal mortality but may overestimate recruitment because they exclude possibly significant levels of killer whale predation on gray whale calves north of the survey site (Barrett-Lennard et al. 2011). The relatively low reproductive output reported is consistent with little or no population growth over the time period (Laake *et al*. 2012; Punt and Wade 2012).

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for the ENP stock is calculated from Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1 + [CV(N)]^2)]^{½})$. Using the 2010/11 abundance estimate of 20,990 and its associated CV of 0.05 (Durban et al. 2013), N_{MIN} for this stock is 20,125.

The minimum population estimate for PCFG gray whales is calculated as the lower 20th percentile of the log-normal distribution of the 2012 mark-recapture estimate of 209 (CV=0.07), or 197 animals.

Current Population Trend

The population size of the ENP gray whale stock has increased over several decades despite an UME in 1999 and 2000 and has been relatively stable since the mid-1990s (see Fig. 2).

Abundance estimates of PCFG gray whales reported by Calambokidis et al. (2014) show a high rate of increase in the late 1990s and early 2000s, but have been relatively stable since 2003.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Using abundance data through 2006/07, an analysis of the ENP gray whale population led to an estimate of R_{max} of 0.062, with a 90% probability the value was between 0.032 and 0.088 (Punt and Wade 2012). This value of R_{max} is also applied to PCFG gray whales, as it is currently the best estimate of R_{max} available for gray whales in the ENP.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the ENP stock of gray whales is calculated as the minimum population size (20,125), times one-half of the maximum theoretical net population growth rate (½ x 6.2% = 3.1%), times a recovery factor of 1.0 for a stock above MNPL (Punt and Wade 2012), or 624 animals per year.

The potential biological removal (PBR) level for PCFG gray whales is calculated as the minimum population size (197 animals), times one half the maximum theoretical net population growth rate (½ x 6.2% = 3.1%), times a recovery factor of 0.5 (for a population of unknown status), resulting in a PBR of 3.1 animals per year. Use of the recovery factor of 0.5 for PCFG gray whales, rather than 1.0 used for ENP gray whales, is based on uncertainty regarding stock structure (Weller et al. 2013) and guidelines for preparing marine mammal stock assessments which state that "Recovery factors of 1.0 for stocks of unknown status should be reserved for cases where there is assurance that N_{min}, R_{max}, and the kill are unbiased and where the stock structure is unequivocal" (NMFS 2005). Given uncertainties in the levels of external versus internal recruitment of PCFG whales described above, the equivocal nature of the stock structure, and the small estimated population size of the PCFG, NMFS will continue to use the default recovery factor of 0.5 for PCFG gray whales.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Serious Injury Guidelines

NMFS uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to distinguish serious from non-serious injury (Angliss and DeMaster 1998, Andersen *et al*. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*".

Fisheries Information

No gray whales were observed entangled in California gillnet fisheries between 2008 and 2012 (Carretta and Enriquez 2009, 2010, 2012a, 2012b, Carretta *et al*., 2014a.), but previous mortality in the swordfish drift gillnet fishery has been observed (Carretta et al. 2004) and there have been recent sightings of free-swimming gray whales entangled in gillnets (Table 1). Alaska gillnet fisheries largely lack observer programs, including those in Bristol Bay known to interact with gray whales. Most data on human-caused mortality and serious injury of gray whales are from strandings, including at-sea reports of entangled animals alive or dead (Carretta et al. 2013, 2014b). Strandings represent only a fraction of actual gray whale deaths (natural or human-caused), as reported by Punt and Wade (2012), who estimated that only 3.9% to 13.0% of gray whales that die in a given year end up stranding and being reported.

A summary of human-caused mortality and serious injury resulting from unknown fishery and marine debris sources (mainly pot/trap or net fisheries) is given in Table 1 for the most recent 5-year period of 2008 to 2012. Total observed human-caused fishery mortality and serious injury for ENP gray whales is 22.25 animals (8 serious injuries, 8.25 prorated serious injuries, and 6 deaths), or 4.45 whales per year (Table 1). Total observed human-caused fishery mortality and serious injury for gray whales observed in the PCFG range and season for the period 2008 to 2012 is 0.75 animals (0.75 prorated serious injuries), or 0.15 whales per year (Table 1). Three gray whales from Table 1 (one death and two serious injuries) were detected in California waters during the known PCFG season, but were south of the area recognized by the IWC as the PCFG management area. It is possible that some of these whales could be PCFG whales, but no photographic identifications were available to establish their identity. They are included in ENP gray whale serious injury and death totals.

Table 1. Human-caused deaths and serious injuries (SI) of gray whales from fishery-related and marine debris sources for the period 2008 to 2012 as recorded by NMFS stranding networks and observer programs.

Date of observation	Location	PCFG range N 41- N 52 AND season?	Description	Determination (SI Prorate value)
13-Oct-2012	Fort Bragg, CA	No	Entangled animal report; animal reported with rope around the peduncle which wasn't seen in photographs but photos did show green gillnet with cuts to the head; animal disappeared and final status is unknown.	SI
31-Aug-2012	Los Angeles, CA	No	Animal first detected near San Diego. Subadult gray whale reported entangled with small gauge, dark-colored line deeply embedded around its tail stock. Little gear trails. Entanglement was once more involved as indicated by scars on the animal's body. Animal in very poor condition - emaciated, scarred and a heavy load of cyamid	Dead

			amphipods. Black line around peduncle, 20 ft trailing; observed off san San Diego on 8/31, completely disentangled off L.A. 9/6, stranded dead 9/14/12.	
22-Aug-2012	Prince William Sound, AK	No	Whale sighted by tour boat. Few details, other than part of a fishing net was observed being trailed from a gray whale's fin. Photos apparently available, but have not been located. Prince william William Sound. Extent and severity of entanglement unknown.	SI (0.75)
16-Jun-2012	Prince William Sound, AK	No	30' gray whale in prince william Prince William Sound entangled in gear. Thrashing at surface and moving at 4-5 knots. No wounds or chafing was observed. Gillnet, corkline (at least 12 floats), and leadline observed over animal's rostrum, body, and tailstock. Both pectoral flippers appeared pinned to body. Animal later appeared tired and was swimming at 2 knots. It was not relocated. Assigned serious injury because gear appears to be constricting movement of whale's flippers.	SI
13-May-2012	Monterey, CA	No	Animal entangled through mouth in at least two sets of suspected pot gear that that hang below. Animal anchored with a short scope in 28 feet of water to suspected pots. Bundle of gear, including 4 buoys lie under animal. Animal having some difficulty getting to surface. Animal eventually disentangled, but results of entanglement may still be life-threatening.	SI
8-May-2012	Eureka, CA	No	Entangled animal report; deep cuts from rope around peduncle and lacerations at fluke notch and lateral edge of fluke; successfully disentangled but long-term survival noted as questionable. Gear was collected and identified as Dungeness crab pot gear. Animal entirely freed of gear. Animal in fair condition and slightly emaciated. Deep cuts (~ 2 inches) from the rope around the peduncle remained. Gear was recovered. Results of entanglement may still be life threatening.	SI
5-May-2012	Monterey, CA	No	Whale watch vessel noticed from images taken of a 20 - 25 foot gray whale they had been observing earlier in the day, that animal was actually entangled. A small gauge line, likely from right side of mouth goes over the animal's back, and over blowholes, to left side of mouth. No buoys or trailing line were observed. Animal in fair condition. Animal sighted next day by whale watch vessel. Confirmed mouth entanglement, appears to be strapping material.	SI (0.75)
28-Apr-2012	Fort Bragg, CA	No	Small gray whale off fort bragg Fort Bragg, CA, in company of two other animals, trailing two buoys.	SI (0.75)
21-Apr-2012	San Simeon, CA	No	Rope like marks on caudal peduncle. Rope impression on pectoral fin. Photos taken.	Dead
17-Apr-2012	Laguna Beach, CA	No	40-foot gray whale reported entangled with approximately 150 feet of line trailing. Four spongex bullet buoys lie along the left side of the animal. Entanglement involves the mouth, a wrap over the head, and the left pectoral flipper. Entanglement appears recent. Partially disentangled on 5/3/12 by fishermen.	SI (0.75)
24-Mar-2012	San Diego, CA	No	Entangled animal report; gillnet gear around peduncle; response effort resulted in successful disentanglement with >100 ft of pink gillnet removed from animal, but animal subsequently observed dead on 03/27 (floating, skin sample taken, no necropsy). Net removed on 03/24 found to contain one dead ca sea lion and three dead sharks.	Dead
28-Jan-2012	San Diego, CA	No	Entangled animal report; towing two orange buoys and at least 150 feet of line; unknown fishery, reported as possible gillnet; no response effort.	SI (0.75)
17-Jan-2012	Unimak Pass, AK	No	A 40' whale was caught in cod pot gear near Unimak Pass. Lines were cut by boat crew and buoys were recovered, however, the pot and some line remained in the water. Any line possibly remaining on animal thought to be minimal. Gray whale species determination made following extensive questioning by local biologist. Determination: prorated serious injury because gear possibly remains on animal.	SI (0.75)
25-Aug-2011	San Mateo, CA	No	One white "crab pot" buoy next to body by left pectoral fin; float stayed next to body and did not change position; animal remained in same position - possibly anchored; only observed for ~2 min; not resighted, no rescue, outcome unknown.	SI
12-Sep-2010	Central Bering Sea	No	Bering Sea / Aleutian Islands flatfish trawl fishery: 12 m animal caught in gear. Photos taken.	Dead
11-May-2010	Orange County CA	No	Free-swimming animal entangled in gillnet; animal first observed inside Dana Point Harbor on 5/11/10; animal successfully	Dead

			disentangled on 5/12/10 & swam out of harbor; animal observed alive in surf zone for several hours on 5/14/10 off Doheny State Beach before washing up dead on beach	
7-May-2010	Cape Foulweather OR	No	Entangled in 3 crab pots, whale not relocated.	SI (0.75)
16-Apr-2010	Seaside OR	No	27-ft long gray whale stranded dead, entangled in crab pot gear	Dead
8-Apr-2010	San Francisco CA	No	Rope wrapped around caudal peduncle; identified as gray whale from photo. Free-swimming, diving. No rescue effort, no resightings, final status unknown	SI
5-Mar-2010	San Diego	No	Free-swimming entangled whale reported by member of the public; no rescue effort initiated; no resightings reported; final status unknown.	SI (0.75)
21-Jul-2009	Trinidad Head CA	Yes	Free-swimming animal with green gillnet, rope & small black floats wrapped around caudal peduncle; report received via HSU researcher on scene during research cruise; animal resighted on 3 Aug; no rescue effort initiated. Photos show rope cutting into caudal peduncle. This whale was re-sighted in 2010 and 2011, still trailing gear. Whale was resighted in 2013 and had shed gear, and was apparently in good health (Jeff Jacobsen, pers. comm.).	NSI
24-Jun-2009	Clallam County, WA	Yes	Whale found entangled in tribal set gillnet in morning. Net had been set 8 pm previous day. Whale able to breath, but not swim freely and was stationary in net. Right pectoral flipper and head were well-wrapped in net webbing. In response to disentanglement attempts, whale reacted violently and swam away. The net was retrieved and found to be torn in two. No confirmation on whether whale was completely free of netting.	SI (0.75)
9-Apr-2009	Sitka, AK	No	Thick black line wrapped twice around whale's body posterior to the eyes was cut and pulled away by private citizen. Animal swam away and dove.	SI (0.75)
25-Mar-2009	Seal Beach CA	No	Free-swimming animal with pink gillnet wrapped around head, trailing 4 feet of visible netting; report received via naturalist on local whale watch vessel; no rescue effort initiated; final status unknown	SI (0.75)
31-Jan-2009	San Diego CA	No	Free-swimming animal towing unidentified pot/trap gear; report received via USCG on scene; USCG reported gear as 4 lobster pots; final status unknown	SI (0.75)
16-Apr-2008	Eel River CA	No	Observed 12 miles west of Eel River by Humboldt State University personnel. It was unknown sex, with an estimated length of 20 ft and in emaciated condition. The animal was described as towing 40-50 feet of line & 3 crab pot buoys from the caudal peduncle and moving very slowly. Vessel retrieved the buoys, pulled them and ~20 ft of line onto the deck and cut it loose from the whale. The whale swam away slowly with 20-30 feet of line still entangling the peduncle, outcome unknown. Identification numbers on buoy traced to crab pot fishery gear that was last fished in Bering Sea in December 2007.	SI

Subsistence/Native Harvest Information

Subsistence hunters in Russia and the United States have traditionally harvested whales from the ENP stock in the Bering Sea, although only the Russian hunt has persisted in recent years (Huelsbeck 1988; Reeves 2002). In 2005, the Makah Indian Tribe requested authorization from NOAA/NMFS, under the MMPA and the Whaling Convention Act, to resume limited hunting of gray whales for ceremonial and subsistence purposes in the coastal portion of their usual and accustomed (U&A) fishing grounds off Washington State (NMFS 2008). The spatial overlap of the Makah U&A and the summer distribution of PCFG whales has management implications. The proposal by the Makah Tribe includes time/area restrictions designed to reduce the probability of killing a PCFG whale and to focus the hunt on whales migrating to/from feeding areas to the north. The Makah proposal also includes catch limits for PCFG whales that result in the hunt being terminated if these limits are met. Also, observations of gray whales moving between the WNP and ENP highlight the need to estimate the probability of a gray whale observed in the WNP being taken during a hunt by the Makah Tribe (Moore and Weller 2013). NMFS has published a notice of intent to prepare an environmental impact statement (EIS) on the proposed hunt (NMFS 2012) and the IWC has evaluated the potential impacts of the proposed hunt and other sources of human-caused mortality on PCFG whales and concluded, with certain qualifications, that the proposed hunt meets the Commission's conservation objectives (IWC 2013). The Scientific Committee has not scheduled an implementation review of the impacts of the Makah hunt on whales using summering feeding areas in the WNP, but is continuing to investigate stock structure of north Pacific gray whales and may schedule such a review in the future (IWC 2013). In 2012, the IWC approved a 6-year quota (2013-2018) of 744 gray whales, with an annual cap of 140, for Russian and U.S. (Makah Indian Tribe) aboriginals based on the joint request and needs statements submitted by the U.S. and Russian federation. The U.S. and Russia have agreed that the quota will be shared with an average annual harvest of 120 whales by the Russian Chukotka people and 4 whales by the Makah Indian Tribe. Total takes by the Russian hunt during the past five years were: 130 in 2008,116 in 2009, 118 in 2010, 128 in 2011, and 143 in 2012 (source: http://iwc.int/table_aboriginal). Based on this information, the annual subsistence take averaged 127 whales during the 5-year period from 2008 to 2012.

Other Mortality

Ship strikes are a source of mortality for gray whales (Table 2). For the most recent five-year period, 2008-2012, the total serious injury and mortality of ENP gray whales attributed to ship strikes is 9.8 animals (including 7 deaths, 2 serious injuries, and 0.8 prorated serious injuries, or 2.0 whales per year (Table 2, Carretta et al. 2013, Carretta et al. 2014b.). The total ship strike serious injury and mortality of gray whales observed in the PCFG range and season during this same period is 0.52 animals, or 0.1 whales per year (Table 2). One gray whale ship strike in Table 2 was detected in California waters during the known PCFG season, but was south of the area recognized by the IWC as the PCFG management area. It is possible that this animal could be a PCFG whale, but no photographic identification was available to establish its identity. It is included in ENP gray whale serious injury and death totals. Additional mortality from ship strikes probably goes unreported because the whales either do not strand or do not have obvious signs of trauma.

In February 2010, a gray whale stranded dead near Humboldt, CA with parts of two harpoons embedded in the body. Since this whale was likely harpooned during the aboriginal hunt in Russian waters, it would have been counted as “struck and lost” in the harvest data.

HABITAT CONCERNS

Near shore industrialization and shipping congestion throughout the migratory corridors of the ENP gray whale stock represent risks by increasing the likelihood of exposure to pollutants and ship strikes, as well as a general degradation of the habitat.

Evidence indicates that the Arctic climate is changing significantly, resulting in a reductions in sea ice cover (Johannessen et al. 2004, Comiso et al. 2008). These changes are likely to affect gray whales. For example, the summer range of gray whales has greatly expanded in the past decade (Rugh et al. 2001). Bluhm and Gradinger (2008) examined the availability of pelagic and benthic prey in the Arctic and concluded that pelagic prey is likely to increase while benthic prey is likely to decrease in response to climate change. They noted that marine mammal species that exhibit trophic plasticity (such as gray whales which feed on both benthic and pelagic prey) will adapt better than trophic specialists.

Global climate change is also likely to increase human activity in the Arctic as sea ice decreases, including oil and gas exploration and shipping (Hovelsrud et al. 2008). Such activity will increase the chance of oil spills and ship strikes in this region. Gray whales have demonstrated avoidance behavior to anthropogenic sounds associated with oil and gas exploration (Malme et al. 1983, 1984) and low-frequency active sonar during acoustic playback experiments (Buck and Tyack 2000, Tyack 2009). Ocean acidification could reduce the abundance of shell-forming organisms (Fabry et al. 2008, Hall-Spencer et al. 2008), many of which are important in the gray whales’ diet (Nerini 1984).

Table 2. Summary of gray whale serious injuries (SI) and deaths attributed to vessel strikes for the five-year period 2008-2012. No vessel strikes were reported in 2012.

Date of observation	Location	PCFG range N 41 - N 52 AND season?	Description	Determination (SI prorate value)
6-Jun-2011	San Mateo CA	No	Massive hemorrhage into the thorax, blood clots around lungs. Lesions indicate massive trauma. Due to carcass position, the skeleton could not be completely examined (lying on back, top of skull in sand).	Dead
8-Apr-2011	San Francisco CA	No	Crushed mandible.	Dead
12-Feb-2011	Los Angeles CA	No	Private recreational vessel collided with free-swimming animal; animal breached just prior to contact, bouncing off side of vessel; dove immediately following contact & was not resighted; no blood observed in water; final status unknown; skin sample collected from vessel and genetically identified	SI (0.14)

			as a female gray whale. Vessel size assumed less than 65 ft and speed unknown.	
22-Jan-2011	San Diego CA	No	Pleasure sailboat collided with free-swimming animal; animal dove immediately following contact & was not resighted; no blood observed in water; final status unknown. Vessel size assumed less than 65 ft. And speed unknown.	SI (0.14)
12-Mar-2010	Santa Barbara CA	No	21 meter sailboat underway at 13 kts collided with free-swimming animal; whale breached shortly after collision; no blood observed in water; minor damage to lower portion of boat's keel; final status unknown; DNA analysis of skin sample confirmed species.	SI
16-Feb-2010	San Diego CA	No	Free-swimming animal with propeller-like wounds to dorsum.	SI (0.52)
9-Sep-2009	Quileute River WA	Yes	USCG vessel reported to be traveling at 10 knots when they hit the gray whale at noon on 9/9/2009. The animal was hit with the prop and was reported alive after being hit, blood observed in water.	SI (0.52)
1-May-2009	Los Angeles CA	No	Catalina island transport vessel collided with free-swimming calf accompanied by adult animal; calf was submerged at time of collision; pieces of flesh & blood observed in water; calf never surfaced; presumed mortality.	SI
27-Apr-2009	Whidbey Is. WA	No	Large amount of blood in body cavity, bruising in some areas of blubber layer and in some internal organs. Findings suggestive of blunt force trauma likely caused by collision with a large ship.	Dead
5-Apr-2009	Sunset Beach CA	No	Dead stranding; 3 deep propeller-like cuts on right side, just anterior of genital opening; carcass towed out to sea	Dead
4-Apr-2009	Ilwaco WA	No	Necropsied, broken bones in skull; extensive hemorrhage head and thorax; sub-adult male	Dead
1-Mar-2008	Mexico	No	Carcass brought into port on bow of cruise ship; collision occurred betweeen ports of San Diego and Cabo San Lucas between 5:00 p.m. On 2/28 & 7:20 a.m. On 3/1	Dead
7-Feb-2008	Orange County CA	No	Carcass; propeller-like wounds to left dorsum from mid-body to caudal peduncle; deep external bruising on right side of head; field necropsy revealed multiple cranial fractures	Dead

STATUS OF STOCK

In 1994, the ENP stock of gray whales was removed from the List of Endangered and Threatened Wildlife (the List), as it was no longer considered endangered or threatened under the Endangered Species Act (NMFS 1994). Punt and Wade (2012) estimated the ENP population was at 85% of carrying capacity (K) and at 129% of the maximum net productivity level (MNPL), with a probability of 0.884 that the population is above MNPL and therefore within the range of its optimum sustainable population (OSP).

Even though the stock is within OSP, abundance will fluctuate as the population adjusts to natural and human-caused factors affecting carrying capacity (Punt and Wade 2012). It is expected that a population close to or at carrying capacity will be more susceptible to environmental fluctuations (Moore et al. 2001). The correlation between gray whale calf production and environmental conditions in the Bering Sea may reflect this (Perryman et al. 2002; Perryman and Weller 2012). Overall, the population nearly doubled in size over the first 20 years of monitoring and has fluctuated for the last 30 years around its average carrying capacity. This is consistent with a population approaching K.

Based on 2008-2012 data, the estimated annual level of human-caused mortality and serious injury for ENP gray whales includes Russian harvest (127), mortality and serious injury from commercial fisheries (4.45), and ship strikes (2.0), totals 133 whales per year, which does not exceed the PBR (624). The IWC completed an implementation review for ENP gray whales (including the PCFG) in 2012 (IWC 2013) and concluded that harvest levels (including the proposed Makah hunt) and other human caused mortality are sustainable, given the current population abundance (Laake et al. 2012, Punt and Wade 2012). Therefore, the ENP stock of gray whales is not classified as a strategic stock.

PCFG gray whales do not currently have a formal status under the MMPA, though the population size appears to have been stable since 2003, based on photo-ID studies (Calambokidis et al. 2014, IWC 2012). Total annual human-caused mortality of PCFG gray whales during the period 2008 to 2012 includes deaths due to commercial fisheries (0.15/yr), and ship strikes (0.1/yr), or 0.25 whales annually. This does not exceed the PBR level of 3.1 whales for this population. Levels of human-caused mortality and serious injury resulting from commercial fisheries and ship strikes for both ENP and PCFG whales represent minimum estimates as recorded by stranding networks or at-sea sightings.

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GRAY WHALE (*Eschrichtius robustus*): Western North Pacific Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Gray whales occur along the eastern and western margins of the North Pacific. In the western North Pacific (WNP), gray whales feed during summer and fall in the Okhotsk Sea off northeast Sakhalin Island, Russia, and off southeastern Kamchatka in the Bering Sea (Weller et al. 1999, 2002; Vertyankin et al. 2004; Tyurneva et al. 2010; Burdin et al. 2013; Figure 1). Some gray whales observed feeding off Sakhalin and Kamchatka migrate during the winter to the west coast of North America in the eastern North Pacific (Mate et al. 2011; Weller et al. 2012; Urbán *et al*. 2013), while others, including at least one whale first identified as a calf off Sakhalin, migrate to areas off Asia in the WNP (Weller et al. 2008; Weller et al. 2013a). Despite the observed movements between the WNP and eastern North Pacific (ENP), genetic comparisons show significant mitochondrial and nuclear genetic differences between whales sampled in the ENP and those sampled on the feeding ground off Sakhalin Island in the WNP (LeDuc et al. 2002; Lang et al. 2011). While a few previously unidentified non-calves are identified annually, a recent population assessment using photo-identification data from 1994 to 2011 fitted to an individually-based model found that whales feeding off Sakhalin Island have been demographically self-contained, at least in recent years, as new recruitment to the population is almost exclusively a result of calves born to mothers from within the group (Cooke et al. 2013).

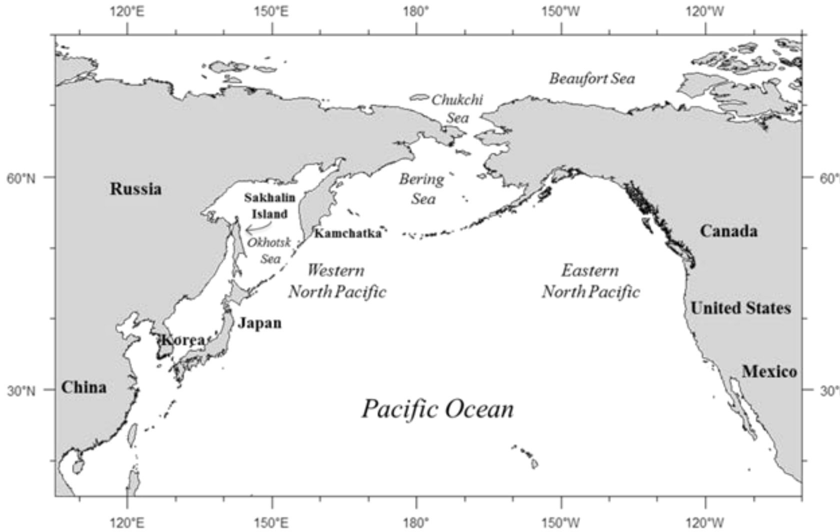

Figure 1. Range map of the Western North Pacific Stock of gray whales, including summering areas off Russia and wintering areas in the western and eastern Pacific.

Historical evidence indicates that the coastal waters of eastern Russia, the Korean Peninsula and Japan were once part of the migratory route in the WNP and that areas in the South China Sea may have been used as wintering grounds (Weller et al. 2002; Weller et al. 2013a). However, contemporary records of gray whales off Asia are rare, with only 13 from Japanese waters between 1990 and 2007 (Nambu *et al*. 2010) and 24 from Chinese waters since 1933 (Wang 1984; Zhu 2002). The last known record of a gray whale off Korea was in 1977 (Park 1995; Kim et al. 2013). While recent observations of gray whales off the coast of Asia are infrequent, they nevertheless continue to occur, including: (1) March/April 2014 - one or possibly two gray whales were sighted and photographed off the Shinano River in Teradomari (Niigata Prefecture) on the Sea of Japan coast of Honshu, Japan (Kato et al. 2014), (2) March 2012 - a gray whale was sighted and photographed in Mikawa Bay (Aichi Prefecture), on the Pacific coast of Honshu, Japan (Kato *et al*. 2012), and (3) November 2011 - a 13 m female gray whale was taken in fishing gear offshore of Baiqingxiang, China, in the Taiwan Strait (Zhu 2012).

Information from tagging, photo-identification and genetic studies show that some whales identified in the WNP off Russia have been observed in the ENP, including coastal waters of Canada, the U.S. and Mexico (Lang 2010; Mate et al. 2011; Weller et al. 2012; Urbán et al. 2013, Mate et al. 2015). In combination, these studies have recorded a total of 27 gray whales observed in both the WNP and ENP. Some whales that feed off Sakhalin Island in summer migrate east across the Pacific to the west coast of North America in winter, while others migrate south to waters off Japan and China. Taken together, these observations indicate that not all gray whales in the WNP share a common wintering ground (Weller et al. 2013a).

In 2012, the National Marine Fisheries Service convened a scientific task force to appraise the currently recognized and emerging stock structure of gray whales in the North Pacific (Weller et al. 2013b). The charge of the task force was to evaluate gray whale stock structure as defined under the Marine Mammal Protection Act (MMPA) and implemented through the National Marine Fisheries Service's Guidelines for Assessing Marine Mammal Stocks (GAMMS; NMFS 2005). Significant differences in both mitochondrial and nuclear DNA between whales sampled off Sakhalin Island (WNP) and whales sampled in the ENP provided convincing evidence that resulted in the task force advising that WNP gray whales should be recognized as a population stock under the MMPA and GAMMS guidelines. Given the interchange of some whales between the WNP and ENP, including seasonal occurrence of WNP whales in U.S. waters, the task force agreed that a stand-alone WNP gray whale population stock assessment report was warranted.

POPULATION SIZE

Photo-identification data collected between 1994 and 2011 on the gray whale summer feeding ground off Sakhalin Island in the WNP were used to calculate an abundance estimate of 140 (SE = ± 6, CV=0.043) whales for the age 1-plus (non-calf) population size in 2012 (Cooke et al. 2013). Some whales (approximately 70 individuals) sighted during the summer off southeastern Kamchatka have not been sighted off Sakhalin Island, but it is as yet unclear whether those whales are part of the WNP stock (IWC 2014).

Minimum Population Estimate

The minimum population estimate (N_{min}) for the WNP stock is calculated from Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{min} = N/\exp(0.842\times[\ln(1 +[CV(N)]^2)]½)$ and the abundance estimate of 140 (CV=0.043) whales from Cooke et al. (2013), resulting in a minimum population estimate of 135 gray whales on the summer feeding ground off Sakhalin Island in the WNP.

Current Population Trend

The WNP gray whale stock has increased over the last 10 years (2002-2012). The estimated realized average annual rate of population increase during this period is 3.3% per annum (± 0.5%) (Cooke et al. 2013).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

An analysis of the ENP gray whale population led to an estimate of R_{max} of 0.062, with a 90% probability the value was between 0.032 and 0.088 (Punt and Wade 2012). This value of R_{max} is also applied to WNP gray whales, as it is currently the best estimate of R_{max} available for any gray whale population.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (135), times one-half the estimated maximum annual growth rate for a gray whale population (½ of 6.2% for the Eastern North Pacific Stock, Punt and Wade 2012), times a recovery factor of 0.1 (for an endangered stock with N_{min} < 1,500, Taylor et al. 2003), and also multiplied by estimates for the proportion of the stock that uses U.S. EEZ waters (0.575) and the proportion of the year that those animals are in the U.S. EEZ (3 months, or 0.25 years) (Moore and Weller 2013), resulting in a PBR of 0.06 WNP gray whales per year, or approximately 1 whale every 17 years (if abundance and other parameters in the PBR equation remained constant over that time period).

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Serious Injury Guidelines

NMFS uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to distinguis serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "injury that is more likely than not to result in mortality".

Fisheries Information

The decline of gray whales in the WNP is attributable to commercial hunting off Korea and Japan between the 1890s and 1960s. The pre-exploitation abundance of WNP gray whales is unknown, but has been estimated to be between 1,500 and 10,000 individuals (Yablokov and Bogoslovskaya 1984). By 1910, after some commercial exploitation had already occurred, it is estimated that only 1,000 to 1,500 gray whales remained in the WNP population (Berzin and Vladimirov 1981). The basis for how these two estimates were derived, however, is not apparent (Weller et al. 2002). By the 1930s, gray whales in the WNP were considered by many to be extinct (Mizue 1951; Bowen 1974).

Today, a significant threat to gray whales in the WNP is incidental catches in coastal net fisheries (Weller et al. 2002; Kato et al. 2012; Weller et al. 2008; Weller et al. 2013a). Between 2005 and 2007, four female gray whales (including one mother-calf pair and one yearling) died in fishing nets on the Pacific coast of Japan. In addition, one adult female gray whale died as a result of a fisheries interaction in November 2011 off Pingtan County, China (Zhu 2012). An analysis of anthropogenic scarring of gray whales photographed off Sakhalin Island found that at least 18.7% (n=28) of 150 individuals identified between 1994 and 2005 had evidence of previous entanglements in fishing gear (Bradford et al. 2009), further highlighting the overall risks coastal fisheries pose to WNP gray whales.

In summer 2013, salmon net fishing was observed for the first time on the gray whale feeding ground off Sakhalin Island. Observations of whales within 100 m of salmon fishing nets have been made and a male gray whale was observed dragging fishing gear (rope), with a related injury on the caudal peduncle at the dorsal insertion point with the flukes (Weller et al. 2014).

Given that some WNP gray whales occur in U.S. waters, there is some probability of WNP gray whales being killed or injured by ship strikes or entangled in fishing gear within U.S. waters.

Subsistence/Native Harvest Information

In 2005, the Makah Indian Tribe requested authorization from NOAA/NMFS, under the Marine Mammal Protection Act of 1972 (MMPA) and the Whaling Convention Act, to resume limited hunting of gray whales for ceremonial and subsistence purposes in the coastal portion of their usual and accustomed (U&A) fishing grounds off Washington State (NOAA 2008). Observations of gray whales moving between the WNP and ENP highlight the need to estimate the probability of a gray whale observed in the WNP being taken during a hunt by the Makah Tribe (Moore and Weller 2013). Given conservation concerns for the WNP population, the Scientific Committee of the International Whaling Commission (IWC) emphasized the need to estimate the probability of a WNP gray whale being struck during aboriginal gray whale hunts (IWC 2012). Additionally, NOAA is required by the National Environmental Policy Act (NEPA) to prepare an Environmental Impact Statement (EIS) pertaining to the Makah's request. The EIS needs to address the likelihood of a WNP whale being taken during the proposed Makah gray whale hunt.

To estimate the probability that a WNP whale might be taken during the proposed Makah gray whale hunt, four alternative models were evaluated. These models made different assumptions about the proportion of WNP whales that would be available for the hunt or utilized different types of data to inform the probability of a WNP whale being taken (Moore and Weller 2013). Based on the preferred model, the probability of striking at least one WNP whale in a single year was estimated to range from 0.006 – 0.012 across different scenarios for the annual number of total gray whales that might be struck. This corresponds to an expectation of ≥ 1 WNP whale strike in one of every 83 to 167 years.

HABITAT CONCERNS

Near shore industrialization and shipping congestion throughout the migratory corridors of the WNP gray whale stock represent risks by increasing the likelihood of exposure to pollutants and ship strikes as well as a general degradation of the habitat. In addition, the summer feeding area off Sakhalin Island is a region rich with offshore oil and gas reserves. Two major offshore oil and gas projects now directly overlap or are in near proximity to this important feeding area, and more development is planned in other parts of the Okhotsk Sea that include the migratory routes of these whales. Operations of this nature have introduced new sources of underwater noise, including seismic surveys, increased shipping traffic, habitat modification, and risks associated with oil spills (Weller et al. 2002). During the past decade, a Western Gray Whale Advisory Panel, convened by the International Union for Conservation of Nature (IUCN), has been providing scientific advice on the matter of anthropogenic threats to gray whales in the WNP (see http://www.iucn.org/wgwap/). Ocean acidification could reduce the abundance of shell-forming organisms (Fabry et al. 2008, Hall-Spencer et al. 2008), many of which are important in the gray whales' diet (Nerini 1984).

STATUS OF STOCK

The WNP stock is listed as "Endangered" under the U.S. Endangered Species Act of 1973 (ESA) and is therefore also considered "strategic" and "depleted" under the MMPA. At the time the ENP stock was delisted, the WNP stock was thought to be geographically isolated from the ENP stock. Recent documentation of some whales moving between the WNP and ENP seems to indicate otherwise (Lang 2010; Mate et al. 2011; Weller et al. 2012; Urbán et al. 2013). Other research findings, however, provide continued support for identifying two separate stocks of North Pacific gray whales, including: (1) significant mitochondrial and nuclear genetic differences between whales that feed in the WNP and those that feed in the ENP (LeDuc et al. 2002; Lang et al. 2011), (2) recruitment into the WNP stock is almost exclusively internal (Cooke et al. 2013), and (3) the abundance of the WNP stock remains low while the abundance of the ENP stock grew steadily following the end of commercial whaling (Cooke et al. 2013). As long as the WNP stock remains listed as endangered under the ESA, it will continue to be considered as depleted under the MMPA.

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Revised 9/21/2016

HUMPBACK WHALE (*Megaptera novaeangliae*): California/Oregon/Washington Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

NMFS has conducted a global Status Review of humpback whales (Bettridge *et al.* 2015), and recently revised the ESA listing of the species (81 FR 62259, September 8, 2016). NMFS is evaluating the stock structure of humpback whales under the MMPA, but no changes to current stock structure are presented at this time. However, effects of the ESA listing final rule on the status of the stock are discussed below. Northern Hemisphere humpback whales (*M. novaeangliae kuzira*) comprise a distinct subspecies based on mtDNA and DNA relationships and distribution compared to North Atlantic humpback whales (*M. n. novaeangliae*) and those in the Southern Hemisphere (*M. n. australis*) (Jackson *et al*. 2014). Humpback whales occur throughout the North Pacific, with multiple populations currently recognized based on low-latitude winter breeding areas (Baker *et al*. 1998, Calambokidis *et al*. 2001, Calambokidis *et al*. 2008, Barlow *et al*. 2011, Fleming and Jackson 2011). North Pacific breeding areas fall broadly into three regions, including the 1) western Pacific (Japan and Philippines); 2) central Pacific (Hawaiian Islands); and 3) eastern Pacific (Central America and Mexico) (Calambokidis *et al*. 2008). Exchange of animals between breeding areas rarely occurs, based on photo-identification data of individual whales (Calambokidis *et al*. 2001, Calambokidis *et al*. 2008). Photo-identification evidence also suggests strong site fidelity to feeding areas, but animals from multiple feeding areas converge on common winter breeding areas (Calambokidis *et al*. 2008). Baker *et al*. (2008) reported significant differences in mtDNA haplotype frequencies among different breeding and feeding areas in the North Pacific, reflecting strong matrilineal site fidelity to the respective migratory destinations. The most significant differences in haplotype frequencies were found between the California/Oregon feeding area and Russian and Southeastern Alaska feeding areas (Baker *et al*. 2008). Among breeding areas, the greatest level of differentiation was found between Okinawa and Central America and most other breeding grounds (Baker *et al*. 2008). Genetic differences between feeding and breeding grounds were also found, even for areas where regular exchange of animals between feeding and breeding grounds is confirmed by photo-identification (Baker *et al*. 2008).

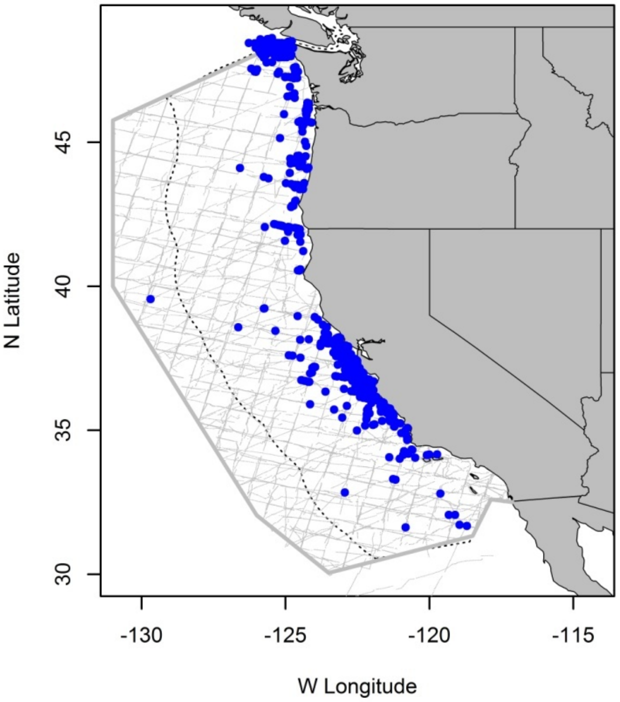

Figure 1. Humpback whale sightings based on shipboard surveys off California, Oregon, and Washington, 1991-2014. Dashed line represents the U.S. EEZ, thin lines indicate completed transect effort of all surveys combined. See Appendix 2 for data sources and information on timing and location of survey effort.

Along the U.S. west coast, one stock is currently recognized, which includes animals that appear to be part of two separate feeding groups, a California and Oregon feeding group and a northern Washington and southern British Columbia feeding group (Calambokidis *et al*. 2008, Barlow *et al*. 2011). Very few photographic matches between these feeding groups have been documented (Calambokidis *et al*. 2008). Humpbacks from both groups have been photographically matched to breeding areas off Central America, mainland Mexico, and Baja California, but whales from the northern Washington and southern British Columbia feeding group also winter near the Hawaiian Islands and the Revillagigedo Islands off Mexico (Barlow *et al*. 2011). Seven 'biologically important areas' for humpback whale feeding are identified off the U.S. west coast by Calambokidis *et al*. (2015), including 5 in California, 1 in Oregon, and 1 in Washington.

For the Marine Mammal Protection Act (MMPA) stock assessment reports, the California/Oregon/Washington Stock is defined to include humpback whales that feed off the west coast of the United States, including animals from both the California-Oregon and Washington-southern British Columbia feeding groups (Calambokidis *et al*. 1996, Calambokidis *et al*. 2008, Barlow *et al*. 2011). Three other stocks are recognized in the U.S. MMPA Pacific stock assessment reports: the Central North Pacific Stock (with feeding areas from Southeast Alaska to the Alaska Peninsula), the Western North Pacific Stock (with feeding areas from the Aleutian Islands, the Bering Sea, and Russia), and the American Samoa Stock in the South Pacific (with largely undocumented feeding areas as far south as the Antarctic Peninsula).

POPULATION SIZE

Based on whaling statistics, the pre-1905 population of humpback whales in the North Pacific was estimated to be 15,000 (Rice 1978), but this population was reduced by whaling to approximately 1,200 by 1966 (Johnson and Wolman 1984). A photo-identification study in 2004-2006 estimated the abundance of humpback whales in the entire Pacific Basin to be 21,808 (CV=0.04) (Barlow *et al*. 2011). Barlow (2016) recently estimated 3,064 (CV= 0.82) humpback whales from a 2014 summer/fall ship line-transect survey of California, Oregon, and Washington waters. Abundance estimates from photographic mark-recapture surveys conducted in California and Oregon waters every year from 1991 through 2011 represent the most precise estimates (Calambokidis 2013). These estimates include only animals photographed in California and Oregon waters and not animals that are part of the separate feeding group found off Washington state and southern British Columbia (Calambokidis *et al*. 2009). California and Oregon estimates range from approximately 1,100 to 2,600 animals, depending on the choice of recapture model and sampling period (Figure 2). The best estimate of abundance for California and Oregon waters is taken as the 2008-2011 Darroch estimate of 1,729 (CV = 0.03) whales, which is also the most precise estimate (Calambokidis and Barlow 2013).

Calambokidis *et al*. (2008) reported a range of photographic mark-recapture abundance estimates (145 – 469) for the northern Washington and southern British Columbia feeding group most recently in 2005. The best model estimate from that study (lowest AIC_c score) was reported as 189 (CV not reported) animals. This estimate is more than 8 years old and is outdated for use in stock assessments; however, because west-coast humpback whale populations are growing (Calambokidis and Barlow 2013), this is still a valid minimum population estimate.

Combining abundance estimates from both the California/Oregon and Washington/southern British Columbia feeding groups (1,729 + 189) yields an estimate of 1,918 (CV≈0.03) animals for the California/Oregon/Washington stock. The approximate CV of 0.03 for the combined estimate reflects that a vast majority of the variance is derived from the California and Oregon estimate (CV=0.03) and that no CV was provided for the Washington state and southern British Columbia estimate.

Minimum Population Estimate

The minimum population estimate for humpback whales in the California/Oregon/Washington stock is taken as the lower 20th percentile of the log-normal distribution of the combined mark-recapture estimate for both feeding groups given above, or 1,876 animals.

Current Population Trend

Ship surveys provide some indication that humpback whales increased in abundance in California coastal waters between 1979/80 and 1991 (Barlow 1994) and between 1991 and 2014 (Barlow 2016), but this increase was not steady, and estimates showed slight dips in 2001 and 2008. Mark-recapture population estimates had shown a long-term increase of approximately 7.5% per year (Calambokidis *et al*. 2009, Figure 2), but more recent estimates show variable trends (Figure 2), depending on the choice of model and time frame used (Calambokidis and Barlow 2013). Population estimates for the entire North Pacific have also increased substantially from 1,200 in 1966 to approximately 18,000 - 20,000 whales in 2004 to 2006 (Calambokidis *et al*. 2008). Although these estimates are based on different methods and the earlier estimate is extremely uncertain, the growth rate implied by these estimates (6-7%) is consistent with growth rate of the California/Oregon/Washington stock.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The proportion of calves in the California/Oregon/Washington stock from 1986 to 1994 appeared much lower than previously measured for humpback whales in other areas (Calambokidis and Steiger 1994), but in 1995-97 a greater proportion of calves were identified, and the 1997 reproductive rates for this population are closer to those reported for humpback whale populations in other regions (Calambokidis et al. 1998). Despite the apparently low proportion of calves, two independent lines of evidence indicate that this stock was growing in the 1980s and early 1990s (Barlow 1994; Calambokidis *et al*. 2003) with a best estimate of 8% growth per year (Calambokidis *et al*. 1999). The current net productivity rate is unknown.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (1,876) times one half the estimated population growth rate for this stock of humpback whales (½ of 8%) times a recovery factor of 0.3 (for an endangered species; see Status of Stock section below regarding ESA listing status) with $N_{min} > 1{,}500$ and CV (N_{min}) < 0.50), resulting in a PBR of 22. Because this stock spends approximately half its time outside the U.S. EEZ, the PBR allocation for U.S. waters is 11 whales per year.

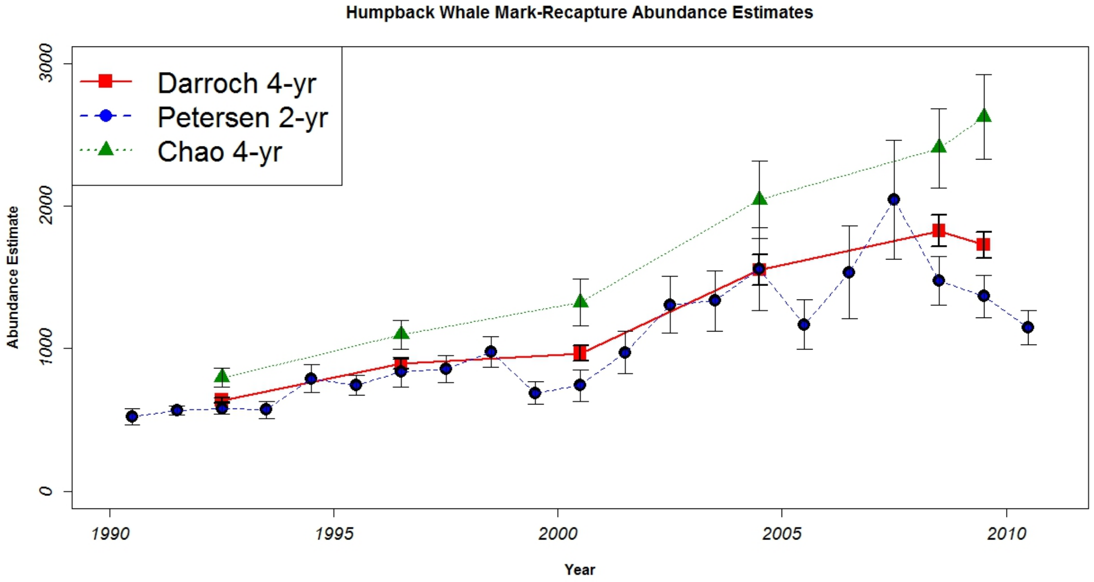

Figure 2. Mark-recapture estimates of humpback whale abundance in California and Oregon, 1991-2011, based on 3 different mark-recapture models and sampling periods (Calambokidis and Barlow 2013). Vertical bars indicate ±2 standard errors of each abundance estimate. Darroch and Chao models use 4 consecutive non-overlapping sample years, except for the last estimates, which use the four most recent years, but overlap with the next-to-last estimate (Calambokidis and Barlow 2013).

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Pot and trap fisheries are the most commonly documented source of serious injury and mortality of humpback whales in U.S. west coast waters (Carretta *et al*. 2013, 2015, 2016a). From 2010 to 2014, there were 27 documented interactions associated with pot and trap fisheries (Carretta *et al.* 2016a, Jannot *et al.* 2016). Five records (3 CA spot prawn pot + 2 unidentified pot/trap fisheries) involved non-serious injuries resulting from human intervention to remove gear, or cases where animals were able to free themselves. Four records involved dead whales, including one case where a pair of severed humpback flukes were found in southern California waters with 2 sets of California Dungeness crab gear attached (Carretta *et al.* 2016a). The remaining 18 cases involved serious injuries (prorated and non-prorated) attributed to unidentified pot/trap fisheries (12 total serious injuries), WA coastal Dungeness crab pot (1), CA Dungeness crab pot (1), and CA spot prawn pot (0.75), for a total of 14.75 serious injuries / 5 years, or 2.95 humpback whales annually (Table 1). Including the 4 deaths attributed to pot/traps, the minimum level of annual mortality and serious injury across all pot/trap fisheries is 14.75 + 4 = 18.75 / 5 years = 3.75 whales annually (Table 1).

Table 1. Summary of available information on the incidental mortality and serious injury of humpback whales (California/Oregon/Washington stock) for commercial fisheries that are likely to take this species (Carretta *et al*. 2015, Carretta *et al.* 2016a, Carretta *et al.* 2016b). Mean annual takes are based on 2010-2014 data unless noted otherwise. Serious injuries may include prorated serious injuries with values less than one (NOAA 2012), thus the sum of serious injury and mortality may not be a whole number.

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed Mortality (and serious injury)	Estimated mortality and serious injury (CV)	Mean Annual Takes (CV)
CA swordfish and thresher shark drift gillnet fishery	2010-2014	observer	22%	0[1]	0.5 (2.2)	0.1 (2.2)
CA halibut/white seabass and other species large mesh (≥3.5”) set gillnet fishery	2010-2014	observer	9%	0	0	0 (n/a)
CA spot prawn pot	2010-2014	Strandings / sightings	n/a	0 (0.75)	n/a	≥ 0.15
Unspecified pot or trap fisheries (includes generic ‘Dungeness’ crab gear not attributed to a specific state fishery)	2010-2014	Strandings / sightings	n/a	1 (12)	n/a	≥ 2.6
CA Dungeness crab pot	2010-2014	Strandings / sightings	n/a	1 (1)	n/a	≥ 0.4
OR Dungeness crab pot	2010-2014	Strandings / sightings	n/a	1 (0)	n/a	≥ 0.2
WA coastal Dungeness crab pot	2010-2014	Strandings / sightings	n/a	0 (1)	n/a	≥ 0.2
WA/OR/CA limited entry sablefish pot	2014	observer	31%	1 (0)	n/a[2]	≥ 0.2
unidentified fisheries	2010-2014	Strandings / sightings	n/a	2 (5.5)	n/a	≥ 1.5
Total Annual Takes						≥ 5.3

Gillnet and unidentified fisheries accounted for 8 interactions with humpback whales between 2010 and 2014 (Carretta *et al.* 2016a). Two interactions involved dead whales, both with evidence of recent entanglements around the tailstock. Three interactions involved at-sea sightings of seriously injured humpback whales with constricting gear (rope and/or netting) that was cutting into the animal. Three interactions involved at-sea sightings of whales trailing gear of unknown type and configuration. The latter 3 cases were prorated as 0.75 serious injuries each according to NMFS serious injury policy guidelines (NOAA 2012). The total annual mortality and serious injury due to unidentified fisheries from 2010 to 2014 is based on 2 deaths + 3 serious injuries + 3 prorated serious injuries (0.75 x 3 = 2.25), or 7.25 whales. The 5-year annual mean serious injury and mortality due to unidentified fisheries during this period is 7.25 / 5 = 1.5 whales. Three humpback whale entanglements (all released alive) were observed in the CA swordfish drift gillnet fishery from over 8,600 fishing sets monitored between 1990 and 2014 (Carretta *et al.* 2016b). Some opportunistic sightings of free-swimming humpback whales entangled in gillnets may also originate from this fishery. The most recent model-based estimate of humpback whale bycatch in this fishery for 2010-2014 is 0.5 whales (CV=2.2). The corresponding ratio estimate of bycatch for the same time period is zero (Carretta *et al.* 2016b). The model-based estimate is considered superior because it utilizes all 25 years of data for estimation, in contrast to the ratio estimate that uses only 2010-2014 data. The model-based estimate does not distinguish between non-serious injuries and mortality and no proration is applied because of small observed sample sizes and the likelihood that whales may swim away with sections of gillnet and not be recorded by the observer program. The average annual estimated bycatch in the CA swordfish drift gillnet fishery is 0.1 whales (0.5 total whales / 5 years).

Total commercial fishery serious injury and mortality of humpback whales for the period 2010-2014 is the sum of pot/trap fishery records (18.75), plus unidentified fishery records (7.5), plus estimates from the CA swordfish drift gillnet fishery (0.5), or 26.75 total whales. The mean annual serious injury and mortality from commercial fisheries during 2010-2014 is 26.75 whales / 5 years = 5.3 whales (Table 1). Most serious injury and mortality records from commercial fisheries reflect opportunistic stranding and at-sea sighting data and thus, represent minimum counts of impacts, for which no correction factor is currently available.

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[1] There were no observations of humpback whales in this fishery during 2010-2014, but the model-based estimate of bycatch for this period results in a positive estimate of bycatch (Carretta *et al*. 2016b).

[2] No estimate of total bycatch has been generated for this fishery.

Ship Strikes

Seven humpback whales (4 deaths, 1 serious injury, and 2 non-serious injuries) were reported struck by vessels between 2010 and 2014 (Carretta *et al.* 2015, Carretta *et al.* 2016a). In addition, there was one serious injury to an unidentified large whale from a ship strike during this time. The average annual serious injury and mortality of humpback whales attributable to ship strikes during 2010-2014 is 1.0 whale per year (4 deaths, plus one serious injury = 5 deaths/injuries / 5 years = 1 whale).).

Other human-caused mortality and serious injury

A humpback whale was entangled in a research wave rider buoy in 2014. The whale is estimated to have been entangled for 3 weeks and had substantial necrotic tissue around the caudal peduncle. Although the whale was fully disentangled by a whale entanglement team, this animal was categorized as a serious injury[3] because of the necrotic condition of the caudal peduncle and the possibility that the whale would lose its flukes due to the severity of the entanglement (NOAA 2012, Carretta *et al.* 2016a).

Habitat Concerns

Increasing levels of anthropogenic sound in the world's oceans (Andrew *et al*. 2002), such as those produced by shipping traffic, or LFA (Low Frequency Active) sonar, have been identified as a habitat concern for whales, as it can reduce acoustic space used for communication (masking) (Clark *et al.* 2009, NOAA 2016). This can be particularly problematic for baleen whales that may communicate using low-frequency sound (Erbe 2016). Based on vocalizations (Richardson *et al*. 1995; Au *et al*. 2006), reactions to sound sources (Lien *et al*. 1990, 1992; Maybaum 1993), and anatomical studies (Hauser *et al*. 2001), humpback whales also appear to be sensitive to mid-frequency sounds, including those used in active sonar military exercises (U.S. Navy 2007).

STATUS OF STOCK

Approximately 15,000 humpback whales were taken from the North Pacific from 1919 to 1987 (Tonnessen and Johnsen 1982), and, of these, approximately 8,000 were taken from the west coast of Baja California, California, Oregon and Washington (Rice 1978), presumably from this stock. Shore-based whaling apparently depleted the humpback whale stock off California twice: once prior to 1925 (Clapham *et al*. 1997) and again between 1956 and 1965 (Rice 1974). There has been a prohibition on taking humpback whales since 1966. As a result of commercial whaling, humpback whales were listed as "endangered" under the Endangered Species Conservation Act of 1969. This protection was transferred to the Endangered Species Act (ESA) in 1973. The humpback whale ESA listing final rule (81 FR 62259, September 8, 2016) established 14 distinct population segments (DPSs) with different listing statuses. The DPSs that occur in waters under the jurisdiction of the United States do not necessarily equate to the existing MMPA stocks. Some of the listed DPSs partially coincide with the currently defined CA/OR/WA stock. Until such time as the MMPA stock delineations are reviewed in light of the DPS designations, NMFS considers this stock to be endangered and depleted for MMPA management purposes (e.g., selection of a recovery factor, stock status). Consequently, the California/Oregon/Washington stock is automatically considered as a "strategic" stock under the MMPA. The estimated annual mortality and serious injury due to commercial fishery entanglements (5.3/yr), and non-fishery entanglements (0.2/yr), plus ship strikes (1.0/yr), equals 6.5 animals, and is less than the PBR allocation of 11 for U.S. waters. Most data on human-caused serious injury and mortality for this population is based on opportunistic stranding and at-sea sighting data and represents a minimum count of total impacts. There is currently no estimate of the fraction of anthropogenic injuries and deaths to humpback whales that are undocumented on the U.S. west coast. Based on strandings and at sea observations, annual humpback whale mortality and serious injury in commercial fisheries (5.3/yr) is greater than 10% of the PBR; therefore, total fishery mortality and serious injury is not approaching zero mortality and serious injury rate. The California/Oregon/Washington stock showed a long-term increase in abundance from 1990 through approximately 2008 (Figure 2), but more recent estimates have shown variable trends.

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[3] This whale was initially listed as a non-serious injury in Carretta *et al.* (2016a) due to insufficient detail in the preliminary reporting. It is considered a serious injury for purposes of this stock assessment report.

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Revised 12/31/2015

BLUE WHALE (*Balaenoptera musculus musculus*): Eastern North Pacific Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

North Pacific blue whales were once thought to belong to as many as five separate populations (Reeves *et al.* 1998), but acoustic evidence suggests only two populations, in the eastern and western north Pacific, respectively (Stafford *et al*. 2001, Stafford 2003, McDonald *et al*. 2006, Monnahan *et al*. 2014). North Pacific blue whales produce two distinct acoustic calls, referred to as "northwestern" and "northeastern" types, and it has been proposed that these represent distinct populations with some degree of geographic overlap (Stafford *et al*. 2001, Stafford 2003, Monnahan *et al*. 2014). The northeastern call predominates in the Gulf of Alaska, the U.S. West Coast, and the eastern tropical Pacific, while the northwestern call predominates from south of the Aleutian Islands to the Kamchatka Peninsula in Russia, though both call types have been recorded concurrently in the Gulf of Alaska (Stafford *et al*. 2001, Stafford 2003). Both call types occur in lower latitudes in the central North Pacific, but differ in their seasonal patterns (Stafford *et al*. 2001). Blue whales satellite-tagged off California in late summer have been found to travel to the eastern tropical Pacific and the Costa Rica Dome area in winter (Mate *et al*. 1999, Bailey *et al.* 2009). Photographs of blue whales in California have also been matched to individuals photographed off the Queen Charlotte Islands in northern British Columbia and to one individual photographed in the northern Gulf of Alaska (Calambokidis *et al*. 2009a). Gilpatrick and Perryman (2008) showed that blue whales from California to Central America (the Eastern North Pacific stock) are on average, two meters shorter than blue whales measured from historic whaling records in the central and western north Pacific.

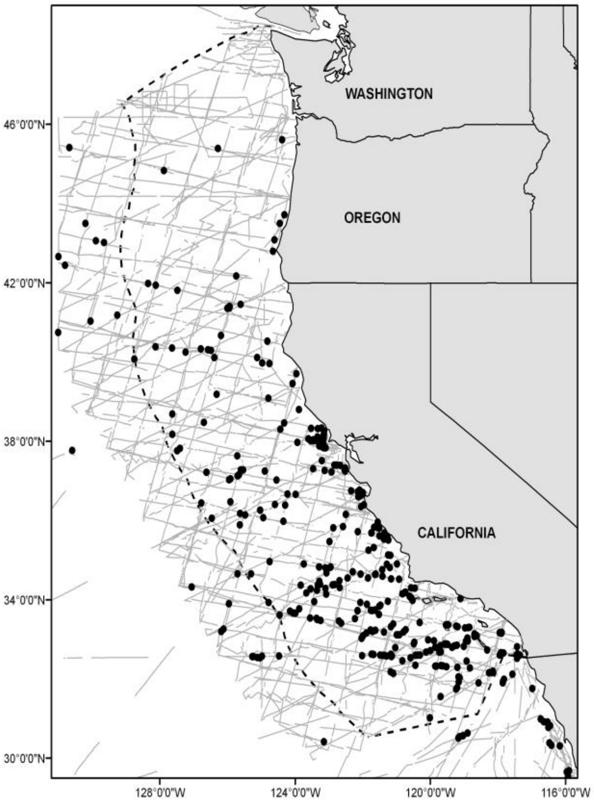

Figure 1. Blue whale sighting locations based on aerial and summer/autumn shipboard surveys off California, Oregon, and Washington, 1991-2008 (see Appendix 2 for data sources and information on timing and location of surveys). Dashed line represents the U.S. EEZ; thin lines represent completed transect effort for all surveys combined.

For the Marine Mammal Protection Act (MMPA) stock assessment reports, the Eastern North Pacific Stock of blue whales includes animals found in the eastern North Pacific from the northern Gulf of Alaska to the eastern tropical Pacific. This definition is consistent with both the distribution of the northeastern call type, photogrammetric length determinations and with the known range of photographically identified individuals. Based on locations where the northeastern call type has been recorded, some individuals in this stock may range as far west as Wake Island and as far south as the Equator (Stafford *et al*. 1999, 2001). The U.S. West Coast is certainly one of the most important feeding areas in summer and fall (Figure 1), but, increasingly, blue whales from this stock have been found feeding to the north and south of this area during summer and fall. Nine 'biologically important areas' (BIAs) for blue whale feeding are identified off the California coast by Calambokidis *et al.* (2015), including six in southern California and three in central California. Most of this stock is believed to migrate south to spend the winter and spring in high productivity areas off Baja California, in the Gulf of California, and on the Costa Rica Dome. Given that these migratory destinations are areas of high productivity and given the observations of feeding in these areas, blue whales can be assumed to feed year round. Some individuals from this stock may be present year-round on the Costa Rica Dome (Reilly and Thayer 1990). However, it is also possible that some Southern Hemisphere blue whales might occur north of the equator during the austral winter. One other stock of North Pacific blue whales (the Central North Pacific stock) is recognized in the Pacific Marine Mammal Protection Act (MMPA) Stock Assessment Reports.

POPULATION SIZE

The size of the feeding stock of blue whales off the U.S. West Coast has been estimated recently by both line-transect and mark-recapture methods. Line-transect abundance estimates from summer/autumn research vessel surveys in the California Current ranged between approximately 400 and 800 animals from 2001 to 2008 (Barlow and Forney 2007, Barlow 2010). These estimates are considerably lower than previous line-transect estimates of approximately 1,900 animals obtained between 1991 and 1996 (Barlow 2010) (Figure 2). The lower abundance estimates appear to be related to a northward shift in the distribution of blue whales out of the study area (as far north as the Gulf of Alaska) and not a population decline (Barlow and Forney 2007, Calambokidis *et al.* 2009a). Mark-recapture estimates are often negatively biased by individual heterogeneity in sighting probabilities (Hammond 1986); however, Calambokidis *et al.* (2010) minimize such effects by selecting one sample that was taken randomly with respect to distance from the coast. Because some fraction of the population is always outside the survey area, the line-transect and mark recapture estimation methods provide different measures of abundance for this stock. Line transect estimates reflect the average density and abundance of blue whales in the study area during summer and autumn surveys, while mark recapture estimates provide an estimate of total population size. New photographic mark-recapture estimates of abundance for the period 2005 to 2011 presented by Calambokidis and Barlow (2013) range from approximately 1,000 to 2,300 animals, with the most consistent estimates represented by a 4-yr sampling period Chao model that incorporates individual capture heterogeneity over time. The Chao model consistently yielded estimates of approximately 1,500 whales (Figure 2). The best estimate of blue whale abundance is taken from the Chao model results of Calambokidis and Barlow (2013) for the period 2008 to 2011, or 1,647 (CV=0.07) whales.

Minimum Population Estimate

The minimum population estimate for blue whales is taken as the lower 20th percentile of the log-normal distribution of abundance estimated from the mark-recapture estimate, or approximately 1,551.

Current Population Trend

Mark-recapture estimates provide the best indicator of population trends for this stock, because of recent northward shifts in blue whale distribution that negatively bias line-transect estimates. Based on mark-recapture estimates shown in Figure 2, there is no evidence of a population size increase in this blue whale population since the early 1990s. While the Petersen mark-recapture estimates show an apparent increase in blue whale abundance since 1996, the estimation errors associated with these estimates are also much higher than for the Chao estimates (Figure 2). Monnahan *et al.* (2015) used a population dynamics model to estimate that the eastern Pacific blue whale population was at 97% of carrying capacity in 2013 and suggest that density dependence and not impacts from ship strikes, explains the observed lack of a population size increase since the early 1990s. The authors estimate that the eastern North Pacific population likely did not drop below 460 whales during the last century, despite being targeted by commercial whaling.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Based on mark-recapture estimates from the US West Coast and Baja California, Mexico, Calambokidis *et al.* (2009b) estimate a rate of increase just under 3% per year, but it is not known if that corresponds to the maximum growth rate of this stock.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (1,551) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.3 (for an endangered species which has a minimum abundance greater than 1,500 and a CV_{Nmin}<0.5), resulting in a PBR of 9.3. Because whales in this stock spends approximately three quarters of their time outside the U.S. EEZ, the PBR allocation for U.S. waters is one-quarter of this total, or 2.3 whales per year.

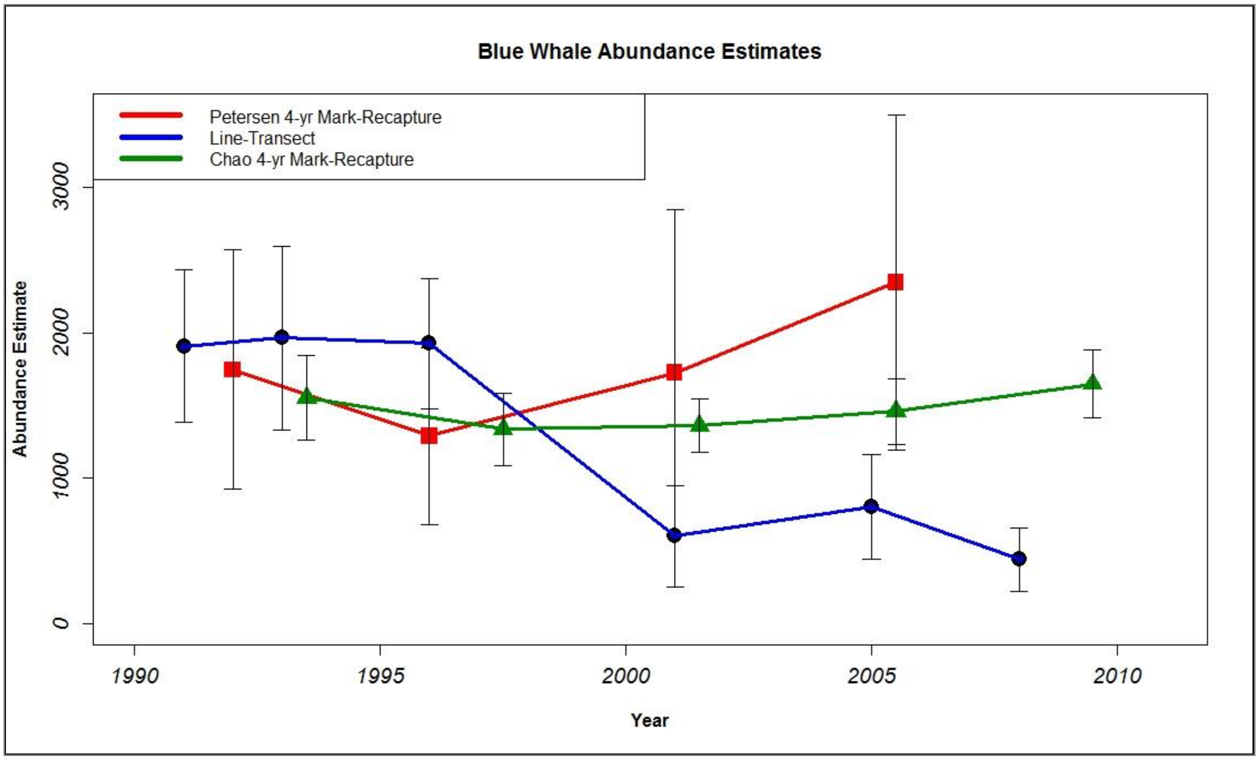

Figure 2. Estimates of blue whale abundance from line-transect and photographic mark-recapture surveys, 1991 to 2011 (Barlow and Forney 2007, Barlow 2010, Calambokidis and Barlow 2013). Vertical bars indicate ±2 standard errors of each abundance estimate.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

The California swordfish drift gillnet fishery is the only fishery that is likely to take blue whales from this stock, but no fishery mortality or serious injuries have been observed since the observer program was initiated in 1990 (Julian and Beeson 1998, Carretta *et al*. 2004, Carretta and Enriquez 2009a, 2009b, 2010, 2012a, 2012b). This results in an average estimate of zero blue whales taken annually (Table 1). Some gillnet mortality of large whales may go unobserved because whales swim away with a portion of the net; however, fishermen report that large rorquals usually swim through nets without entangling and with very little damage to the nets.

Gillnets have been documented to entangle marine mammals off Baja California (Sosa-Nishizaki *et al*. 1993), but no recent bycatch data from Mexico are available.

Table 1. Summary of available information on the incidental mortality and injury of blue whales (Eastern North Pacific stock) for commercial fisheries that might take this species (Carretta and Enriquez 2009a, 2009b, 2010, 2012a, 2012b).

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed Mortality (and injury)	Estimated mortality (CV in parentheses)	Mean Annual Takes (CV in parentheses)
CA/OR thresher shark/swordfish drift gillnet fishery	2001-2013	observer	19%	0	0	0 (n/a)
Total Annual Takes						0 (n/a)

Ship Strikes

Ship strikes were implicated in the deaths of four blue whales and the serious injury of a fifth whale between 2009 and 2013 (Carretta *et al*. 2015). Five deaths occurred in 2007, the highest number recorded for any year. The remaining four ship strike deaths occurred in 2009 (2) and 2010 (2). One additional whale was seriously injured in 2010 and its prorated serious injury value is 0.56 (Carretta *et al*. 2013, 2014). During 2009-2013, there were an additional two serious injuries of unidentified large whales attributed to ship strikes, some of which may have been blue whales (Carretta *et al*. 2015). No methods have been developed to prorate the number of unidentified ship strike cases to species, because identified cases are likely biased towards species that are large, easy to identify, and more likely to be detected, such as blue and fin whales. Most observed blue whale ship strikes have been in the southern California Bight, where large container ship ports overlap with seasonal blue whale distribution (Berman-Kowalewski *et al*. 2010). Several blue whales have been photographed in California with large gashes in their dorsal surface that appear to be from ship strikes. Including ship strike records identified to species and prorated serious injuries, blue whale mortality and injuries attributed to ship strikes in California waters averaged 0.9 per year during 2009-2013 (Carretta *et al*. 2015). NOAA previously implemented a mitigation plan that includes NOAA weather radio and U.S. Coast Guard advisory broadcasts to mariners entering the Santa Barbara Channel to be observant for whales, along with recommendations that mariners transit the channel at 10 knots or less. The Channel Islands National Marine Sanctuary also developed a blue whale/ship strike response plan, which involved weekly overflights to record whale locations. Additional plan information can be found at http://channelislands.noaa.gov/focus/alert.html. Documented ship strike deaths and serious injuries are derived from actual counts of whale carcasses and should be considered minimum values. Where evaluated, estimates of detection rates of cetacean carcasses are consistently quite low across different regions and species (<1% to 17%), highlighting that observed numbers are unrepresentative of true impacts (Kraus *et al*. 2005, Perrin *et al*. 2011, Williams *et al*. 2011, Prado *et al*. 2013). Due to this negative bias, Redfern *et al*. (2013) stress that the number of ship strike deaths of blue whales in the California Current likely exceeds PBR.

Impacts of ship strikes on population recovery of the eastern North Pacific blue whale population were recently assessed by Monnahan *et al*. (2015). Their population dynamics model incorporates data on historic whaling removals, levels of ship strikes, and projected numbers of vessels using the region through 2050. The authors conclude that this stock was at 97% of carrying capacity in 2013 and that current ship strike levels do not pose a threat to the status of this stock. Caveats to the carrying capacity analysis include the assumption that the population was already at carrying capacity prior to commercial whaling of this stock in the early 20th century and that carrying capacity has not changed appreciably since that time (Monnahan *et al*. 2015).

STATUS OF STOCK

The reported take of North Pacific blue whales by commercial whalers totaled 9,500 between 1910 and 1965 (Ohsumi and Wada 1972). Approximately 3,000 of these were taken from the west coast of North America from Baja California, Mexico to British Columbia, Canada (Tonnessen and Johnsen 1982; Rice 1992; Clapham *et al*. 1997; Rice 1974). Recently, Monnahan *et al*. (2014) estimated that 3,411 blue whales (95% range 2,593–4,114) were removed from the eastern North Pacific populations between 1905 and 1971. Blue whales in the North Pacific were given protected status by the IWC in 1966, but Doroshenko (2000) reported that a small number of blue whales were taken illegally by Soviet whalers after that date. As a result of commercial whaling, blue whales were listed as "endangered" under the Endangered Species Conservation Act of 1969. This protection was transferred to the Endangered Species Act (ESA) in 1973. Despite a current analysis suggesting that the Eastern North Pacific population is at 97% of carrying capacity (Monnahan *et al*. 2015), blue whales are listed as “endangered”, and consequently the Eastern North Pacific stock is automatically considered a "depleted" and "strategic" stock under the MMPA. Conclusions about the population’s current status relative to carrying capacity depend upon assumptions that the population was already at carrying capacity before commercial whaling impacted the population in the early 1900s, and that carrying capacity has remained relatively constant since that time (Monnahan *et al*. 2015). If carrying capacity has changed significantly in the last century, conclusions regarding the status of this population would necessarily change (Monnahan *et al*. 2015). The observed annual incidental mortality and injury rate (0.9/year) from ship strikes is less than the calculated PBR (2.3) for this stock, but this rate does not include unidentified large whales struck by vessels, some of which may have been blue whales, nor does it include undetected and unreported ship strikes of blue whales. The number of blue whales struck by ships in the California Current likely exceeds the PBR for this stock (Redfern *et al*. 2013). To date, no blue whale mortality has been associated with California gillnet fisheries; therefore, total fishery mortality is approaching zero mortality and serious injury rate.

Habitat Concerns

Increasing levels of anthropogenic sound in the world’s oceans has been suggested to be a habitat concern for blue whales (Reeves *et al*. 1998, Andrew *et al*. 2002). Tagged blue whales exposed to simulated mid-frequency sonar and pseudo-random noise demonstrated a variety of behavioral responses, including no change in behavior, termination of deep dives, directed travel away from sound sources, and cessation of feeding (Goldbogen *et al.* 2013). Behavioral responses were highly dependent upon the type of sound source and the behavioral state of the animal at the time of exposure. Deep-feeding and non-feeding whales reacted more strongly to experimental sound sources than surface-feeding whales that typically showed no change in behavior. The authors stated that behavioral responses to such sounds are influenced by a complex interaction of behavioral state, environmental context, and prior exposure of individuals to such sound sources. One concern expressed by the authors is if blue whales did not habituate to such sounds near feeding areas that "repeated exposures could negatively impact individual feeding performance, body condition and ultimately fitness and potentially population health." Currently, no evidence indicates that such reduced population health exists, but such evidence would be difficult to differentiate from natural sources of reduced fitness or mortality in the population. Nine blue whale feeding areas identified off the California coast by Calambokidis *et al.* (2015) represent a diversity of nearshore and offshore habitats that overlap with a variety of anthropogenic activities, including shipping, oil and gas extraction, and military activities.

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FIN WHALE (*Balaenoptera physalus physalus*): California/Oregon/Washington Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Northern Hemisphere fin whales (*B. physalus physalus*) likely comprise distinct Pacific and Atlantic subspecies (Archer *et al*. 2013). Mizroch *et al*. (2009) described eastern and western North Pacific populations, based on a review of sightings data, catch statistics, recaptures of marked whales, blood chemistry data, and acoustics. The two populations are thought to have separate wintering and mating grounds off of Asia and North America and during summer, whales from each population may co-occur near the Aleutian Islands and Bering Sea (Mizroch *et al*. 2009). Non-migratory populations exist in the Gulf of California (Tershy et al. 1993; Bérubé et al. 2002) and the East China Sea (Fujino 1960). Evidence of additional subpopulations near Sanriku-Hokkaido and the Sea of Japan exists, based on seasonal catch data and recaptures of marked animals (Mizroch *et al*. 2009). Fin whales occur throughout the North Pacific, from the southern Chukchi Sea to the Tropic of Cancer (Mizroch *et al*. 2009), but their wintering areas are poorly known. Fin whales are scarce in the eastern tropical Pacific in summer (Wade and Gerrodette 1993) and winter (Lee 1993). Fin whales occur year-round in the Gulf of Alaska (Stafford et al. 2007); the Gulf of California (Tershy et al. 1993; Bérubé et al. 2002); California (Dohl et al. 1983); and Oregon and Washington (Moore et al. 1998). Fin whales satellite-tagged in the Southern California Bight (SCB) appear to use the region year-round, although they seasonally range to central California and Baja California before returning to the SCB (Falcone and Schorr 2013). The longest satellite track reported by Falcone and Schorr (2013) was a fin whale tagged in the SCB in January 2014, with the whale moving south to central Baja California by February and north to the Monterey area by late June. Archer *et al*. (2013) present evidence for geographic separation of fin whale mtDNA clades near Point Conception, California: a significantly higher proportion of 'clade A' is composed of samples from the SCB and Baja California, while 'clade C' is largely represented by samples from central California, Oregon, Washington, and the Gulf of Alaska.

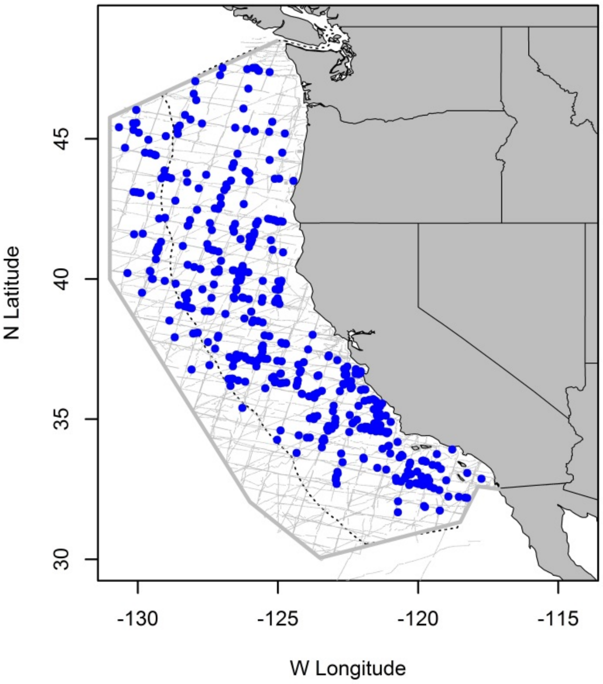

Figure 1. Fin whale sighting locations based on shipboard surveys off California, Oregon, and Washington, 1991-2014. Dashed line represents the U.S. EEZ; thin lines indicate completed transect effort of all surveys combined.

Insufficient information exists to determine population structure, but from a conservation perspective it may be risky to assume panmixia in the entire North Pacific. This report covers the stock of fin whales found along the coasts of California, Oregon, and Washington. Because fin whale abundance appears lower in winter/spring in California (Dohl *et al*. 1983; Forney *et al*. 1995) and in Oregon (Green *et al*. 1992), it is likely that the distribution of this stock extends seasonally outside these coastal waters. Fin whales are present year-round in southern California waters, as evidenced by individually-identified whales photographed in all four seasons (Falcone and Schorr 2013). The Marine Mammal Protection Act (MMPA) stock assessment reports recognize three stocks of fin whales in the North Pacific: 1) the California/Oregon/Washington stock (this report), 2) the Hawaii stock, and 3) the Northeast Pacific stock.

POPULATION SIZE

The pre-whaling population of fin whales in the North Pacific was estimated to be 42,000-45,000 (Ohsumi and Wada 1974). In 1973, the North Pacific population was estimated to have been reduced to 13,620-18,680 (Ohsumi and Wada 1974), of which 8,520-10,970 were estimated to belong to the eastern Pacific stock. The best estimate of fin whale abundance in California, Oregon, and Washington waters out to 300 nmi is from a trend-model analysis of line-transect data from 1991 through 2014 (Nadeem *et al*. 2016; Fig. 2), which generated an estimate for 2014 of 9,029 (CV=0.12) whales. The new estimates are based on similar methods to those first applied to this population by Moore and Barlow (2011). However, the new abundance estimates are substantially higher than earlier estimates because the new analysis incorporates lower estimates of *g(0)*, the trackline detection probability (Barlow 2015). The trend-model analysis incorporates information from the entire 1991-2014 time series for each annual estimate of abundance, and given the strong evidence of an increasing abundance trend over that time (Moore and Barlow 2011, Nadeem *et al.* 2016), the best estimate of abundance is represented by the estimate for the most recent year, or 2014. This is probably an underestimate because it excludes some fin whales that could not be identified in the field and were recorded as “unidentified rorqual” or “unidentified large whale”.

Minimum Population Estimate

The minimum population estimate for fin whales is taken as the lower 20th percentile of the posterior distribution of abundance estimated for 2014, or approximately 8,127 whales.

Current Population Trend

Indications of recovery in CA coastal waters date back to 1979/80 (Barlow 1994), but there is now strong evidence that fin whale abundance increased in the California Current between 1991 and 2008 based on analysis of abundance data from line transect surveys conducted in the California Current between 1991 and 2014 (Nadeem *et al*. 2016, Figure 2). Abundance in waters out to 300 nmi off the coast of California approximately doubled between 1991 and 1993, from approximately 1,744 (CV = 0.25) to 3,369 (CV= 0.21), suggesting probable dispersal of animals into this area. Across the entire study area (waters off California, Oregon, and Washington), the mean annual abundance increase was 7.5%, although abundance appeared stable between 2008 and 2014. In all, there has been a roughly 5-fold increase between 1991 and 2014. Since 2005, the abundance increase has been driven by increases off northern California, Oregon and Washington, while numbers off Central and Southern California have been stable (Nadeem *et al*. 2016). Zerbini *et al*. (2006) found similar evidence of increasing abundance trend for fin whales in Alaskan waters at a rate of 4.8% per year between 2001 and 2003.

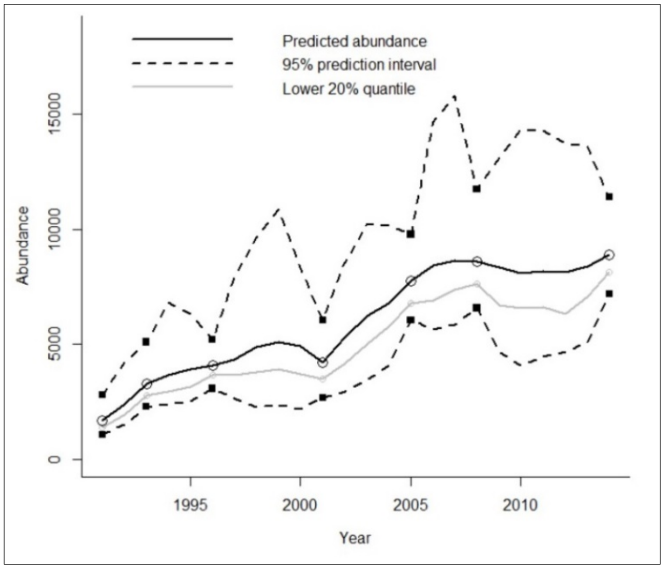

Figure 2. Trend-based estimates of fin whale abundance, 1991- 2014, with 95% Bayesian credible intervals (Nadeem *et al*. 2016).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Estimated annual rates of increase in the California Current (California, Oregon, and Washington waters) averaged 7.5% from 1991 to 2014 (Nadeem *et al*. 2016). However, it is unknown how much of this growth is due to immigration rather than birth and death processes. A doubling of the abundance estimate in California waters between 1991 and 1993 cannot be explained by birth and death processes alone, and movement of individuals between U.S. west coast waters and other areas (e.g., Alaska, Mexico) have been documented (e.g., Mizroch et al. 1984).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (8,127) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.5 (for an endangered species, with N_{min} > 5,000 and CV_{Nmin} < 0.50, Taylor *et al.* 2003), resulting in a PBR of 81 whales.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

One fin whale death (in 1999) was observed in the California swordfish drift gillnet fishery from over 8,600 observed sets between 1990 and 2014 (Carretta *et al*. 2016a.). Although no fin whales have been observed taken in the fishery since 1999, new model-based bycatch estimates include a very small estimate of 0.1 whales (CV=3) for the most recent 5-year period, 2010-2014 (Carretta *et al.* 2016a). The large CV of this bycatch estimate is a consequence of the mean estimate being very small. This estimate is based on inclusion of 25 years of observer data spanning 1990-2014 and reflects a very low long-term observed bycatch rate scaled up to levels of unobserved fishing effort. Mean annual takes (<0.1) for this fishery (Table 1) are based on 2010-2014 data. Some gillnet mortality of large whales may go unobserved because whales swim away with a portion of the net. One fin whale sighted at-sea was determined to be seriously injured (line cutting into the whale) as a result of interactions with unknown fishing gear during 2010-2014 (Carretta *et al.* 2016b). Including systematic fishery observations in the CA swordfish drift gillnet fishery and opportunistic sightings of fishery-related injuries, the mean annual serious injury and mortality of fin whales for 2010-2014 is ≥0.2 whales (Table 1). Gillnets have been documented to entangle marine mammals off Baja California (Sosa-Nishizaki et al. 1993), but no recent bycatch data from Mexico are available.

Table 1. Summary of available information on the incidental mortality and injury of fin whales (CA/OR/WA stock) for commercial fisheries that might take this species.

Fishery Name	Data Type	Year(s)	Percent Observer Coverage	Observed (or self-reported)	Estimated Mortality (and serious injury)	Mean Annual Takes (CV in parentheses)
CA swordfish and thresher shark drift gillnet fishery	2010-2014	observer	22%	0[1]	0.1 (CV=3)	<0.1 (CV=3)
Unidentified fishery interactions	2010-2014	at-sea sightings	n/a	1	0 (1)	≥ 0.2
Minimum total annual takes						≥ 0.2 (CV=3)

Ship Strikes

Ship strikes were implicated in the deaths of nine fin whales during 2010-2014 (Carretta *et al.* 2015, Carretta *et al.* 2016b). During 2010-2014, there was one additional serious injury to an unidentified large whale attributed to a ship strike. Additional mortality from ship strikes probably goes unreported because the whales do not strand or, if they do, they do not always have obvious signs of trauma. The average observed annual mortality and serious injury due to ship strikes is 1.8 fin whales per year during 2010-2014. Documented ship strike deaths and serious injuries are derived from actual counts of whale carcasses and should be considered minimum values. Where evaluated, estimates of detection rates of cetacean carcasses are consistently quite low across different regions and species (<1% to 33%), highlighting that observed numbers underestimate true impacts (Carretta *et al*. 2016c, Kraus *et al*. 2005, Williams *et al*. 2011, Prado *et al*. 2013, Wells *et al.* 2015).

STATUS OF STOCK

Fin whales in the North Pacific were given protected status by the IWC in 1976. Fin whales are formally listed as "endangered" under the Endangered Species Act (ESA), and consequently the California

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[1] There were no observations of fin whale entanglements in this fishery during 2010-2014, but the model-based estimate of bycatch for this period results in a positive estimate of bycatch (Carretta *et al*. 2016a).

to Washington stock is automatically considered as a "depleted" and "strategic" stock under the MMPA. The total documented incidental mortality and serious injury (2.0/yr) due to fisheries (0.2/yr) and ship strikes (1.8/yr) is less than the calculated PBR (81). Total fishery mortality is less than 10% of PBR and, therefore, may be approaching zero mortality and serious injury rate. There is strong evidence that the population has increased since the early 1990s (Moore and Barlow 2011, Nadeem *et al.* 2016). Increasing levels of anthropogenic sound in the world's oceans has been suggested to be a habitat concern for whales, particularly for baleen whales that may communicate using low-frequency sound (Croll *et al.* 2002). Behavioral changes associated with exposure to simulated mid-frequency sonar, including no change in behavior, cessation of feeding, increased swimming speeds, and movement away from simulated sound sources has been documented in tagged *blue* whales (Goldbogen *et al.* 2013), but it is unknown if fin whales respond in the same manner to such sounds.

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Revised 2/8/2017

SEI WHALE (*Balaenoptera borealis borealis*): Eastern North Pacific Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The International Whaling Commission (IWC) only considers one stock of sei whales in the North Pacific (Donovan 1991), but some evidence exists for multiple populations (Masaki 1977; Mizroch *et al.* 1984; Horwood 1987). Sei whales are distributed far out to sea in temperate regions of the world and do not appear to be associated with coastal features. Whaling effort for this species was distributed continuously across the North Pacific between 45-55ºN (Masaki 1977). Two sei whales that were tagged off California were later killed off Washington and British Columbia (Rice 1974) and the movement of tagged animals has been noted in many other regions of the North Pacific. Sei whales are rare in the California Current (Dohl *et al.* 1983; Barlow 1997; Forney *et al.* 1995; Mangels and Gerrodette 1994, Barlow 2016), but were the fourth most common whale taken by California coastal whalers in the 1950s-1960s (Rice 1974). They are extremely rare south of California (Wade and Gerrodette 1993; Lee 1993). Lacking additional information on sei whale population structure, sei whales in the eastern North Pacific (east of longitude 180º) are considered as a separate stock.

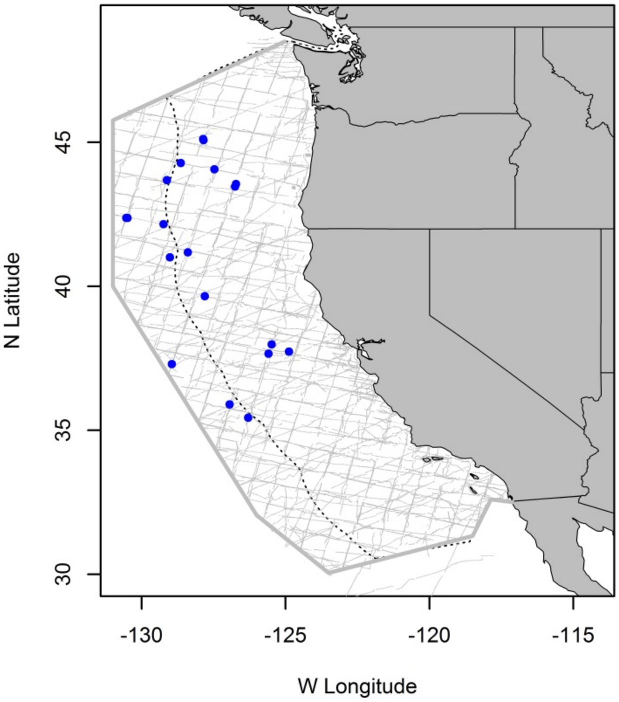

Figure 1. Sei whale sighting locations from shipboard surveys off California, Oregon, and Washington, 1991-2014. Dashed line represents the U.S. EEZ; thin lines indicate completed transect effort of all surveys combined.

POPULATION SIZE

Ohsumi and Wada (1974) estimate the pre-whaling abundance of sei whales to be 58,000-62,000 in the North Pacific. Later, Tillman (1977) used a variety of different methods to estimate the abundance of sei whales in the North Pacific and revised this pre-whaling estimate to 42,000. His estimates for the year 1974 ranged from 7,260 to 12,620. All methods depend on using the history of catches and trends in CPUE or sighting rates; there have been no direct estimates of sei whale abundance in the entire (or eastern) North Pacific based on sighting surveys. Sei whale sightings in California, Oregon, and Washington waters during extensive ship and aerial surveys between 1991- 2014 have been relatively rare (Figure 1, Hill and Barlow 1992; Carretta and Forney 1993; Mangels and Gerrodette 1994; VonSaunder and Barlow 1999; Barlow 2003; Forney 2007; Barlow 2010, Barlow 2016). Green *et al.* (1992) did not report any sightings of sei whales in aerial surveys of Oregon and Washington. Abundance estimates for the two most recent line transect surveys of California, Oregon, and Washington waters in 2008 and 2014 out to 300 nmi are 311 (0.76) and 864 (0.40) sei whales, respectively (Barlow 2016). The best estimate of abundance for California, Oregon, and Washington waters out to 300 nmi is the unweighted geometric mean of the 2008 and 2014 estimates, or 519 (CV=0.40) sei whales (Barlow 2016).

Minimum Population Estimate

The minimum population estimate for sei whales is taken as the lower 20th percentile of the log-normal distribution of abundance estimated from 2008 and 2014 shipboard line-transect surveys, or approximately 374 whales.

Current Population Trend

There are no data on trends in sei whale abundance in the eastern North Pacific waters. Although the population in the North Pacific is expected to have grown since being given protected status in 1976, the possible effects of continued unauthorized take (Yablokov 1994) and incidental ship strikes and gillnet mortality make this uncertain. Barlow (2016) noted that an increase in sei whale abundance observed in 2014 in the California Current is partly due to recovery of the population from commercial whaling, but may also involve distributional shifts in the population.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

There are no estimates of the growth rate of sei whale populations in the North Pacific (Best 1993).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (374) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.1 (for an endangered species), resulting in a PBR of 0.75 whales.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

The California swordfish drift gillnet fishery is the only fishery that is likely to take sei whales from this stock, but no fishery mortality or serious injuries have been observed from over 8,600 monitored fishing sets from 1990-2014 (Carretta *et al.* 2017, Table 1). Mean annual takes for this fishery (Table 1) are based on 2010-2014 data. This results in an average estimate of zero sei whales taken annually. However, some gillnet mortality of large whales may go unobserved because whales swim away with a portion of the net.

Table 1. Summary of available information on the incidental mortality and injury of sei whales (eastern North Pacific stock) for commercial fisheries that might take this species. n/a indicates that data are not available. Mean annual takes are based on 2010-2014 data unless noted otherwise.

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed mortality (and injury in parentheses)	Estimated mortality (CV in parentheses)	Mean annual takes (CV in parentheses)
CA/OR thresher shark/swordfish drift gillnet fishery	2010-2014	observer	22%	0	0	0 (n/a)

Ship Strikes

There have been no documented ship strikes of sei whales in the most recent 5-year period, 2010-2014 (Carretta *et al.* 2016), although one ship strike death was reported in Washington in 2003 (NMFS Northwest Regional Office, unpublished data). During 2010-2014, there were an additional eight injuries of unidentified large whales attributed to ship strikes. Additional mortality from ship strikes probably goes unreported because the whales do not strand or, if they do, they do not always have obvious signs of trauma. The average observed annual mortality due to ship strikes is zero sei whales per year for the period 2010-2014.

STATUS OF STOCK

The NMFS recovery plan for the sei whale (NMFS 2011) notes that basic information such as distribution, abundance, trends and stock structure is of poor quality or largely unknown, owing to the rarity of sightings of this species. Sei whales were estimated to have been reduced to 20% (8,600 out of 42,000) of their pre-whaling abundance in the North Pacific (Tillman 1977). The initial abundance has never been reported separately for the eastern North Pacific stock, but this stock was also probably depleted by whaling. Sei whales are formally listed as "endangered" under the Endangered Species Act (ESA), and consequently the eastern North Pacific stock is automatically considered as a "depleted" and "strategic" stock under the Marine Mammal Protection Act (MMPA). Total known estimated fishery mortality is zero and therefore is approaching zero mortality and serious injury rate. Although the current known rate of ship strike deaths and serious injuries is zero, it is likely that some sei whale ship strikes are unreported. Increasing levels of anthropogenic sound in the world's oceans has been suggested to be a habitat concern for whales, particularly for baleen whales that may communicate using low-frequency sound (Croll *et al.* 2002). Behavioral changes associated with exposure to simulated mid-frequency sonar, including no change in behavior, cessation of feeding, increased swimming speeds, and movement away from simulated sound sources has been documented in tagged blue whales (Goldbogen *et al.* 2013), but it is unknown if sei whales respond in the same manner to such sounds.

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Revised 8/16/2016

MINKE WHALE (*Balaenoptera acutorostrata scammoni*): California/Oregon/Washington Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

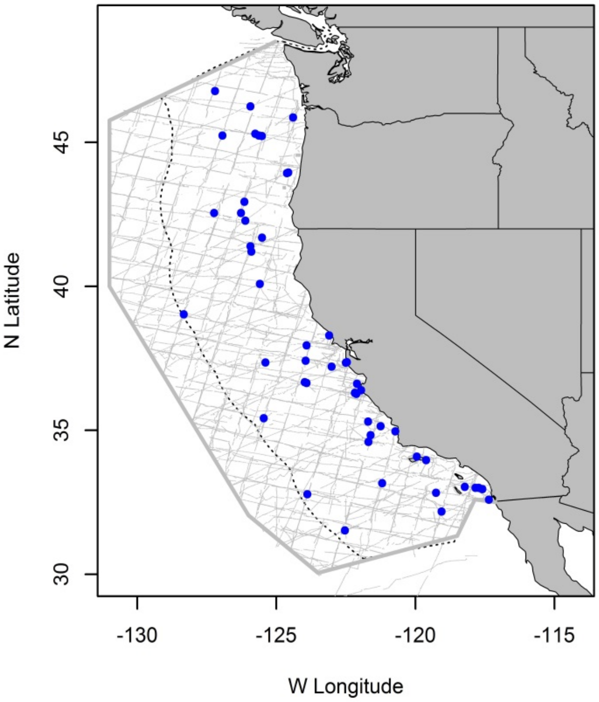

Figure 1. Minke whale sighting locations based on shipboard surveys off California, Oregon, and Washington, 1991-2014. Dashed line represents the U.S. EEZ; thin lines indicate completed transect effort of all surveys combined.

The International Whaling Commission (IWC) recognizes 3 stocks of minke whales in the North Pacific: one in the Sea of Japan/East China Sea, one in the rest of the western Pacific west of 180ºN, and one in the "remainder" of the Pacific (Donovan 1991). The "remainder" stock only reflects the lack of exploitation in the eastern Pacific and does not imply that only one population exists in that area (Donovan 1991). In the "remainder" area, minke whales are relatively common in the Bering and Chukchi seas and in the Gulf of Alaska, but are not considered abundant in any other part of the eastern Pacific (Leatherwood et al. 1982; Brueggeman et al. 1990). In the Pacific, minke whales are usually seen over continental shelves (Brueggeman et al. 1990). In the extreme north, minke whales are believed to be migratory, but in inland waters of Washington and in central California they appear to establish home ranges (Dorsey et al. 1990). Minke whales occur year-round in California (Dohl et al. 1983; Forney et al. 1995; Barlow 1997) and in the Gulf of California (Tershy et al. 1990). Minke whales are present at least in summer/fall along the Baja California peninsula (Wade and Gerrodette 1993). Because the "resident" minke whales from California to Washington appear behaviorally distinct from migratory whales further north, minke whales in coastal waters of California, Oregon, and Washington (including Puget Sound) are considered as a separate stock. Minke whales in Alaskan waters are considered in a separate stock assessment report.

POPULATION SIZE

No estimates have been made for the number of minke whales in the entire North Pacific. The most recent abundance estimate for this stock is based on the geometric mean of estimates obtained from ship line transect surveys in summer and autumn in 2008 and 2014, or 636 (CV=0.72) whales (Barlow 2016).

Minimum Population Estimate

The minimum population estimate for minke whales is taken as the lower 20th percentile of the log-normal distribution of abundance estimated from 2008 and 2014 summer/fall ship surveys in California, Oregon, and Washington waters (Barlow 2016) or approximately 369 whales.

Current Population Trend

There are no data on trends in minke whale abundance in waters of California, Oregon and/or Washington.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

There are no estimates of the growth rate of minke whale populations in the North Pacific (Best 1993).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (369) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.48 (for a stock of unknown status with a mortality estimate CV > 0.30 and < 0.60), resulting in a PBR of 3.5 whales.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Table 1. Summary of available information on the incidental mortality and injury of minke whales (CA/OR/WA stock) for commercial fisheries that might take this species (Carretta *et al.* 2016a). Mean annual takes are based on 2010-2014 data.

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed mortality (and serious injury)	Estimated mortality (CV)	Mean annual takes (CV)
CA/OR thresher shark/swordfish drift gillnet fishery	2010-2014	observer	22%	1[1]	4.5 (0.58)	0.9 (0.58)
CA halibut and other species large mesh (>3.5”) set gillnet fishery	2010-2014	observer	9%	0	0	n/a
Unidentified fisheries	2010-2014	Sightings and strandings	n/a	1 (0.75)	1.75 (n/a)	≥ 0.35 (n/a)
Total annual takes						≥1.3 (0.58)

Fishery Information

Minke whales may occasionally be caught in coastal set gillnets off California, in salmon drift gillnet in Puget Sound, Washington, and in offshore drift gillnets off California. Four minke whales were observed entangled (2 dead, 2 released alive) between 1990-2014 in the California swordfish drift gillnet fishery from over 8,600 monitored fishing sets (Carretta *et al.* 2016a). One animal ‘released alive’ in 1999 occurred in a set with a large hole in the net from which a skin sample was collected and positively-identified as a minke whale with genetic sequencing. It is unknown whether or not gear remained on the whale. The estimate for the drift gillnet fishery in Table 1 (4.5 whales / 5 years = 0.9 annually) currently reflects total bycatch, regardless of animal condition (Carretta *et al.* 2016a). Two additional minke whale fishery interactions were recorded during 2010-2014: an entangled whale sighted at sea with rope and net material (=0.75 serious injury) and a live stranding of an animal that later died and appeared to have been previously entangled in unknown cable material (Carretta *et al.* 2016b). The mean annual mortality and serious injury of minke whales from this stock during 2010-2014 is 1.3 animals (Table 1).

Ship Strikes

No ship strikes of minke whales were reported during the most recent 5-year period of 2010-2014. Additional mortality from ship strikes probably goes unreported because the whales do not strand or, if they do, they do not always have obvious signs of trauma.

STATUS OF STOCK

Minke whales are not listed as "endangered" under the Endangered Species Act and are not considered "depleted" under the MMPA. The greatest uncertainty in their status is whether entanglement in commercial gillnets and ship strikes could have reduced this relatively small population. Because of this,

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[1] One minke whale was observed entangled in this fishery during the 2010-2014 period. The entanglement occurred in 2011 (Carretta *et al.* 2016a).

the status of the west-coast stock is considered "unknown". The annual mortality and serious injury due to fisheries (1.3/yr) and ship strikes (0.0/yr) is less than the calculated PBR for this stock (3.5), so they are not considered a "strategic" stock under the MMPA. Fishery mortality is not less than 10% of the PBR; therefore, total fishery mortality is not approaching zero mortality and serious injury rate. There is no information on trends in the abundance of this stock. Harmful algal blooms are a habitat concern for minke whales and at least one death along the U.S. west coast has been attributed to domoic acid toxicity resulting from the consumption of northern anchovy prey items (Fire *et al.* 2010). Increasing levels of anthropogenic sound in the world's oceans has been suggested to be a habitat concern for whales, particularly for baleen whales that may communicate using low-frequency sound (Croll *et al*. 2002). Behavioral changes associated with exposure to simulated mid-frequency sonar, including no change in behavior, cessation of feeding, increased swimming speeds, and movement away from simulated sound sources has been documented in tagged blue whales (Goldbogen *et al*. 2013), but it is unknown if minke whales respond in the same manner to such sounds.

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Revised 12/31/2015

BRYDE'S WHALE (*Balaenoptera edeni*): Eastern Tropical Pacific Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The International Whaling Commission (IWC) recognizes 3 stocks of Bryde's whales in the North Pacific (eastern, western, and East China Sea), 3 stocks in the South Pacific (eastern, western and Solomon Islands), and one cross-equatorial stock (Peruvian) (Donovan 1991). Bryde's whales are distributed widely across the tropical and warm-temperate Pacific (Leatherwood et al. 1982), and there is no justification for splitting stocks between the northern and southern hemispheres (Donovan 1991). Past surveys have shown them to be common and distributed throughout the eastern tropical Pacific with a concentration around the equator east of 110ºW (corresponding approximately to the IWC's "Peruvian stock") and a lower densities west of 140ºW (Lee 1993; Wade and Gerrodette 1993). They are also the most common baleen whale in the central Gulf of California (Tershy et al. 1990). Sightings and acoustic recordings of Bryde’s whales in southern California waters have increased in the past decade (Kerosky *et al*. 2012, Smultea *et al*. 2012), possibly signaling a northward range expansion (Kerosky *et al*. 2012). Acoustic recordings indicate Bryde’s whales are present in southern California waters from summer through early winter (Kerosky *et al*. 2012). At least seven sightings have been documented in southern / central California waters between 1991 and 2014 (Barlow and Forney 2007, Smultea *et al*. 2012, Barlow 2016). Bryde's whales in California waters likely belong to a larger population inhabiting at least the eastern part of the tropical Pacific. Acoustic call types of Bryde’s whales in southern California waters match a type found along the west coast of Baja California (Kerosky *et al*. 2012). For the Marine Mammal Protection Act (MMPA) stock assessment reports, Bryde's whales within the Pacific U.S. Exclusive Economic Zone are divided into two areas: 1) the eastern tropical Pacific (east of 150ºW and including the Gulf of California and waters off California; this report), and 2) Hawaiian waters.

POPULATION SIZE

In the western North Pacific, Bryde's whale abundance in the early 1980s was estimated independently by tag mark-recapture and ship survey methods to be 22,000 to 24,000 (Tillman and Mizroch 1982; Miyashita 1986). Bryde's whale abundance has never been estimated for the entire eastern Pacific; however, a portion of that stock in the eastern tropical Pacific was estimated as 13,000 (CV=0.20; 95% CI = 8,900-19,900) (Wade and Gerrodette 1993), and the minimum number in the Gulf of California was estimated at 160 based on individually-identified whales (Tershy et al. 1990). The most recent verified sighting in California waters occurred in 2014 during a systematic line-transect survey designed to estimate cetacean abundance (Barlow 2016). That sighting did not occur during standard search effort and thus, no estimate of abundance is available from the 2014 survey.

Minimum Population Estimate

The only minimum estimate of Bryde’s whale abundance for the eastern tropical Pacific (11,163; Wade and Gerrodette 1993) is over 8 years old and thus, no current estimate of minimum abundance is available.

Current Population Trend

There are no data on trends in Bryde's whale abundance in the eastern tropical Pacific.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

There are no estimates of the growth rate of Bryde's whale populations in the Pacific (Best 1993).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock cannot be calculated because a current abundance estimate is unavailable.

HUMAN CAUSED MORTALITY

Historic Whaling

The reported take of North Pacific Bryde's whales by commercial whalers totaled 15,076 in the western Pacific from 1946-1983 (Holt 1986) and 2,873 in the eastern Pacific from 1973-81 (Cooke 1983). In addition, 2,304 sei-or-Bryde's whales were taken in the eastern Pacific from 1968-72 (Cooke 1983) (based on subsequent catches, most of these were probably Bryde's whales). None were reported taken by shore-based whaling stations in central or northern California between 1919 and 1926 (Clapham et al. 1997) or 1958 and 1965 (Rice 1974). There has been a prohibition on taking Bryde's whales since 1988.

Table 1. Summary of available information on the incidental mortality and injury of Bryde's whales (eastern tropical Pacific stock) for commercial fisheries that might take this species (Carretta *et al*. 2014a, 2012a, 2012b, Carretta and Enriquez 2009, 2010; Carretta *et al*. 2004). n/a indicates that data are not available. Mean annual takes are based on 2001-2013 data unless noted otherwise.

Fishery Name	**Year(s)**	**Data Type**	**Percent Observer Coverage**	**Observed mortality (and injury in parentheses)**	**Estimated mortality (CV in parentheses)**	**Mean annual takes (CV in parentheses)**
CA/OR thresher shark/swordfish drift gillnet fishery	2001-2013	observer	19%	0	0	0
Total annual takes						0

Fishery Information

The California swordfish drift gillnet fishery is the only fishery that is likely to take Bryde's whales from this stock, but no entanglements have been observed (Table 1). Detailed information on this fishery is provided in Appendix 1. Mean annual takes for this fishery are zero (Table 1) and are based on 2001-2013 data, the period during which a season/area closure has limited most fishing to southern California waters. Although Bryde's whales have not been observed entangled in California gillnets, some gillnet mortality of large whales may go unobserved because whales swim away with a portion of the net.

Ship Strikes

One Bryde's whale was documented to have been killed by a ship strike in 2010 (Carretta et al. 2014b, Carretta et al. 2015). The whale was initially sighted alive in Washington state waters with propeller marks and stranded dead about a week later. The mean annual serious injury and mortality rate of Bryde's whales over the most recent 5-year period (2009-2013) is 0.2 whales annually.

STATUS OF STOCK

Commercial whaling of Bryde's whales was largely limited to the western Pacific. Bryde's whales are not listed as "threatened" or "endangered" under the Endangered Species Act (ESA). Bryde's whales in the eastern tropical Pacific would not be considered a strategic stock under the MMPA. The total human-caused mortality rate is 0.2 whales annually. Current abundance of this stock is unknown and therefore PBR cannot be calculated for this stock. Likewise, human-caused mortality cannot be evaluated in the context of PBR. Increasing levels of anthropogenic sound in the world's oceans has been suggested to be a habitat concern for whales, particularly for baleen whales that may communicate using low-frequency sound.

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Revised 7/15/2014

ROUGH-TOOTHED DOLPHIN (*Steno bredanensis*): Hawaii Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Rough-toothed dolphins are found throughout the world in tropical and warm-temperate waters (Perrin et al. 2009). They are present around all the main Hawaiian Islands, though they are uncommon near Maui and the 4-Islands region (Baird et al. 2013) and have been observed close to the islands and atolls at least as far northwest as Pearl and Hermes Reef (Bradford et al. 2013). Rough-toothed dolphins were occasionally seen offshore throughout the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands during both 2002 and 2010 surveys (Barlow 2006, Bradford et al. 2013; Figure 1).

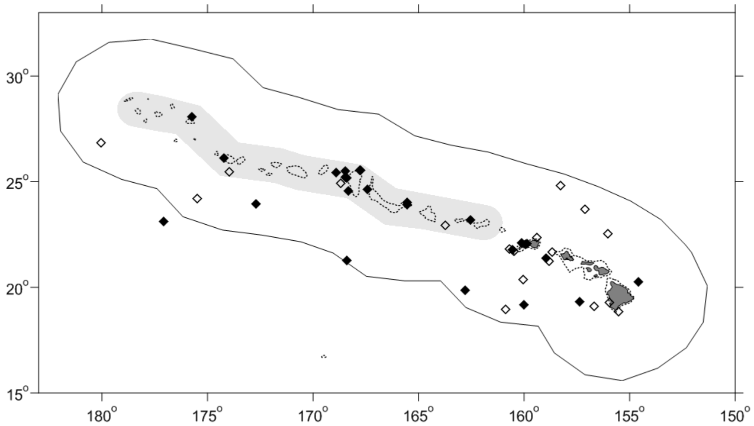

Figure 1. Rough-toothed dolphin sighting locations during the 2002 (open diamonds) and 2010 (black diamonds) shipboard cetacean surveys of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006, Bradford et al. 2013; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ. Gray shading indicates area of Papahanaumokuakea Marine National Monument. Dotted line represents the 1000m isobath.

Little is known about stock structure for this species in the North Pacific. Photographic identification studies around the main Hawaiian Islands suggest that dispersal rates between the islands of Kauai/Niihau and Hawaii do not exceed 2% per year (Baird *et al.* 2008). Resighting rates off the island of Hawaii are high, with 75% of well-marked individuals resighted on two or more occasions, suggesting high site fidelity and low population size. Preliminary results of genetic studies of individuals sampled from Kauai/Niihau and Hawaii Island (Albertson, unpublished data), together with resighting data, suggest there may be at least two island-associated stocks of rough-toothed dolphins in main Hawaiian Islands (Oleson et al. 2013). Rough-toothed dolphins have also been documented in American Samoan waters (Oleson 2009).

For the Marine Mammal Protection Act (MMPA) stock assessment reports, there are two Pacific management stocks: 1) The Hawaii Stock (this report), and 2) the American Samoa Stock. The Hawaii stock includes animals found both within the Hawaiian Islands EEZ and in adjacent high seas waters; however, because data on abundance, distribution, and human-caused impacts are largely lacking for high seas waters, the status of this stock is evaluated based on data from the U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

POPULATION SIZE

A population estimate for this species is available from the eastern tropical Pacific (Wade and Gerrodette 1993), but it is not known whether these animals are part of the same population that occurs around the Hawaiian Islands. Mark-recapture estimates for the islands of Kauai/Nihau and Hawaii were derived from identification photographs obtained between 2003 and 2006, resulting in estimates of 1,665 (CV=0.33) around Kauai/Niihau and 198 (CV=0.12) around the island of Hawaii (Baird *et al.* 2008). These estimates are specific to those island areas and do not represent the abundance of rough-toothed dolphins within the Hawaiian EEZ, as surveys were primarily conducted within 40km of shore. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 8,709 (CV=0.45) rough-toothed dolphins (Barlow 2006). The recent 2010 shipboard line-transect survey of the Hawaiian Islands EEZ resulted in an abundance estimate of 6,288 (CV = 0.39) rough-toothed dolphins (Bradford et al. 2013). This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow et al. 1995) of the 2010 abundance estimate or 4,581 rough-toothed dolphins within the Hawaiian Islands

EEZ.

Current Population Trend

No data are available on current population trend. The broad and overlapping confidence intervals around the 2002 and 2010 estimates preclude assessment of trends with the available data.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Hawaii stock of rough-toothed dolphins is calculated as the minimum population size within the U.S. EEZ of the Hawaiian Islands (4,581) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a stock of unknown status with no known fishery mortality or serious injury; Wade and Angliss 1997), resulting in a PBR of 46 rough-toothed dolphins per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*". Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fishery Information

Information on fishery-related mortality and serious injury of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Rough-toothed dolphins are known to take bait and catch from several Hawaiian sport and commercial fisheries operating near the main islands (Shallenberger 1981; Schlais 1984; Nitta and Henderson 1993). They have been specifically reported to interact with the day handline fishery for tuna (palu-ahi), the night handline fishery for tuna (ika-shibi), and the troll fishery for billfish and tuna (Schlais 1984; Nitta and Henderson 1993). Baird *et al.* (2008) reported increased vessel avoidance of boats by rough-toothed dolphins off the island of Hawaii relative to those off Kauai or Niihau and attributed this to possible shooting of dolphins that are stealing bait or catch from recreational fisherman off the island of Hawaii (Kuljis 1983). No estimates of human-caused mortality or serious injury are currently available for nearshore hook and line fisheries because these fisheries are not observed or monitored for protected species bycatch.

There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Between 2007 and 2011, no rough-toothed dolphins were observed hooked or entangled in the SSLL fishery (100% observer coverage) or the DSLL fishery (20-22% observer coverage) (McCracken 2013, Bradford & Forney 2013). However, eight unidentified cetaceans were taken in the DSLL fishery, and two unidentified cetaceans were taken in the SSLL fishery, some of which may have been rough-toothed dolphins.

STATUS OF STOCK

The Hawaii stock of rough-toothed dolphins is not considered strategic under the 1994 amendments to the MMPA, The status of rough-toothed dolphins in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Rough-toothed dolphins are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor designated as "depleted" under the MMPA. There have been no reports of recent mortality or serious injuries; however, there is no systematic monitoring for interactions with protected species within near-shore fisheries that may take this species, thus mean annual takes are undetermined. Insufficient information is available to determine whether the total fishery mortality and serious injury for rough-toothed dolphins is insignificant and approaching zero mortality and serious injury rate.

One rough-toothed dolphin stranded in the main Hawaiian Islands tested positive for *Brucella* (Chernov, 2010) and another for *Morbillivirus* (Jacob 2012). *Brucella* is a bacterial infection may limit recruitment by compromising male and female reproductive systems if it is common in the population, and can also cause neurological disorders that may result in death (Van Bressem et al. 2009). Although *morbillivus* is known to trigger lethal disease in cetaceans (Van Bressem et al. 2009), its impact on the health of the stranded animal is not known (Jacob 2012). The presence of *morbillivirus* in 10 species (Jacob 2012) and *Brucella* in 3 species (Chernov 2010, West unpublished data) raises concerns about the history and prevalence of these diseases in Hawaii and the potential population impacts on Hawaiian cetaceans. It is not known if *Brucella or Morbillivirus* are common in the Hawaii stock.

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ROUGH-TOOTHED DOLPHIN *(Steno bredanensis)*: American Samoa Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Figure 1. Rough-toothed dolphin sightings during cetacean sighting surveys around Tutuila, American Samoa, 2003-2006 (Johnston et al, 2008).

Rough-toothed dolphins are found throughout the world in tropical and warm-temperate waters (Perrin et al. 2009). Rough-toothed dolphins are common in the South Pacific from the Solomon Islands, where they were taken by dolphin hunters, to French Polynesia and the Marquesas (reviewed by Reeves et al 1999). Rough-toothed dolphins have been observed during summer and winter surveys around the American Samoan island of Tutuila (Johnston et al. 2008) and are thought to be common throughout the Samoan archipelago (Craig 2005). Rough-toothed dolphins were among the most commonly-sighted cetaceans during small boat surveys conducted from 2003 to 2006 around Tutuila, though not observed during a 2006 survey of Swain's Island and the Manu'a Group (Johnston et al. 2008). Photo-identification data collected during the surveys suggest the presence of a resident population of rough-toothed dolphins in the waters surrounding Tutuila (Johnston et al. 2008). Approximately 1/3 of the individuals within the photo-id catalog were sighted in multiple years (Johnston et al. 2008). One rough-toothed dolphin was taken entangled near 40-fathom bank south of the islands by the American Samoa-based longline in 2008 (Oleson 2009), indicating some rough-toothed dolphins maintain a more pelagic distribution. Nothing is known about stock structure for this species in the South Pacific. For the Marine Mammal Protection Act (MMPA) stock assessment reports, there are two Pacific management stocks: 1) The Hawaiian Stock, which includes animals found within the U.S. EEZ of the Hawaiian Islands, and 2) the American Samoa Stock, which include animals inhabiting the EEZ waters around American Samoa (this report).

POPULATION SIZE

No abundance estimates are currently available for rough-toothed dolphins in U.S. EEZ waters of American Samoa; however, density estimates for rough-toothed dolphins in other tropical Pacific regions can provide a range of likely abundance estimates in this unsurveyed region. Published estimates of rough-toothed dolphins (animals per km^2) in the Pacific are: 0.0035 (CV=0.45) for the U.S. EEZ of the Hawaiian Islands (Barlow 2006); 0.0017 (CV=0.63) for nearshore waters surrounding the main Hawaiian Islands (Mobley et al. 2000), 0.0076 (CV=0.32) and 0.0017 (CV=0.16) for the eastern tropical Pacific Ocean (Wade and Gerrodette 1993; Ferguson and Barlow 2003). Applying the lowest and highest of these density estimates to U.S. EEZ waters surrounding American Samoa (area size = 404,578 km^2) yields a range of plausible abundance estimates of 692 – 3,115 rough-toothed dolphins.

Minimum Population Estimate

No minimum population estimate is currently available for waters surrounding American Samoa, but the rough-toothed dolphin density estimates from other tropical Pacific regions (Barlow 2003, Mobley et al. 2000, Wade and Gerrodette 1993, Ferguson and Barlow 2003, see above) can provide a range of likely values. The lognormal 20th percentiles of plausible abundance estimates for the American Samoa EEZ, based on the densities observed elsewhere, range from 426 – 2,731 rough-toothed dolphins.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

No PBR can presently be calculated for rough-toothed dolphins within the American Samoa EEZ, but based on the range of plausible minimum abundance estimates (426 – 2,731), a recovery factor of 0.40 (for a species of unknown status with a fishery mortality and serious injury rate CV > 0.50 within the American Samoa EEZ; Wade and Angliss 1997), and the default growth rate (½ of 4%), the PBR would likely fall between 3.4 and 22 rough-toothed dolphins per year.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Information on fishery-related mortality of cetaceans in Hawaiian waters is limited, but the gear types used in American Samoan fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Gillnets appear to capture marine mammals wherever they are used, and float lines from lobster traps and longlines can be expected to occasionally entangle whales (Perrin et al. 1994). The primary fishery in American Samoa is the commercial pelagic longline fishery that targets tunas, which was introduced in 1995 (Levine and Allen 2009). In 2008, there were 28 federally permitted vessels within the longline fishery in American Samoa. The fishery has been monitored since March 2006 under a mandatory observer program, which records all interactions with protected species (Pacific Islands Regional Office 2009). One rough-toothed dolphin was seriously injured by the fishery in 2008 (Oleson 2009).

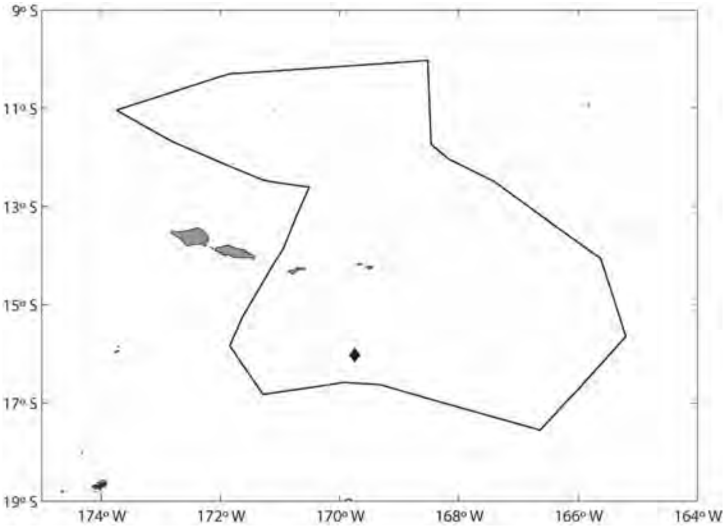

Figure 2. Locations of observed rough-toothed dolphin takes (filled diamonds) in the American Samoa longline fishery, 2006-2008. Solid lines represent the U.S. EEZ. Set locations in this fishery are summarized in Appendix 1.

Table 1. Summary of available information on incidental mortality and serious injury of rough-toothed dolphins (American Samoan stock) in commercial fisheries within the U.S. EEZ (Oleson 2009). Longline fishery take estimates represent only those trips with at least 10 sets/trip (Oleson 2009). Mean annual takes are based on 2006-2008 data unless otherwise indicated.

Fishery Name	Year	Data Type	Percent Observer Coverage	Observed and estimated mortality and serious injury of rough-toothed dolphins in the American Samoa EEZ		
				American Samoa EEZ		
				Obs.	Estimated (CV)	Mean Annual Takes (CV)
American Samoa-based longline fishery	2006 2007 2008	observer data	9.0% 7.7% 8.5%	0 0 1	0 (-) 0 (-) 10.9 (2.0)	3.6 (0.6)
Minimum total annual takes within U.S. EEZ waters						3.6 (0.6)

Prior to 1995, bottom fishing and trolling were the primary fisheries in American Samoa but they became less prominent after longlining was introduced (Levine and Allen 2009). Nearshore subsistence fisheries include spear fishing, rod and reel, collecting, gill netting, and throw netting (Craig 1993, Levine and Allen 2009). Information on fishery-related mortality of cetaceans in the nearshore fisheries is unknown, but the gear types used in American Samoan fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Gillnets appear to capture marine mammals wherever they are used. Although boat-based nearshore fisheries have been randomly monitored since 1991, by the American Samoa Department of Marine and Wildlife Sources (DMWR), no estimates of annual human-caused mortality and serious injury of cetaceans are available.

STATUS OF STOCK

The status of rough-toothed dolphins in American Samoan waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this species. It is not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The status of the American Samoan stock of rough-toothed dolphins under the 1994 amendments to the MMPA cannot be determined at this time because no abundance estimates are available and PBR cannot be calculated. However, the estimated rate of fisheries-related mortality or serious injury within the American Samoa EEZ (3.6 animals per year) is between the range of likely PBRs (3.4 – 22) for this region. Insufficient information is available to determine whether the total fishery mortality and serious injury for rough-toothed dolphins is insignificant and approaching zero mortality and serious injury rate.

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RISSO'S DOLPHIN (*Grampus griseus*): Hawaii Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Risso's dolphins are found in tropical to warm-temperate waters worldwide (Perrin et al. 2009). Risso's dolphins represent less than 1% of all odontocete sightings in leeward surveys of the main Hawaii Islands from 2000 to 2012 (Baird et al. 2013); however, six sightings were made during a 2002 survey and 12 during a 2010 survey of the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands (Barlow 2006, Bradford et al. 2013; Figure 1).

For the Marine Mammal Protection Act (MMPA) stock assessment reports, Risso's dolphins within the Pacific U.S. EEZ are divided into two discrete areas: 1) Hawaiian waters (this report), and 2) waters off California, Oregon and Washington. The Hawaiian stock includes animals found both within the Hawaiian Islands EEZ and in adjacent high seas waters; however, because data on abundance, distribution, and human-caused impacts are largely lacking for high seas waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

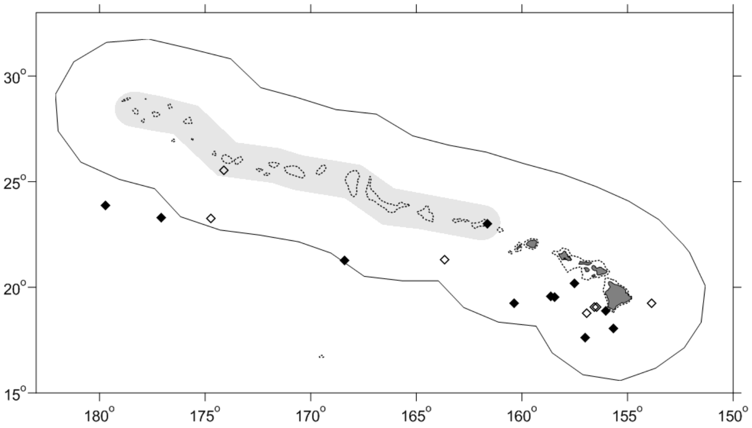

Figure 1. Risso's dolphin sighting locations during the 2002 (open diamonds) and 2010 (black diamonds) shipboard cetacean surveys of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006, Bradford et al. 2013; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ. Gray shading indicates area of Papahanaumokuakea Marine National Monument. Dotted line is the 1000m isobath.

POPULATION SIZE

Population estimates are available from Japan (Miyashita 1993), the eastern tropical Pacific (Wade and Gerrodette 1993), and the U.S. West Coast (Barlow and Forney 2007), but it is not known whether these animals are part of the same population that occurs around the Hawaiian Islands and in the central North Pacific. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 2,372 (CV=0.97) Risso's dolphins (Barlow 2006). The recent 2010 shipboard line-transect survey of the Hawaiian Islands EEZ resulted in an abundance estimate of 7,256 (CV=0.41) Risso's dolphins (Bradford et al. 2013). This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow et al. 1995) of the 2010 abundance estimate, or 5,207 Risso's dolphins within the Hawaiian Islands EEZ.

Current Population Trend

The broad and overlapping confidence intervals around the 2002 and 2010 estimates preclude assessment of trends with the available data.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate for Hawaiian animals.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Hawaii stock of Risso's dolphins is calculated as the minimum population size within the U.S. EEZ of the Hawaiian Islands (5,207) <u>times</u> one half the default maximum net growth rate for cetaceans (½ of 4%) <u>times</u> a recovery factor of 0.40 (for a stock of unknown status with a

Hawaiian Islands EEZ fishery mortality and serious injury rate CV greater than 0.80 ; Wade and Angliss 1997), resulting in a PBR of 42 Risso's dolphins per year.

HUMAN CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*". Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

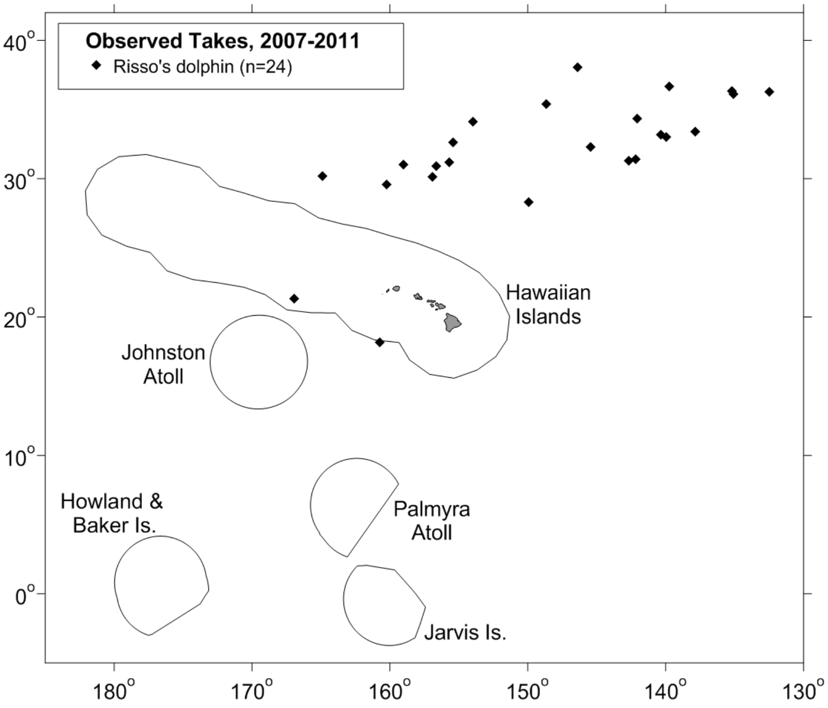

Figure 2. Locations of Risso's dolphin takes (filled diamonds) in Hawaii-based longline fisheries, 2007-2011. Solid lines represent the U.S. EEZs. Fishery descriptions are provided in Appendix 1.

Fishery Information

Table 1. Summary of available information on incidental mortality and serious injury of Risso's dolphin (Hawaii stock) in commercial longline fisheries, within and outside of U.S. EEZs (McCracken 2013). Mean annual takes are based on 2007-2011 data unless indicated otherwise. Information on all observed takes (T) and combined mortality events & serious injuries (MSI) is included. Total takes were prorated to deaths, serious injuries, and non-serious injuries based on the observed proportions of each outcome.

				Observed total interactions (T) and mortality events, and serious injuries (MSI), and total estimated mortality and serious injury (M&SI) of Risso's dolphins			
				Outside U.S. EEZs		**Hawaiian EEZ**	
Fishery Name	**Year**	**Data Type**	**Percent Observer Coverage**	**Obs. T/MSI**	**Estimated M&SI (CV)**	**Obs. T/MSI**	**Estimated M&SI (CV)**
Hawaii-based deep-set longline fishery	2007	Observer data	20%	1/1	3 (1.4)	0	0 (-)
	2008		22%	1/1	2 (1.5)	0	0 (-)
	2009		21%	0	0 (-)	0	0 (-)
	2010		21%	0	0 (-)	1/1	3 (0.7)
	2011		20%	0	0 (-)	0	0 (-)
Mean Estimated Annual Take (CV)					**0.9 (1.5)**		**0.6 (2.0)**
Hawaii-based shallow-set longline fishery	2007	Observer data	100%	3/3	3	0	0
	2008		100%	4/4	4	0	0
	2009		100%	3/2	2	0	0
	2010		100%	7/6	6	0	0
	2011		100%	4/3	3	0	0
Mean Annual Takes (100% coverage)					**3.6**		**0**
Minimum total annual takes within U.S. EEZ							**0.6 (2.0)**

Information on fishery-related mortality and serious injury of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. No interactions between nearshore fisheries and Risso's dolphins have been reported in Hawaiian waters. No estimates of human-caused mortality or serious injury are currently available for nearshore hook and line fisheries because these fisheries are not observed or monitored for protected species bycatch.

There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2007 and 2011, 21 Risso's dolphins were observed killed or seriously injured in the SSLL fishery (100% observer coverage), and 3 Risso's dolphins were observed killed or seriously injured in the DSLL fishery (20-22% observer coverage) (Bradford & Forney 2013, McCracken 2013). One Risso's dolphin in the DSLL fishery and two in the SSLL fishery were killed, 16 in the SSLL fishery and two in the DSLL fishery were considered to have been seriously injured, and the remaining three interactions in the SSLL fishery were determined to be not seriously injured (Bradford & Forney 2013) based on evaluation of the observer's description of the interaction and following the most recently developed criteria for assessing serious injury in marine mammals (NMFS 2012). Average 5-yr estimates of annual mortality and serious injury for 2007-2011are 4.5 (CV = 1.5) Risso's dolphins outside of U.S. EEZs, and 0.6 (CV = 2.0) within the Hawaiian Islands EEZ (Table 1, McCracken 2013). Eight additional unidentified cetaceans were taken in the DSLL fishery, and two unidentified cetaceans were taken in the SSLL fishery, some of which may have been Risso's dolphins.

STATUS OF STOCK

The Hawaii stock of Risso's dolphins is not considered strategic under the 1994 amendments to the MMPA. The status of Risso's dolphins in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this stock. Risso's dolphins are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor designated as "depleted" under the MMPA. The estimated rate of fisheries related mortality or serious injury within the Hawaiian Islands EEZ (0.6 animals per year) is less than the PBR (42).The total fishery mortality and serious injury can be considered to be insignificant and approaching zero because mortality and serious injury is less than 10% of PBR.

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Revised 6/4/2014

COMMON BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*): Hawaiian Islands Stock Complex- Kauai/Niihau, Oahu, 4-Islands, Hawaii Island, Hawaii Pelagic

STOCK DEFINITION AND GEOGRAPHIC RANGE

Common bottlenose dolphins are widely distributed throughout the world in tropical and warm-temperate waters (Perrin et al. 2009). The species is primarily coastal in much of its range, but there are populations in some offshore deepwater areas as well. Bottlenose dolphins are common throughout the Hawaiian Islands, from the island of Hawaii to Kure Atoll (Shallenberger 1981, Baird et al 2013). Summer/fall shipboard surveys of the waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands resulted in 18 sightings in 2002 and 20 sightings in 2010 (Barlow 2006, Bradford et al. 2013; Figure 1). In the Hawaiian Islands, bottlenose dolphins are found in shallow inshore waters and deep water (Baird et al. 2009).

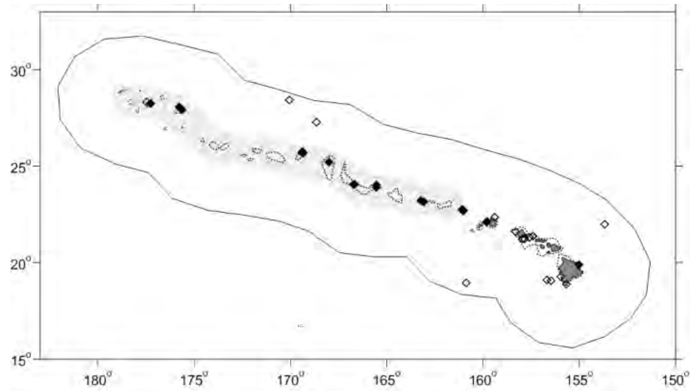

Figure 1. Bottlenose dolphin sighting locations during the 2002 (open diamonds) and 2010 (black diamonds) shipboard cetacean surveys of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006, Bradford et al. 2013; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ. Gray shading indicates area of Papahanaumokuakea Marine National Monument. Dotted line represents the 1000m isobath. Insular stock boundaries are shown in Figure 2.

Separate offshore and coastal forms of bottlenose dolphins have been identified along continental coasts (Ross and Cockcroft 1990; Van Waerebeek et al. 1990), and there is evidence that similar onshore-offshore forms may exist in Hawaiian waters. In their analysis of sightings of bottlenose dolphins in the eastern tropical Pacific (ETP), Scott and Chivers (1990) noted a large hiatus between the westernmost sightings and the Hawaiian Islands. These data suggest that bottlenose dolphins in Hawaiian waters belong to a separate stock from those in the ETP. Furthermore, recent photo-identification and genetic studies off Oahu, Maui, Lanai, Kauai, Niihau, and Hawaii suggest limited movement of bottlenose dolphins between islands and offshore waters (Baird et al. 2009; Martien et al. 2012). These data suggest the existence of demographically distinct resident populations at each of the four main Hawaiian Island groups – Kauai & Niihau, Oahu, the '4-island' region (Molokai, Lanai, Maui, Kahoolawe), and Hawaii. Genetic data support inclusion of bottlenose dolphins in deeper waters surrounding the main Hawaiian Islands as part of the broadly distributed pelagic population (Martien et al 2012).

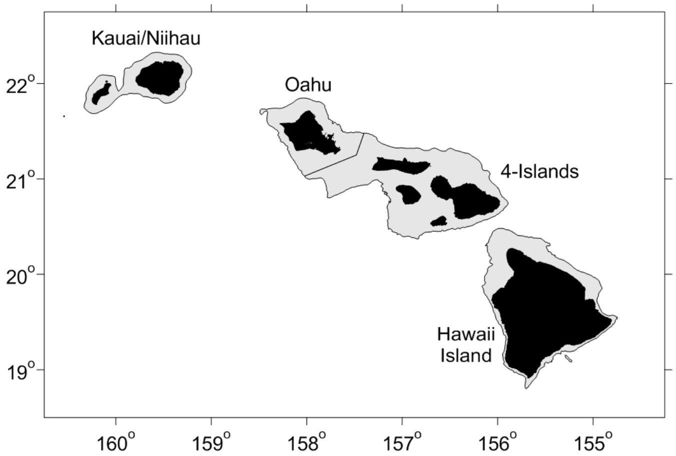

Figure 2. Main Hawaiian Islands insular bottlenose dolphin stock boundaries (gray shading). Areas beyond the 1000 m isobath represent the pelagic stock range.

Over 99% of the bottlenose dolphins linked through photo-identification to one of the insular populations around the main Hawaiian Islands (Baird et al. 2009) have been documented in waters of 1000 m or less (Martien & Baird 2009). Based on these data, Martien & Baird (2009) suggested that the boundaries between the insular stocks and the Hawaii Pelagic stock be placed along the 1000 m isobath. Since that isobath does not separate Oahu from the 4-Islands Region, the boundary between those stocks runs approximately equidistant between the 500 m isobaths around Oahu and the 4-

Islands Region, through the middle of Kaiwi Channel. These boundaries (Figure 2) are applied in this report to recognize separate insular and pelagic bottlenose dolphin stocks for management (NMFS 2005). These boundaries may be revised in the future as additional information becomes available. To date, no data are available regarding population structure of bottlenose dolphins in the Northwestern Hawaiian Islands (NWHI), though sightings during the 2010 survey indicate they are commonly found close to the islands and atolls there (Bradford et al 2013). Given the evidence of island resident populations in the main Hawaiian Islands, the larger distances between islands in the NWHI, and the finding of population structure within the NWHI in other dolphin species (Andrews 2010), it is likely that additional demographically independent populations of bottlenose dolphins exist in the NWHI. However, until data become available upon which to base stock designations in this area, the NWHI will remain part of the Hawaii Pelagic Stock. For the Marine Mammal Protection Act (MMPA) Pacific stock assessment reports, bottlenose dolphins within the Pacific U.S. EEZ are divided into seven stocks: 1) California, Oregon and Washington offshore stock, 2) California coastal stock, and five Pacific Islands Region management stocks (this report): 3) Kauai/Niihau, 4) Oahu, 5) 4-Islands (Molokai, Lanai, Maui, Kahoolawe), 6) Hawaii Island and 7) the Hawaiian Pelagic Stock, including animals found both within the Hawaiian Islands EEZ and in adjacent high seas waters. Because data on abundance, distribution, and human-caused impacts are largely lacking for high seas waters, the status of the Hawaii pelagic stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005). Estimates of abundance, potential biological removals, and status determinations for the five Hawaiian stocks are presented separately below.

HUMAN CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen *et al*. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*". Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fishery Information

Information on fishery-related mortality of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaii fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. There are at least two reports of entangled bottlenose dolphins drowning in gillnets off Maui (Nitta and Henderson, 1993, Maldini 2003, Bradford & Lyman 2013). Although gillnet fisheries are not observed or monitored through any State or Federal program, State regulations now ban gillnetting around Maui and much of Oahu and require gillnet fishermen to monitor their nets for bycatch every 30 minutes in those areas where gillnetting is permitted. In 2009, one bottlenose dolphin, known to frequent aquaculture pens off the Kona Coast of the island of Hawaii, was seen with a hook and line

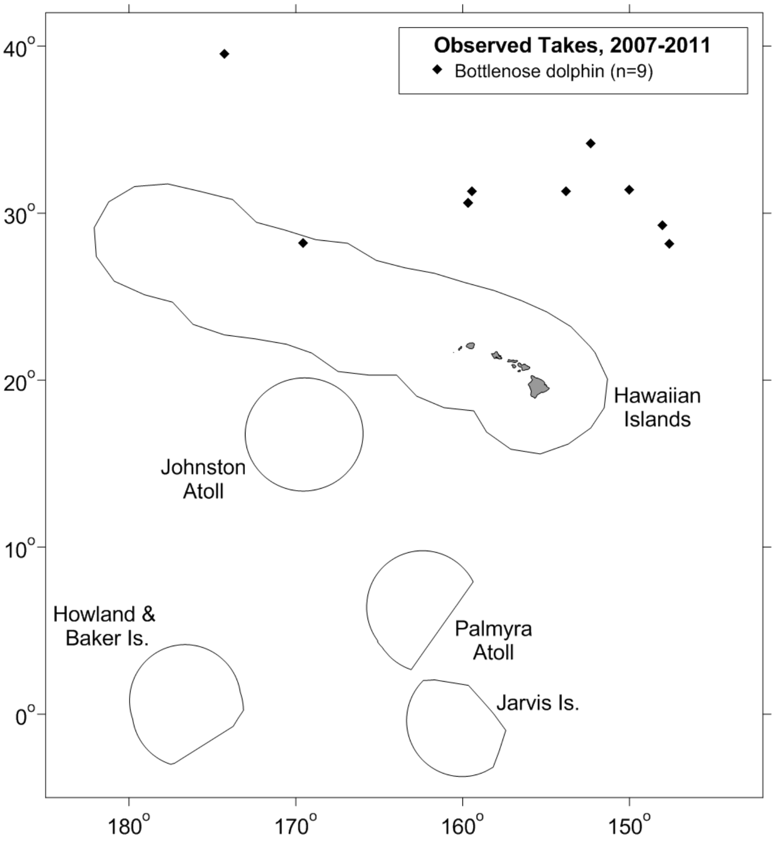

Figure 3. Locations of observed Pelagic Stock bottlenose dolphin takes (filled diamonds) in the Hawaii-based longline fishery, 2007-2011. Solid lines represent the U. S. EEZ. Fishery descriptions are provided in Appendix 1.

trailing out of its mouth (Bradford & Lyman 2013). Based on the description and photographs, this injury was considered serious under the most recently developed criteria for assessing serious injury in marine mammals (NMFS 2012). The animal was resighted in February 2012 without the fish hook and in normal body condition, such that this injury is no longer considered serious. The responsible fishery is not known. No estimates of human-caused mortality or serious injury are currently available for nearshore hook and line or gillnet fisheries because these fisheries are not observed or monitored for protected species bycatch.

Bottlenose dolphins are one of the species commonly reported to steal bait and catch from several Hawaii sport and commercial fisheries (Nitta and Henderson 1993; Schlais 1984). Observations of bottlenose dolphins stealing bait or catch have been made in the day handline fishery (palu-ahi) for tuna, the night handline fishery for tuna (ika-shibi), the handline fishery for mackerel scad, the troll fishery for billfish and tuna, and the inshore set gillnet fishery (Nitta and Henderson 1993). Nitta and Henderson (1993) indicated that bottlenose dolphins remove bait and catch from handlines used to catch bottomfish off the island of Hawaii and Kaula Rock and formerly on several banks of the Northwestern Hawaiian Islands. Fishermen claim interactions with dolphins that steal bait and catch are increasing, including anecdotal reports of bottlenose dolphins getting “snagged” (Rizzuto 2007). Interaction rates between dolphins and the NWHI bottomfish fishery were estimated based on studies conducted in 1990-1993, indicating that an average of 2.67 dolphin interactions, defined as incidence of dolphins removing bait or catch from hooks, occurred for every 1000 fish brought on board (Kobayashi and Kawamoto 1995) These interactions generally involved bottlenose dolphins and it is not known whether these interactions result in serious injury or mortality of dolphins. This fishery was observed from 2003 through 2005 at 18-25% coverage, during which time, no incidental takes of cetaceans were reported. The bottomfish fishery is no longer permitted for the Northwestern Hawaiian Islands.

Table 1. Summary of available information on incidental mortality and serious injury of bottlenose dolphins (Hawaii Pelagic stock) in commercial longline fisheries, within and outside of the U.S. EEZs (McCracken 2013). Mean annual takes are based on 2007-2011 data unless otherwise indicated; n/a = not available. Information on all observed takes (T) and combined mortality events & serious injuries (MSI) is included. Total takes were prorated to deaths, serious injuries, and non-serious injuries based on the observed proportions of each outcome.

Fishery Name	Year	Data Type	Percent Observer Coverage	Observed total interactions (T) and mortality events, and serious injuries (MSI), and total estimated mortality and serious injury (M&SI) of Hawaii Pelagic stock bottlenose dolphins			
				Outside U.S. EEZs		Hawaiian EEZ	
				Obs. T/MSI	Estimated M&SI (CV)	Obs. T/MSI	Estimated M&SI (CV)
Hawaii-based deep-set longline fishery	2007	Observer data	20%	0	0 (-)	0	0 (-)
	2008		22%	0	0 (-)	0	0 (-)
	2009		21%	1/1	5 (0.5)	0	0 (-)
	2010		21%	1/1	4 ().6)	0	0 (-)
	2011		20%	0	0 (-)	0	0 (-)
Mean Estimated Annual Take (CV)					**1.9 (0.6)**		**0 (-)**
Hawaii-based shallow-set longline fishery	2007	Observer data	100%	3/3	3	1/1	1
	2008		100%	0	0	0	0
	2009		100%	0	0	0	0
	2010		100%	2/2	2	0	0
	2011		100%	2/1	1	0	0
Mean Annual Takes (100% coverage)					**1.2**		**0.2**
Minimum total annual takes within U.S. EEZ							**0.2 (-)**

There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2007 and 2011, seven bottlenose dolphins were observed hooked or entangled in the SSLL fishery (100% observer coverage), and two bottlenose dolphins were observed taken in the DSLL fishery (20-22% observer coverage) (Bradford & Forney 2013, McCracken 2013). Based on the locations, these takes are all considered to have been from the Pelagic Stock of bottlenose dolphins. Eight of the nine dolphins were considered to have been seriously injured (Bradford & Forney 2013), based on an evaluation of the observer’s description of the interaction and following the most recently developed criteria for assessing serious injury in marine mammals (NMFS 2012). Average 5-yr estimates of annual mortality and serious injury for the Pelagic Stock during 2007-2011 are 3.1 (CV = 0.6) bottlenose dolphins outside of U.S. EEZs, and 0.2 (CV = 0) within the Hawaiian Islands EEZ (Table 1, McCracken 2013). Eight unidentified cetaceans were taken in the DSLL fishery, and two unidentified cetaceans were taken in the SSLL fishery, some of which may have been bottlenose dolphins.

KAUAI/NIIHAU STOCK

POPULATION SIZE

A photo-identification study conducted from 2003 to 2005 identified 102 individual bottlenose dolphins around Kauai and Niihau (Baird et al. 2009). A Lincoln-Peterson mark-recapture analysis of the photo-identification data resulted in an abundance estimate of 147 (CV=0.11), or 184 animals when corrected for the proportion of marked individuals (Baird et al. 2009). The CV of this estimate is likely negatively-biased, as it does not account for variation in the proportion of marked animals within groups.

Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow et al 1995) of the Baird et al. (2009) mark-recapture estimate, or 168 bottlenose dolphins. This is greater than the number of distinct individuals (102) identified during the photo-identification study.

Current Population Trend

Only one abundance estimate is available for this stock, such that there is insufficient information to assess population trends.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate for this species in Hawaiian waters.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (168) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a stock of unknown status with no reported fishery mortality or serious injury within the Kauai/Niihau stock range; Wade and Angliss 1997), resulting in a PBR of 1.7 bottlenose dolphins per year.

STATUS OF STOCK

The Kauai/Niihau Stock of bottlenose dolphins is not considered strategic under the 1994 amendments to the MMPA. The status of bottlenose dolphins in the Kauai/Niihau stock relative to OSP is unknown, and there are insufficient data to evaluate abundance trends. No habitat issues are known to be of concern for this stock. Bottlenose dolphins are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor designated as "depleted" under the MMPA. There have been no reports of recent mortality or serious injuries; however, there is no systematic monitoring for interactions with protected species within near-shore fisheries that may take this species, thus mean annual takes are undetermined. Insufficient information is available to determine whether the total fishery mortality and serious injury for bottlenose dolphins is insignificant and approaching zero mortality and serious injury rate.

OAHU STOCK

POPULATION SIZE

A photo-identification study conducted in 2002, 2003 and 2006 identified 67 individual bottlenose dolphins around Oahu (Baird et al. 2009). A Lincoln-Peterson mark-recapture analysis of the photo-identification data resulted in an abundance estimate of 594 (CV=0.54), or 743 animals when corrected for the proportion of marked individuals (Baird et al. 2009). The estimate does not include individuals from the Northeastern (windward) side of the island.

Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow et al 1995) of the Baird et al. (2009) mark-recapture estimate, or 485. This is substantially greater than the number of distinct individuals (67) identified during the photo-identification study.

Current Population Trend

Only one abundance estimate is available for this stock, such that there is insufficient information to assess population trends.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate for this species in Hawaiian waters.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Oahu stock is calculated as the minimum population size (485) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a stock of unknown status with no reported fishery mortality in the Oahu stock range; Wade and Angliss 1997), resulting in a PBR of 4.9 bottlenose dolphins per year.

STATUS OF STOCK

The Oahu stock of bottlenose dolphins is not considered strategic under the 1994 amendments to the MMPA. The status of bottlenose dolphins in Oahu waters relative to OSP is unknown, and there are insufficient data to evaluate abundance trends. No habitat issues are known to be of concern for this stock. Bottlenose dolphins are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor designated as "depleted" under the MMPA. There have been no reports of recent mortality or serious injuries; however, there is no systematic monitoring for interactions with protected species within near-shore fisheries that may take this species, thus mean annual takes are undetermined. Insufficient information is available to determine whether the total fishery mortality and serious injury for bottlenose dolphins is insignificant and approaching zero mortality and serious injury rate.

4-ISLANDS STOCK

POPULATION SIZE

A photo-identification study conducted from 2000-2006 identified 98 individual bottlenose dolphins around Maui and Lanai (Baird et al. 2009). A Lincoln-Peterson mark-recapture analysis of the photo-identification data resulted in an abundance estimate of 153 (CV=0.24), or 191 animals when corrected for the proportion of marked individuals (Baird et al. 2009). This abundance estimate likely underestimates the total number of bottlenose dolphins in the 4-islands region because it does not include individuals from the Northeastern (windward) sides of Maui and Molokai. The CV of this estimate is likely negatively-biased, as it does not account for variation in the proportion of marked animals within groups.

Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow et al 1995) of the Baird et al. (2009) mark-recapture estimate, or 156 bottlenose dolphins. This is greater than the number of distinct individuals (98) identified during the photo-identification study.

Current Population Trend

Only one abundance estimate is available for this stock, such that there is insufficient information to assess population trends.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate for this species in Hawaiian waters.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the 4-Islands stock is calculated as the minimum population size (156) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a stock of unknown status with no reported fishery mortality in the 4-Islands stock area; Wade and Angliss 1997), resulting in a PBR of 1.6 bottlenose dolphins per year.

STATUS OF STOCK

The 4-Islands Region Stock of bottlenose dolphins is not considered strategic under the 1994 amendments to the MMPA. The status of bottlenose dolphins in 4-Islands waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this stock. Bottlenose dolphins are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. There have been no reports of recent mortality or serious injuries of this stock; however, there is no systematic monitoring for interactions with protected species within near-shore fisheries that may take this species, thus mean annual takes are undetermined. Insufficient information is available to determine whether the total fishery mortality and serious injury for bottlenose dolphins is insignificant and approaching zero mortality and serious injury rate.

HAWAII ISLAND STOCK

POPULATION SIZE

A photo-identification study conducted from 2000-2006 identified 69 individual bottlenose dolphins around the island of Hawaii (Baird et al. 2009). A Lincoln-Peterson mark-recapture analysis of the photo-identification data resulted in an abundance estimate of 102 (CV=0.13), or 128 animals when corrected for the proportion of marked individuals (Baird et al. 2009). This abundance estimate likely underestimates the total number of bottlenose dolphins around the island of Hawaii because it does not include individuals from the Northeastern (windward) side of the island. The CV of this estimate is likely negatively-biased, as it does not account for variation in the proportion of marked animals within groups.

Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow et al 1995) of the Baird et al. (2009) mark-recapture estimate, or 115 bottlenose dolphins. This is greater than the number of distinct individuals (69) identified during the photo-identification study.

Current Population Trend

Only one abundance estimate is available for this stock, such that there is insufficient information to assess population trends.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate for this species in Hawaiian waters.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Hawaii Island stock is calculated as the minimum population size (115) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a stock of unknown status with no reported fishery mortality in the Hawaii Islands stock area; Wade and Angliss 1997), resulting in a PBR of 1.1 bottlenose dolphins per year.

STATUS OF STOCK

The Hawaii Island Stock of bottlenose dolphins is not considered strategic under the 1994 amendments to the MMPA. The status of bottlenose dolphins in waters around Hawaii Island relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Hawaii Island bottlenose dolphins are regularly seen near aquaculture pens off the Kona coast, and aquaculture workers have been observed feeding bottlenose dolphins. Bottlenose dolphins in this region are also known to interact with divers. Bottlenose dolphins are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor designated as "depleted" under the MMPA. There have been no reports of recent mortality or serious injuries; however, there is no systematic monitoring of takes in near-shore fisheries that may take this species, thus mean annual takes are undetermined. Insufficient information is available to determine whether the total fishery mortality and serious injury for bottlenose dolphins is insignificant and approaching zero mortality and serious injury rate.

HAWAII PELAGIC STOCK

POPULATION SIZE

Population estimates have been made in Japanese waters (Miyashita 1993), but it is not known whether these animals are part of the same population that occurs around the Hawaiian Islands. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 3,215 (CV= 0.59) bottlenose dolphins (Barlow 2006), equivalent to a density of 1.31 individuals per 1000 km^2. Applying this density to the area of the Pelagic Stock between the 1000m isobath and the Hawaiian Islands EEZ boundary (see Figures 1-2), the stock-specific abundance for 2002 was estimated as 3,178 (CV=0.59). The recent 2010 shipboard line-transect survey of the Hawaiian Islands EEZ resulted in an abundance estimate of 5,950 (CV = 0.59) bottlenose dolphins within the pelagic stock area (Bradford et al 2013). This is currently the best available abundance estimate for the Hawaii Pelagic stock.

Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow et al 1995) of the 2010 line-transect abundance estimate for the Hawaii Pelagic Stock, or 3,755 bottlenose dolphins.

Current Population Trend

The broad and overlapping confidence intervals around the 2002 and 2010 estimates preclude assessment of population trends with the available data.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate for this species in Hawaiian waters.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size within the U.S EEZ of the Hawaiian Islands (3,755) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.5 (for a stock of unknown status with a Hawaiian Islands EEZ fishery mortality and serious injury rate CV of 0; Wade and Angliss 1997), resulting in a PBR of 38 bottlenose dolphin per year.

STATUS OF STOCK

The Hawaii Pelagic Stock of bottlenose dolphins is not considered strategic under the 1994 amendments to the MMPA. The status of bottlenose dolphins in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this stock. It is not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor designated as "depleted" under the MMPA. The estimated rate of fisheries-related mortality or serious injury within the Hawaiian Islands EEZ (0.2 animals per year) is less than the PBR (38). The total fishery mortality and serious injury for Hawaii pelagic bottlenose dolphins is insignificant and approaching zero mortality and serious injury rate.

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Revised 6/4/2014

PANTROPICAL SPOTTED DOLPHIN (*Stenella attenuata attenuata*): Hawaiian Islands Stock Complex – Oahu, 4-Islands, Hawaii Island, and Hawaii Pelagic Stocks

STOCK DEFINITION AND GEOGRAPHIC RANGE

Pantropical spotted dolphins are primarily found in tropical and subtropical waters worldwide (Perrin et al. 2009). Much of what is known about the species in the North Pacific has been learned from specimens obtained in the large directed fishery in Japan and in the eastern tropical Pacific (ETP) tuna purse-seine fishery (Perrin et al. 2009). Spotted dolphins are common and abundant throughout the Hawaiian archipelago, including nearshore where they are the second most frequently sighted species during nearshore surveys (Baird et al. 2013). Summer/fall shipboard surveys of the waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands resulted in 14 sightings in 2002 and 49 sightings in 2010 (Barlow 2006, Bradford et al. 2013; Figure 1). Fourteen strandings of this species have been documented in Hawaii since 1975 (Nitta 1991, Maldini et al. 2005, NMFS PIR Marine Mammal Response Network database), including two since 2007. Morphological differences and distribution patterns indicate that the spotted dolphins around the Hawaiian Islands belong to a stock that is distinct from those in the ETP (Perrin 1975; Dizon et al. 1994; Perrin et al. 1994b). Their possible affinities with other stocks elsewhere in the Pacific have not been investigated.

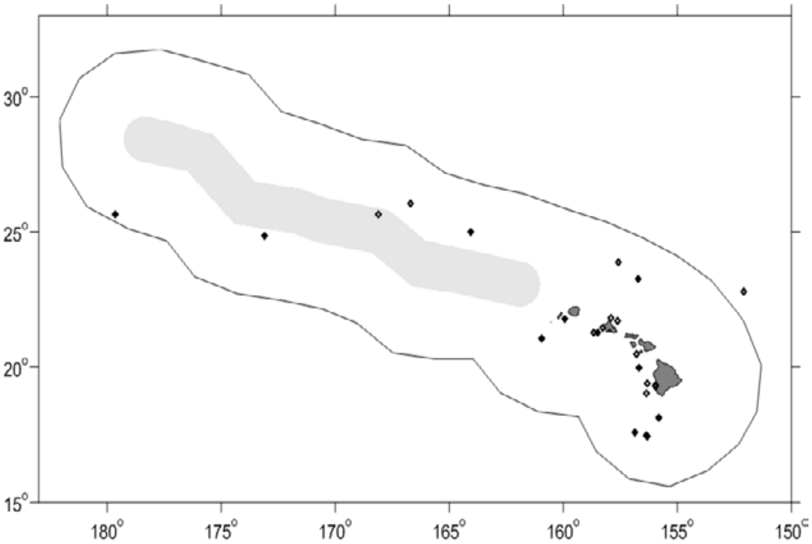

Figure 1. Pantropical spotted dolphin sighting locations during the 2002 (open diamonds) and 2010 (black diamonds) shipboard surveys of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006, Bradford et al. 2013; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ. Gray shading indicates area of Papahanaumokuakea Marine National Monument. Dotted line represents the 1000m isobath. Insular stock boundaries are shown in Figure 2.

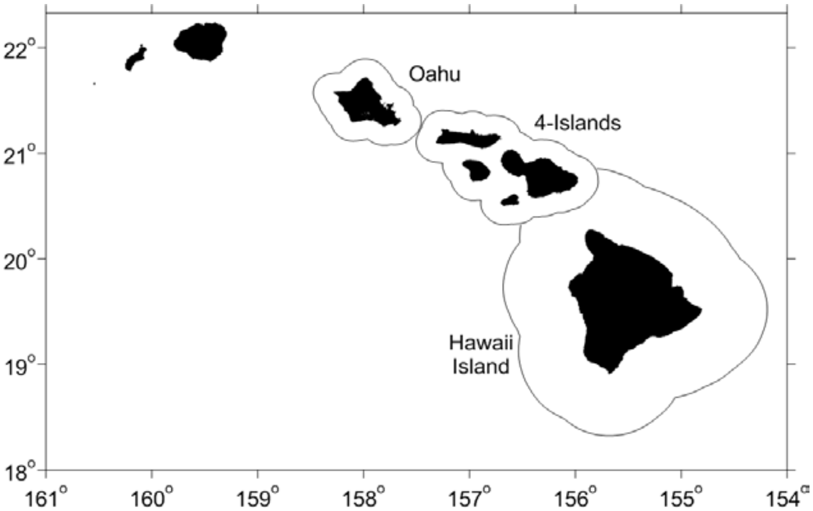

Figure 2. Main Hawaiian Islands insular spotted dolphin stock boundaries (gray lines). Oahu and 4-Islands stocks extend 20km from shore. Hawaii Island stock extends to 65km from shore based on distance of furthest encounter.

Pantropical spotted dolphins have been observed in all months of the year around the main Hawaiian Islands, and in areas ranging from shallow near-shore water to depths of 5,000 m, although they peak in sighting rates in depths from 1,500 to 3,500 m (Baird et al. 2013). Although they represent from 22.9 to 26.5% of the odontocete sightings from Oahu, the 4-islands, and Hawaii Island, they are largely absent from the nearshore waters around Kauai and Niihau, representing only 3.9% of sightings in that area (Baird et al. 2013). Genetic analyses of 176 unique samples of pantropical spotted dolphins collected during near-shore surveys off each of the main Hawaiian Islands from 2002 to 2003, and near Hawaii Island from 2005 through 2008 suggest three island-associated stocks are evident (Courbis 2011). The results of the Courbis (2011) study indicate that pantropical spotted dolphins in Hawaii's nearshore waters have low haplotypic diversity with haplotypes unique to each of the island areas. Courbis (2011) conducted extensive tests on the relatedness of individuals among islands using the microsatellite dataset and found significant differences in haplotype frequencies between islands, suggesting genetic differentiation in spotted dolphins among islands. Genetic differentiation is supported by the results of assignments tests, which indicate support for 3 island-associated populations: Hawaii Island, the 4-Islands region, and Oahu. Samples from Kauai and Niihau did not cluster together, but instead were spread among the Hawaii and Oahu clusters. Analysis of migration rate further support the separation of pantropical spotted dolphins into three island-associated stocks, with migration between regions on the order of a few individuals per generation. Based on an overview of all available information on pantropical spotted dolphins in Hawaiian waters, and NMFS guidelines for assessing marine mammal stocks (NMFS 2005), Oleson et al. (2013) proposed designation of three new island associated stocks in Hawaiian waters, as well as recognition of a fourth broadly distributed spotted dolphin stock, given the frequency of sightings in pelagic waters. Fishery interactions with pantropical spotted dolphins and sightings near Palmyra and Johnston Atolls (NMFS PIR unpublished data) demonstrate that this species also occurs in U.S. EEZ waters there, but it is not known whether these animals are part of the Hawaiian population or are a separate stock(s) of pantropical spotted dolphins.

For the Marine Mammal Protection Act (MMPA) stock assessment reports, there are four Pacific management stocks within the Hawaiian Islands EEZ (Oleson et al. 2013): 1) the Oahu stock, which includes spotted dolphins within 20km of Oahu, 2) the 4-Island stock, which includes spotted dolphins within 20 km of Maui, Molokai, Lanai, and Kahoolawe collectively, 3) the Hawaii Island stock, which includes spotted dolphins found within 65km from Hawaii Island, and 4) the Hawaii pelagic stock, which includes spotted dolphins inhabiting the waters throughout the Hawaiian Islands EEZ, outside of the insular stock areas, but including adjacent high seas waters. Because data on abundance, distribution, and human-caused impacts are largely lacking for high seas waters, the status of the Hawaii pelagic stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005). Spotted dolphins involved in eastern tropical Pacific tuna purse-seine fisheries are managed separately under the MMPA.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NMFS 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*". Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fishery Information

Information on fishery-related mortality of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Entanglement in gillnets and hooking or entanglement in various hook and line fisheries have been reported for small cetaceans in Hawaii

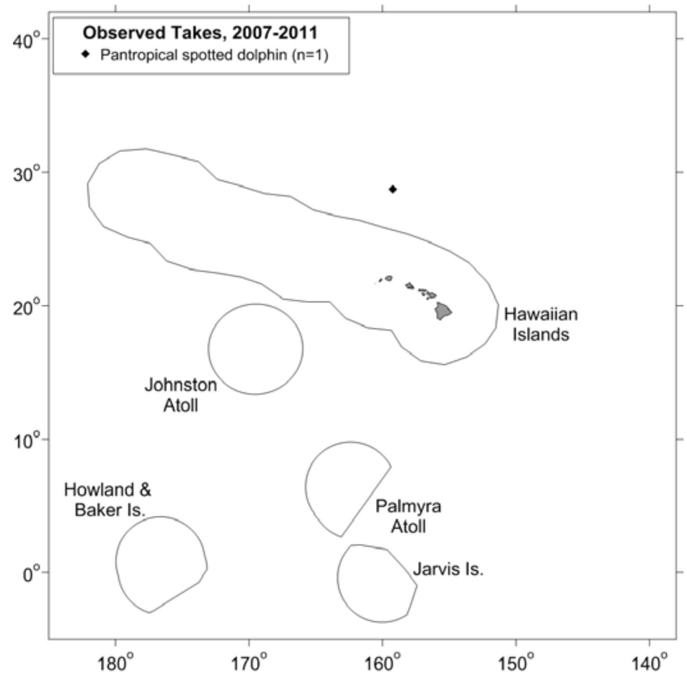

Figure 3. Locations of observed spotted dolphin takes (filled diamonds) in the Hawaii deep-set longline fishery, 2007-2011. Solid lines represent the U.S. EEZ. Set locations in this fishery are summarized in Appendix 1.

(Nitta & Henderson, 1993). No estimates of human-caused mortality or serious injury are currently available for nearshore hook and line or gillnet fisheries because these fisheries are not observed or monitored for protected species bycatch. Commercial and recreational troll fisherman have been observed “fishing” dolphins off the islands of Hawaii, Lanai, and Oahu, including spotted dolphins, in order to catch tuna associated with the animals (Courbis et al. 2009, Rizzuto, 2007, Shallenberger 1981). Anecdotal reports from fisherman indicate that spotted dolphins are sometimes hooked (Rizzuto 1997) and photographs of dolphins suggest animals may be injured by both lines and propeller strikes (Baird unpublished data). In 2010 a spotted dolphin (4-Islands stock) was observed entangled in fishing line off Lanai. There were several wraps of line around the body and peduncle and a constricting wrap around the dorsal fin (Bradford & Lyman 2013). Based on the information provided, this entanglement is considered a serious injury under the most recently developed criteria for assessing serious injury in marine mammals (NMFS 2012). The responsible fishery is not known.

Table 1. Summary of available information on incidental mortality and serious injury of pantropical spotted dolphins (Hawaii pelagic stock) in commercial longline fisheries, within and outside of the U.S. EEZs (McCracken 2013). Mean annual takes are based on 2007-2011data unless otherwise indicated. Information on all observed takes (T) and combined mortality events & serious injuries (MSI) is included. Total takes were prorated to deaths, serious injuries, and non-serious injuries based on the observed proportions of each outcome.

Fishery Name	Year	Data Type	Percent Observer Coverage	Observed total interactions (T) and mortality events, and serious injuries (MSI), and total estimated mortality and serious injury (M&SI) of Hawaii pelagic pantropical spotted dolphins			
				Outside U.S. EEZs		**Hawaiian EEZ**	
				Obs. T/MSI	**Estimated M&SI (CV)**	**Obs. T/MSI**	**Estimated M&SI (CV)**
Hawaii-based deep-set longline fishery	2007	Observer data	20%	0	0 (-)	0	0 (-)
	2008		22%	1/1	3 (0.5)	0	0 (-)
	2009		21%	0	0 (-)	0	0 (-)
	2010		21%	0	0 (-)	0	0 (-)
	2011		20%	0	0 (-)	0	0 (-)
Mean Estimated Annual Take (CV)					**0.6 (1.1)**		**0 (-)**
Hawaii-based shallow-set longline fishery	2007	Observer data	100%	0	0	0	0
	2008		100%	0	0	0	0
	2009		100%	0	0	0	0
	2010		100%	0	0	0	0
	2011		100%	0	0	0	0
Mean Annual Takes (100% coverage)					**0**		**0**
Minimum total annual takes within U.S. EEZ							**0 (-)**

There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2007 and 2011, no pantropical spotted dolphin were observed hooked or entangled in the SSLL fishery (100% observer coverage), and one pantropical spotted dolphin was observed incidentally killed in high seas waters in the DSLL fishery (20-22% observer coverage) (Bradford & Forney 2013, McCracken 2013) (Figure 3). Average 5-year estimates of annual mortality and serious injury for 2007-2011 are 0.6 (CV=1.1) spotted dolphins outside of U.S. EEZs, and none within the Hawaiian Islands EEZ (Table 1, McCracken 2013). Eight additional unidentified cetaceans were taken in the DSLL fishery, and two unidentified cetaceans were taken in the SSLL fishery, some of which may have been spotted dolphins.

OAHU STOCK

POPULATION SIZE

The population size of the Oahu stock of spotted dolphins has not been estimated.

Minimum Population Estimate

There is no information on which to base a minimum population estimate of the Oahu stock of spotted dolphins.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Oahu stock is calculated as the minimum population estimate times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no estimated fishery mortality or serious injury within the Oahu stock area; Wade and Angliss 1997). Because there is no minimum population estimate available the PBR for the Oahu stock of spotted dolphins is undetermined.

STATUS OF STOCK

The Oahu stock of spotted dolphins is not considered a strategic stock under the MMPA. The status of Oahu spotted dolphins relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance for this stock. Spotted dolphins are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor designated as "depleted" under the MMPA. There is no information with which to determine whether the total fishery mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate.

4-ISLANDS STOCK

POPULATION SIZE

The population size of 4-Islands stock of spotted dolphins has not been estimated.

Minimum Population Estimate

There is no information on which to base a minimum population estimate of the 4-Islands stock of spotted dolphins.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the 4-Islands stock is calculated as the minimum population estimate times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no estimated fishery mortality or serious injury within the 4-Islands stock area; Wade and Angliss 1997). Because there is no minimum population estimate available for this stock the PBR for 4-Islands stock of spotted dolphins is undetermined.

STATUS OF STOCK

The 4-Islands stock of spotted dolphins is not considered a strategic stock under the MMPA. The status of 4-Islands spotted dolphins relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance for this stock. Spotted dolphins are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor designated as "depleted" under the MMPA. Although one dolphin has been considered seriously injured due to an interaction with fishing gear, insufficient data are available to determine whether the total fishery mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate.

HAWAII ISLAND STOCK

POPULATION SIZE

The population size of the Hawaii Island stock of spotted dolphins has not been estimated. An extensive collection of identification photos from this population are available; however, a photo-identification catalog has not been developed. Such a catalog could serve as the basis for developing mark-recapture estimates, but no such analyses have yet been conducted.

Minimum Population Estimate

There is no information on which to base a minimum population estimate of the Hawaii Island stock of spotted dolphins.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Hawaii Island stock is calculated as the minimum population estimate times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no estimated fishery mortality or serious injury within the Hawaii Island stock area; Wade and Angliss 1997). Because there is no minimum population estimate available for this stock the PBR for Hawaii Island stock of spotted dolphins is undetermined.

STATUS OF STOCK

The Hawaii Island stock of spotted dolphins is not considered a strategic stock under the MMPA. The status of Hawaii Island spotted dolphins relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance for this stock. Spotted dolphins are not listed as “threatened” or “endangered” under the Endangered Species Act (1973), nor designated as “depleted” under the MMPA. There are insufficient data to determine whether the total fishery mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. One spotted dolphin found stranded on Hawaii Island has tested positive for *Morbillivirus* (Jacob 2012). Although *morbillivus* is known to trigger lethal disease in cetaceans (Van Bressem et al. 2009), its impact on the health of the stranded animal is not known (Jacob 2012). The presence of *morbillivirus* in 10 species of cetacean in Hawaiian waters (Jacob 2012) raises concerns about the history and prevalence of this disease in Hawaii and the potential population impacts on Hawaiian cetaceans.

HAWAII PELAGIC STOCK

POPULATION SIZE

Population estimates are available for Japanese waters (Miyashita 1993), but it is not known whether any of these animals are part of the same population that occurs around the Hawaiian Islands. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 8,978 (CV=0.48) pantropical spotted dolphins (Barlow 2006). The recent 2010 shipboard line-transect survey of the Hawaiian Islands EEZ resulted in an abundance estimate of 15,917 (CV=0.40) spotted dolphins within the pelagic stock area (Bradford et al. 2013). This is currently the best available abundance estimate for pantropical spotted dolphins within the Hawaiian Islands EEZ.

Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow et al. 1995) of the 2010 abundance estimate for the pelagic stock area or 11,508 pantropical spotted dolphins.

Current Population Trend

The broad and overlapping confidence intervals around the 2002 and 2010 abundance estimates preclude assessment of trend with the available data.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Hawaii pelagic pantropical spotted dolphin stock is calculated as the minimum population estimate within the U.S. EEZ of the Hawaiian Islands (11,508) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a stock of unknown status with no known fishery mortality within the U.S. EEZ of the Hawaiian Islands; Wade and Angliss 1997), resulting in a PBR of 115 pantropical spotted dolphins per year.

STATUS OF STOCK

The Hawaii pelagic stock of spotted dolphins is not considered strategic under the 1994 amendments to the MMPA. The status of Hawaii pelagic pantropical spotted dolphins relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this species. Pantropical spotted dolphins are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor designated as "depleted" under the MMPA. Given the absence of recent recorded fishery-related mortality or serious injuries within U.S. EEZs, the total fishery mortality and serious injury can be considered to be insignificant and approaching zero.

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Revised 07/15/2014

SPINNER DOLPHIN (*Stenella longirostris longirostris*): Hawaiian Islands Stock Complex- Hawaii Island, Oahu/4-islands, Kauai/Niihau, Pearl & Hermes Reef, Midway Atoll/Kure, Hawaii Pelagic

STOCK DEFINITION AND GEOGRAPHIC RANGE

Six morphotypes within four subspecies of spinner dolphins have been described worldwide in tropical and warm-temperate waters (Perrin et al. 2009). The Gray's (or pantropical) spinner dolphin (*Stenella longirostris longirostris*) is the most widely distributed subspecies and is found in the Atlantic, Indian, central and western Pacific Oceans (Perrin *et al.* 1991). Within the central and western Pacific, spinner dolphins are island-associated and use shallow protected bays to rest and socialize during the day then move offshore at night to feed (Norris and Dohl 1980; Norris *et al.* 1994). Summer/fall shipboard surveys of the waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands, resulted in 8 sightings in 2002 and 2 sightings in 2010,though none of the 2010 sightings occurred during on-effort survey (Barlow 2006, Bradford et al. 2013; Figure 1).

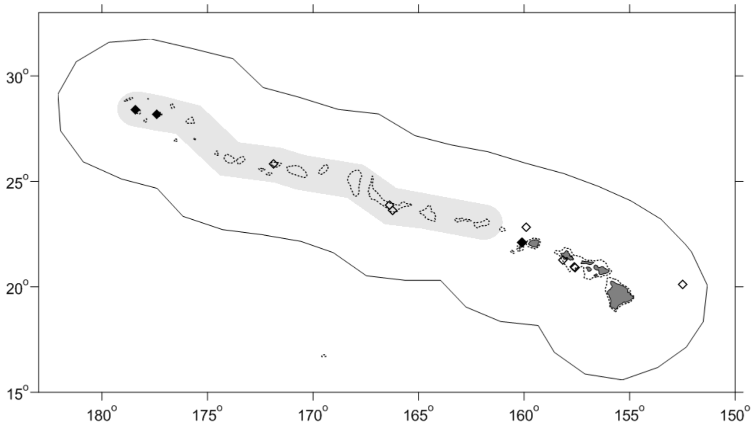

Figure 1. Spinner dolphin sighting locations during the 2002 (open diamonds) and 2010 (black diamonds) shipboard cetacean surveys of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006, Bradford et al. 2013; see Appendix 2 for details on timing and location of survey effort). Outer line indicates approximate boundary of survey area and U.S. EEZ. Gray shading indicates area of Papahanaumokuakea Marine National Monument. Dotted line represents the 1000m isobath. Insular stock boundaries are shown in Figure 2.

Hawaiian spinner dolphins belong to a stock that is separate from animals in the eastern tropical Pacific (Perrin 1975; Dizon et al. 1994). The Hawaiian form is referable to the subspecies *S. longirostris longirostris*, which occurs pantropically (Perrin 1990). Andrews et al. (2010) found that mtDNA control region haplotype and nucleotide diversities of Hawaiian spinner dolphins are low compared with those from other geographic regions and suggested the existence of strong barriers to gene flow, both geographic and ecological. Her analyses also reveal significant genetic distinction, at both mtDNA and microsatellite loci, between spinner dolphins sampled in American Sāmoa and those sampled in the Hawaiian Islands (Johnston *et al.* 2008, Andrews et al. 2010). Andrews et al. (2010) also found significant genetic distinctions between spinner dolphins sampled at different islands within the Hawaiian Archipelago. Most significant was differentiation between animals sampled off the Kona Coast of Hawaii Island and animals sampled at all other Hawaiian Islands. Similarly, in the

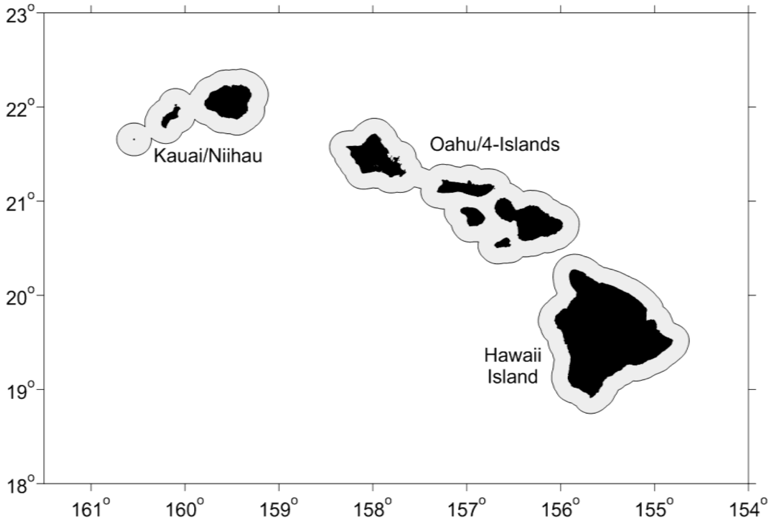

Figure 2. Spinner dolphin stock boundaries in the main Hawaiian Islands (Midway/Kure and Pearl and Hermes stock ranges not pictured). Animals outside of the defined island areas are considered to be part of the Hawaii pelagic stock.

Northwestern Hawaiian Islands, spinner dolphins sampled at Midway and Kure were shown not to be genetically distinct from each other, but are distinct from those sampled at all other islands. Andrews (2009) also found that none of the pairwise comparisons between French Frigate Shoals, Niihau, Kauai, and Oahu were statistically significant and Oahu was not significantly differentiated from Maui/Lanai. Assignment tests, which may provide information about recent gene flow, show that for most islands and atolls within the Hawaiian Archipelago, more samples assigned to the island/atoll at which they were collected than to any other island. These patterns are supported by available photo-ID and animal movement data (Karczmarski et al. 2005). Spinner dolphin genetic data are lacking from some islands and atolls within the Hawaiian Archipelago (e.g., Molokai, Kahoolawe, Nihoa, Mokumanamana (Necker), Gardner Pinnacles, Laysan, and Lisianski). Sighting data confirms the presence of spinner dolphins at some of these locations (e.g., Molokai, Kahoolawe, Mokumanamana, and Gardner Pinnacles; PIFSC unpublished data), however, without genetic or photo-identification data it is difficult to evaluate connectivity between these dolphins and those at other islands.

Hill et al. (2010) proposed designation of island-associated stocks of spinner dolphins at Midway/Kure, Pearl and Hermes Reef, Kauai/Niihau, Oahu/4-Islands, and Hawaii Island based on microsatellite and mtDNA genetic data (Andrews et al. 2010), known movement patterns (Karczmarski 2005), and the geographic distances between the Hawaiian Islands. They suggested an offshore boundary for each island-associated stock at 10 nmi from shore based on anecdotal accounts of spinner dolphin distribution. Analysis of individual spinner dolphin movements suggests that few individuals move long distances (from one main Hawaiian Island to another) and no dolphins have been seen farther than 10 nmi from shore (Hill et al. 2011). Based on the maximum distance from shore observed for island-associated animals, a 10 nmi stock boundary has been assumed for management under the MMPA. Norris et al. (1994) suggested that spinner dolphins may move between leeward and windward shores of the main Hawaiian Islands seasonally.

For the Marine Mammal Protection Act (MMPA) stock assessment reports, there are six stocks within the U.S. EEZ of the Hawaiian Islands: 1) Hawaii Island, 2) Oahu/4-Islands, 3) Kauai/Niihau, 4) Pearl & Hermes Reef, 5) Kure/Midway, and 6) Hawaii Pelagic, including animals found both within the Hawaiian Islands EEZ (outside of island-associated boundaries) and in adjacent high seas waters. Because data on abundance, distribution, and human-caused impacts are largely lacking for high seas waters, the status of the Hawaii pelagic stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005). Spinner dolphins in the eastern tropical Pacific that may interact with tuna purse-seine fisheries are managed separately under the MMPA.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen *et al*. 2008, NMFS 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*". Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fishery Information

Information on fishery-related mortality of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaii-based fisheries cause marine mammal mortality and serious injury in other U.S. fisheries. Entanglement in gillnets and hooking or entanglement in various hook and line fisheries have been reported for small cetaceans in Hawaii (Nitta & Henderson, 1993). Although gillnet fisheries are not observed or monitored through any State or Federal program, State regulations ban gillnetting around Maui and much of Oahu and require gillnet fishermen to monitor their nets for bycatch every 30 minutes. The bottomfish handline fishery in the Northwestern Hawaiian Islands was observed from 1990 to 1993, resulting in an estimate of 2.67 cetacean interactions per 1,000 landed fish, though none are thought to involve spinner dolphins (Kobayashi and Kawamoto 1995), and again in 2003 to 2005 (18-25% observer coverage) resulting in no incidental takes of cetaceans (NMFS PIR Observer Program). The bottomfish fishery is no longer permitted for the Northwestern Hawaiian Islands. Bottomfish fishermen in the main Hawaiian Islands claim interactions with dolphins that steal bait and catch are increasing. It is not known whether these alleged interactions result in serious injury or mortality of dolphins, nor whether spinner dolphins are involved.

Two spinner dolphins have been reported hooked or entangled by fishing gear in the main Hawaiian Islands between 2007 and 2011 (Bradford & Lyman 2013). One animal was seen in November 2009 off Lahaina, Maui (Oahu/4-Islands stock) with a hook embedded in its right lower jaw and through the tongue, preventing the dolphin from closing its mouth. The animal was seen again two days later, but has not been seen since. One additional spinner dolphin was seen in September 2011 off Kailua-Kona, Hawaii (Hawaii Island stock) with a section of netting entangled around its rostrum and trailing down its side. The animal was swimming behind other dolphins in the group and may not have been able to open its mouth. Based on the description and photographs, both injuries are considered serious under the most recently developed criteria for assessing serious injury in marine mammals (NMFS 2012). It is not possible to attribute either interaction to a specific fishery given insufficient details about the gear involved. There are six additional reports between 1991 and 2006 of spinner dolphins found entangled, hooked, or shot (Bradford & Lyman 2013). No estimates of annual human-caused mortality and serious injury are available for nearshore hook and line or gillnet fisheries because these fisheries are not observed or monitored for protected species interactions.

There are two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. However, there are fishery closures within 25-75 miles from shore in the MHI and 50 miles from shore in the NWHI where insular or island-associated stocks occur. Between 2007 and 2011, no spinner dolphins were observed hooked or entangled in the SSLL fishery (100% observer coverage) or the DSLL fishery (20-22% observer coverage) (McCracken 2013, Bradford & Forney 2013).

HAWAII ISLAND STOCK

POPULATION SIZE

Over the past few decades abundance estimates have been produced from studies along the Kona coast of Hawaii Island. Norris et al. (1994) photo-identified 192 individuals along the west coast of Hawaii and estimated 960 animals for this area in 1979-1980. For the same study region, Östman (1994) photo-identified 677 individual spinner dolphins from 1989 to 1992 and using the same estimation procedures as Norris et al. (1994), estimated a population size of 2,334 spinner dolphins. New open mark-recapture estimates based on intensive year-round photo-identification surveys in Kauhako Bay, Kealakekua Bay, Honaunau Bay, and Makako Bay along the Kona Coast of Hawaii Island in 2010 and 2011 have resulted in an abundance estimate of 631 (CV=0.09) for the Hawaii Island stock (Tyne et al. 2013). Considerable seasonal variation in spinner dolphin occurrence on the leeward versus south and east sides of the island is thought to occur, with lower abundance off the leeward Kona coast in the winter, potentially due to increased wind and swell in that region (Norris et al. 1994). Because the most recent abundance estimate is based on year-round surveys, at least some of the animals present on the leeway side seasonally have likely been seen. However, because only four Bays were surveyed, it is likely that some portion of the population is not included in this abundance estimate and the new estimate is an underestimate of total population size.

Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the log-normal 20th distribution (Barlow et al. 1995) around the 2011 abundance estimate for Hawaii Island, or 585 spinner dolphins.

Current Population Trend

Quantitative trend analyses have not been conducted with the available data, as estimates from the 1970s and 1980s did not include year-round surveys and used a different survey area than the 2010-2011 surveys.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate for this species in Hawaiian waters.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Hawaii Island stock is calculated as the minimum population estimate (585) <u>times</u> one half the default maximum net growth rate for cetaceans (½ of 4%) <u>times</u> a recovery factor of 0.50 (for a stock of unknown status with no estimated fishery mortality or serious injury within the U.S. EEZ of the Hawaiian Islands; Wade and Angliss 1997) resulting in a PBR of 5.9 spinner dolphins per year.

STATUS OF STOCK

The Hawaii Island stock of spinner dolphins is not considered a strategic stock under the MMPA. The status of Hawaii Island spinner dolphins relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance for this stock. A habitat issue of increasing concern is the potential effect of swim-with-dolphin programs and other tourism activities on spinner dolphins around the main Hawaiian Islands (Danil et al. 2005, Courbis & Timmel 2009). All Hawaiian spinner dolphin stocks are potentially exposed to high levels of Navy sonar and frequent detonations during training exercises. The sensitivity of spinner dolphins to these sound levels is unknown and therefore the impact of these exercises on spinner dolphin stocks is unknown. Spinner dolphins are not listed as “threatened” or “endangered” under the Endangered Species Act (1973), nor designated as “depleted” under the MMPA. Insufficient information is available to determine whether the total fishery mortality and serious injury for this Hawaii Island spinner dolphin stock is insignificant and approaching zero mortality and serious injury rate.

OAHU/4-ISLANDS STOCK

POPULATION SIZE

As part of the Marine Mammal Research Program of the Acoustic Thermometry of Ocean Climate (ATOC) study, a total of twelve aerial surveys were conducted within 25 nmi of the main Hawaiian Islands in 1993, 1995 and 1998. An abundance estimate of 3,184 (CV=0.37) spinner dolphins was calculated from the combined survey data (Mobley et al. 2000), now representing the Kauai/Niihau, Oahu/4-Islands, and Hawaii Island stocks. New mark-recapture estimates based on photo-identification studies have resulted in new seasonal abundance estimates for the Oahu/4-Islands stock. Closed capture models provide two separate estimates for the leeward coast of Oahu representing different time periods: 160 (CV = 0.14) for June to July, 2002; and 355 (CV = 0.09) for July to September 2007 (Hill et al. 2011). The 2002 estimate is now more than 8 years old and therefore will no longer be used based on NMFS Guidelines for Assessing Marine Mammal Stocks (NMFS 2005). The 2007 estimate is considered the best-available estimate of the population size of the Oahu/4-Islands stock; however, it is likely an underestimate as it includes only dolphins found off the leeward coast of Oahu, and does not account for individuals that may spend most of their time along other parts of Oahu or somewhere in the 4-Islands area.

Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow et al. 1995) from the 2007 abundance estimate for the summertime leeward coast of Oahu and the 4-Islands area, or 329 spinner dolphins. This minimum estimate is likely negatively-biased, as it represents a minimum estimate of the number of dolphins, accounting only for those along the leeward Oahu coast in 2007; no data were included from the rest of the stock range.

Current Population Trend

There are insufficient data to evaluate trends in abundance for this stock.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate for this species in Hawaiian waters. A default level of 4% is assumed for maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Oahu/4-Islands stock is calculated as the minimum population estimate (329) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no estimated fishery mortality or serious injury within the U.S. EEZ of the Hawaiian Islands; Wade and Angliss 1997) resulting in a PBR of 3.3 spinner dolphins per year.

STATUS OF STOCK

The Oahu/4-Islands stock of spinner dolphins is not considered a strategic stock under the MMPA. The status of Oahu/4-Islands spinner dolphins relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance for this stock. A habitat issue of increasing concern is the potential effect of swim-with-dolphin programs and other tourism activities on spinner dolphins around the main Hawaiian Islands (Danil et al. 2005, Courbis and Timmel 2009). All Hawaiian spinner dolphin stocks are potentially exposed to high levels of Navy sonar and frequent detonations during training exercises. The sensitivity of spinner dolphins to these sound levels is unknown and therefore the impact of these exercises on spinner dolphin stocks is unknown. Spinner dolphins are not listed as “threatened” or “endangered” under the Endangered Species Act (1973), nor designated as “depleted” under the MMPA. Insufficient data exist to determine whether the total fishery mortality and serious injury for this Oahu/4-Islands spinner dolphin stock is insignificant and approaching zero mortality and serious injury rate. One spinner dolphin found stranded on Oahu has tested positive for *Morbillivirus* (Jacob 2012). Although *morbillivus* is known to trigger lethal disease in cetaceans (Van Bressem et al. 2009), its impact on the health of the stranded animal is not known (Jacob 2012). The presence of *morbillivirus* in 10 species of cetacean in Hawaiian waters

(Jacob 2012), raises concerns about the history and prevalence of this disease in Hawaii and the potential population impacts on Hawaiian cetaceans.

KAUAI/NIIHAU STOCK

POPULATION SIZE

As part of the Marine Mammal Research Program of the Acoustic Thermometry of Ocean Climate (ATOC) study, a total of twelve aerial surveys were conducted within 25 nmi of the main Hawaiian Islands in 1993, 1995 and 1998. An abundance estimate of 3,184 (CV=0.37) spinner dolphins was calculated from the combined survey data (Mobley et al. 2000), now representing the Kauai/Niihau, Oahu/4-Islands, and Hawaii Island stocks. Those data are well over 8 years old and abundance estimates from these data are out of date. New mark-recapture estimates based on photo-identification studies have resulted in a new seasonal abundance estimate for the Kauai/Niihau stock. Closed capture models provide an estimate of 601 (CV = 0.20) spinner dolphins for the leeward coast of Kauai for the period October to November 2005. This estimate is considered the best-available estimate of the population size of the Kauai/Niihau stock; however, it is likely an underestimate as it includes only dolphins found off the leeward coast of Kauai, and does not account for individuals that may spend most of their time along other parts of Kauai, Niihau, or Kaula Rock.

Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow et al. 1995) from the leeward Kauai abundance estimate, or 509 spinner dolphins. This minimum estimate is likely negatively-biased, as it represents a minimum estimate of the number of dolphins, accounting only for those along the leeward Kauai coast in 2005; no data were included from the rest of the stock range near Niihau or Kaula Rock.

Current Population Trend

There is only one abundance estimate available for the stock area of Kauai/Niihau from 2005 and thus, no trend analysis is possible.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate for this species in Hawaiian waters. A default level of 4% is assumed for maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Kauai/Niihau stock is calculated as the minimum population estimate (509) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a stock of unknown status with no estimated fishery mortality or serious injury within the U.S. EEZ of the Hawaiian Islands; Wade and Angliss 1997 resulting in a PBR of 5.1 spinner dolphins per year.

STATUS OF STOCK

The Kauai/Niihau stock of spinner dolphins is not considered a strategic stock under the MMPA. The status of Kauai/Niihau spinner dolphins relative to OSP is unknown, and there are insufficient data to evaluate abundance trends. A habitat issue of increasing concern is the potential effect of swim-with-dolphin programs and other tourism activities on spinner dolphins around the main Hawaiian Islands (Danil et al. 2005, Courbis & Timmel 2009). All Hawaiian spinner dolphin stocks are potentially exposed to high levels of Navy sonar and frequent detonations during training exercises. The sensitivity of spinner dolphins to these sound levels is unknown and therefore the impact of these exercises on spinner dolphin stocks is unknown. Spinner dolphins are not listed as “threatened” or “endangered” under the Endangered Species Act (1973), nor designated as “depleted” under the MMPA. Insufficient data are available to determine whether the total fishery mortality and serious injury for this Kauai/Niihau spinner dolphin stock is insignificant and approaching zero mortality and serious injury rate.

PEARL & HERMES REEF STOCK

POPULATION SIZE

There is no information on the abundance of the Pearl & Hermes Reef stock of spinner dolphins. A photo-identification catalog of individual spinner dolphins from this stock is available, though inadequate survey effort and low re-sighting rates prevent robust estimation of abundance.

Minimum Population Estimate

There is no information on which to base a minimum population estimate for the Pearl & Hermes Reef stock of spinner dolphins.

Current Population Trend

Insufficient data exists to assess population trends.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate for this species in Hawaiian waters.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Pearl & Hermes Reef stock is calculated as the minimum population estimate times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no estimated fishery mortality or serious injury within the U.S. EEZ of the Hawaiian Islands; Wade and Angliss 1997). Because there is no minimum population estimate available for this stock the PBR for Pearl & Hermes Reef stock of spinner dolphins is undetermined.

STATUS OF STOCK

The Pearl & Hermes Reef stock of spinner dolphins is not considered a strategic stock under the MMPA. The status of Pearl & Hermes Reef spinner dolphins relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance for this stock. Spinner dolphins are not listed as “threatened” or “endangered” under the Endangered Species Act (1973), nor designated as “depleted” under the MMPA. Because the stock resides entirely within the Paphanaumokuakea Marine National Monument, where fishing is not permitted, it is assumed that the rate of mortality and serious injury within the stock area is zero.

MIDWAY ATOLL/KURE STOCK

POPULATION SIZE

In the Northwestern Hawaiian Islands, a multi-year photo-identification study at Midway Atoll resulted in a population estimate of 260 spinner dolphins based on 139 identified individuals (Karczmarski et al. 1998). This abundance estimate for the Midway Atoll/Kure stock of spinner dolphins is now more than 8 years old and therefore will no longer be used, based on NMFS Guidelines for Assessing Marine Mammal Stocks (NMFS 2005). A 2010 shipboard line-transect survey within the Hawaiian EEZ resulted in a single off-effort sighting of spinner dolphins at Kure Atoll. This sighting cannot be used within a line-transect framework; however, photographs of individuals may be used in the future to estimate the abundance of spinner dolphin at Midway Atoll/Kure using mark-recapture methods.

Minimum Population Estimate

The minimum population estimate for the Midway Atoll/Kure stock is now more than 8 years old and therefore will no longer be used (NMFS 2005). There is no current minimum population estimate available for this stock.

Current Population Trend

Insufficient data exists to assess population trends.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate for this species in Hawaiian waters.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Midway Atoll/Kure stock is calculated as the minimum population estimate times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no estimated fishery mortality or serious injury within the U.S. EEZ of the Hawaiian Islands; Wade and Angliss 1997). The PBR for the Midway Atoll/Kure stock of spinner dolphins is undetermined because no minimum population estimate is available for this stock.

STATUS OF STOCK

The Midway Atoll/Kure stock of spinner dolphins is not considered strategic under the MMPA. The status of Midway Atoll/Kure spinner dolphins relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Spinner dolphins are not listed as “threatened” or “endangered” under the Endangered Species Act (1973), nor designated as “depleted” under the MMPA. Because the stock resides entirely within the Paphanaumokuakea Marine National Monument, where fishing is not permitted, it is assumed that the rate of mortality and serious injury within the stock area is zero

HAWAII PELAGIC STOCK

POPULATION SIZE

A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 3,351 (CV=0.74) spinner dolphins (Barlow 2006); however, this estimate assumed a single Hawaiian Islands stock. This estimate for the Hawaiian EEZ is more than 8 years old and therefore will no longer be used based on NMFS Guidelines for Assessing Marine Mammal Stocks (NMFS 2005). A 2010 shipboard line-transect survey within the Hawaiian EEZ did not result in any sightings of pelagic spinner dolphins.

Minimum Population Estimate

No minimum population estimate is available for this stock, as there were no sightings of pelagic spinner dolphins during a 2010 shipboard line-transect survey of the Hawaiian EEZ.

Current Population Trend

Insufficient data exists to assess population trends.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate for this species in Hawaiian waters.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Hawaii pelagic stock is calculated as the minimum population estimate times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no estimated fishery mortality or serious injury within the U.S. EEZ of the Hawaiian Islands; Wade and Angliss 1997). Because there is no minimum population estimate for Hawaii pelagic spinner dolphins, the potential biological removal (PBR) is undetermined.

STATUS OF STOCK

The Hawaii pelagic stock of spinner dolphins is not considered a strategic stock under the MMPA. The status of Hawaii pelagic spinner dolphins relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance for this stock. Spinner dolphins are not listed as “threatened” or “endangered” under the Endangered Species Act (1973), nor as “depleted” under the MMPA. While the estimated rate of fishery mortality and serious injury for this stock is zero in observed U.S. fisheries, this rate cannot be evaluated in the context of the Zero Mortality Rate Goal (ZMRG) (NMFS 2004) because ZMRG is calculated in the context of PBR (<10% of PBR), which is undetermined for this stock. This stock likely extends outside of U.S. EEZ waters, where international high seas fisheries may interact with and take animals from this stock.

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SPINNER DOLPHIN (S*tenella longirostris longirostris*): American Samoa Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Gray's spinner dolphins (*Stenella longirostris longirostris*) are the most widely distributed subspecies of spinner dolphins and are found in tropical and subtropical waters of the Atlantic, Indian, central and western Pacific Oceans (Perrin et al. 1991, Norris et al. 1994, Oremus *et al.* 2007, Johnston et al. 2008). Spinner dolphins are considered common in American Samoa (Reeves et al. 1999). During small-boat surveys from 2003 to 2006 in the waters surrounding the island of Tutuila, the spinner dolphin was the most frequently encountered species (i.e., 34 of 52 sightings) and was found in waters with a mean depth of 44m (Johnston et al. 2008). Photo-identification data collected during the surveys indicate the presence of a resident population of spinner dolphins in the waters surrounding Tutuila (Johnston et al. 2008). Approximately 1/3 of the individuals within the photo-id catalog were sighted in multiple years (Johnston et al. 2008). In addition, some of these individuals demonstrated strong site fidelity and were encountered within only a few kilometers from one year to the next (Johnston et al. 2008). During a shipboard survey in 2006 spinner dolphins were also encountered just south of the island of Ta'u, American Samoa (Johnston et al. 2008).

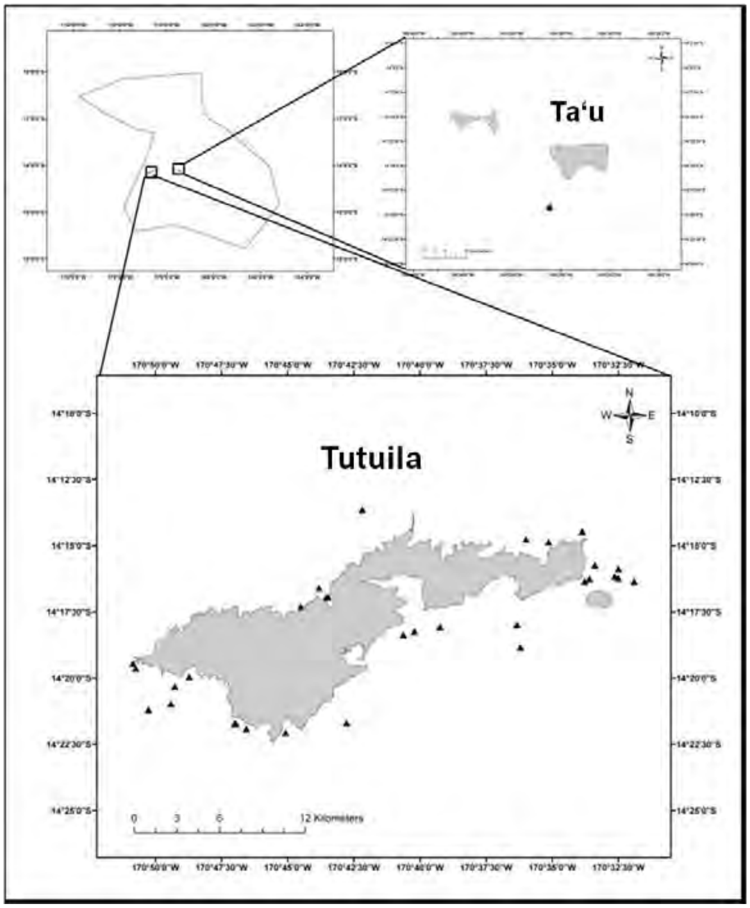

Figure 1. Spinner dolphin sightings from visual sighting surveys, 2003-2006 (Johnston et al 2008).

Genetic analyses of biopsy samples collected during the 2003-2006 small boat surveys around Tutuila indicate that spinner dolphins in American Samoa are distinct from those of the Hawaiian Archipelago. Pairwise F-statistical analyses revealed significant ($p<0.001$) genetic distinction, at both mtDNA and microsatellite loci, between spinner dolphins sampled in American Samoa and those sampled in the Hawaiian Islands (Johnston et al. 2008, Andrews 2009). For the Marine Mammal Protection Act (MMPA) stock assessment reports, there are eight Pacific management stocks, six of these extend from the Hawaiian archipelago to 10 nmi offshore: 1) Kure/Midway, 2) Pearl and Hermes Reef, 3) French Frigate Shoals, 4) Kauai/Niihau, 5) Oahu/4-Islands, and 6) Hawaii Island, The Hawaii Pelagic Stock, which includes animals within the U.S. EEZ of the Hawaiian Islands, but more than 10 nmi from the shore where insular populations exist, and 8) the American Samoa Stock, which include animals inhabiting the EEZ waters around American Samoa (this report). Spinner dolphins involved in eastern tropical Pacific tuna purse-seine fisheries are managed separately under the MMPA.

POPULATION SIZE

No abundance estimates are currently available for spinner dolphins in U.S. EEZ waters of American Samoa; however, density estimates for spinner dolphins in other tropical Pacific regions can provide a range of likely abundance estimates in this unsurveyed region. Published estimates of spinner dolphins (animals per km^2) in the Pacific are: 0.0014 (CV=0.74) for the U.S. EEZ of the Hawaiian Islands (Barlow 2006); 0.0443 (CV=0.37) for nearshore waters surrounding the main Hawaiian Islands (Mobley et al. 2000), 0.0532 (CV=0.19) and 0.0473

(CV=0.15) for the eastern tropical Pacific Ocean (Wade and Gerrodette 1993; Ferguson and Barlow 2003), and 0.1280 (CV=0.27) for eastern tropical Pacific waters west of 120°W and north or south of 10°, a region with similar oceanographic conditions to those around American Samoa. Applying the lowest and highest of these density estimates to U.S. EEZ waters surrounding American Samoa (area size = 404,578 km^2) yields a range of plausible abundance estimates of 553 – 51,773 spinner dolphins.

Minimum Population Estimate

No minimum population estimate is currently available for waters surrounding American Samoa, but the spinner dolphin density estimates from other tropical Pacific regions (Barlow 2003, Mobley et al. 2000, Wade and Gerrodette 1993, Ferguson and Barlow 2003, see above) can provide a range of likely values. The lognormal 20th percentiles of plausible abundance estimates for the American Samoa EEZ, based on the densities observed elsewhere, range from 317 – 41,483 spinner dolphins.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current and maximum net productivity rate in American Samoan waters.

POTENTIAL BIOLOGICAL REMOVAL

No PBR can presently be calculated for spinner dolphins within the American Samoa EEZ, but based on the range of plausible minimum abundance estimates (317 – 41,483), a recovery factor of 0.50 (for a species of unknown status with no fishery mortality and serious injury within the American Samoa EEZ; Wade and Angliss 1997), and the default growth rate (½ of 4%), the PBR would likely fall between 3.2 and 415 spinner dolphins per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Information on fishery-related mortality of cetaceans in American Samoan waters is limited, but the gear types used in American Samoa's fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Gillnets appear to capture marine mammals wherever they are used, and float lines from lobster traps and longlines can be expected to occasionally entangle whales (Perrin et al. 1994). The primary fishery in American Samoa is the commercial pelagic longline fishery that targets tunas, which was introduced in 1995 (Levine and Allen 2009). In 2008, there were 28 federally permitted vessels within the longline fishery in American Samoa (Levine and Allen 2009). The fishery has been monitored since March 2006 under a mandatory observer program, which records all interactions with protected species (Pacific Islands Regional Office 2009). No interactions with spinner dolphins have been recorded. Prior to 1995, bottomfishing and trolling were the primary fisheries in American Samoa but became less prominent after longlining was introduced (Levine and Allen 2009). Nearshore subsistence fisheries include spear fishing, rod and reel, collecting, gill netting, and throw netting (Craig 1993, Levine and Allen 2009). Information on fishery-related mortality of cetaceans in the nearshore fisheries is unknown, but the gear types used in American Samoan fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Gillnets appear to capture marine mammals wherever they are used. Although boat-based nearshore fisheries have been randomly monitored since 1991, by the American Samoa Department of Marine and Wildlife Sources (DMWR), no estimates of annual human-caused mortality and serious injury of cetaceans are available.

STATUS OF STOCK

The status of spinner dolphins in American Samoan waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. No habitat issues are known for spinner dolphins in American Samoa. Spinner dolphins are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The American Samoan stock of spinner dolphins is not considered a strategic stock under the 1994 amendments to the MMPA because the estimated rate of mortality and serious injury within the American Samoa EEZ is zero. Insufficient information is available to determine whether the total fishery mortality and serious injury for spinner dolphins is insignificant and approaching zero mortality and serious injury rate.

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Revised 7/15/2014

STRIPED DOLPHIN (*Stenella coeruleoalba*): Hawaii Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

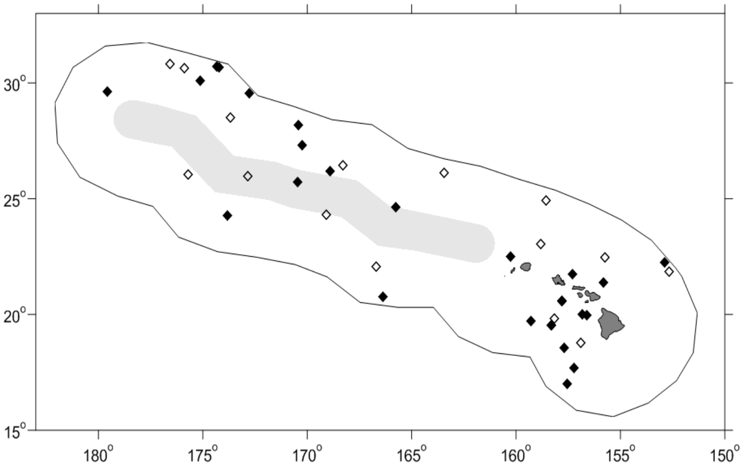

Figure 1. Striped dolphin sighting locations during the 2002 (open diamonds) and 2010 (black diamonds) shipboard surveys of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006, Bradford et al. 2013; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ. Gray shading indicates area of Papahanaumokuakea Marine National Monument.

Striped dolphins are found in tropical to warm-temperate waters throughout the world (Perrin et al. 2009). Sightings have historically been infrequent in nearshore waters (Shallenberger 1981, Mobley et al. 2000, Baird et al. 2013). Summer/fall shipboard surveys of the waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands, resulted in 15 sightings of striped dolphins in 2002 and 29 in 2010 (Figure 1; Barlow 2006, Bradford et al. 2013).

Striped dolphins have been intensively exploited in the western North Pacific, where three migratory stocks are provisionally recognized (Kishiro and Kasuya 1993). In the eastern tropical Pacific all striped dolphins are provisionally considered to belong to a single stock (Dizon et al. 1994). For the Marine Mammal Protection Act (MMPA) stock assessment reports, striped dolphins within the Pacific U.S. EEZ are divided into two discrete areas: 1) waters off California, Oregon and Washington, and 2) waters around Hawaii (this report), including animals found both within the Hawaiian Islands EEZ and in adjacent high seas waters. Because data on abundance, distribution, and human-caused impacts are largely lacking for high seas waters, the status of the Hawaii stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005). Striped dolphins involved in eastern tropical Pacific tuna purse-seine fisheries are managed separately under the MMPA.

POPULATION SIZE

Population estimates are available for Japanese waters (Miyashita 1993) and the eastern tropical Pacific (Wade and Gerrodette 1993), but it is not known whether any of these animals are part of the same population that occurs around the Hawaiian Islands. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 13,143 (CV=0.46) striped dolphins (Barlow 2006). The recent 2010 shipboard line-transect survey of the Hawaiian Islands EEZ resulted in an abundance estimate of 20,650 (CV=0.36) striped dolphins (Bradford et al. 2013). This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow et al. 1995) of the 2010 abundance estimate, or 15,391 striped dolphins.

Current Population Trend

The broad and overlapping confidence intervals around the 2002 and 2010 estimates preclude assessment of trends with the available data.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Hawaii stock of striped dolphins is calculated as the minimum population size within the U.S. EEZ of the Hawaiian Islands (15,391) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.5 (for a stock of unknown status with no known fishery mortality and serious injury within the Hawaiian Islands EEZ ; Wade and Angliss 1997), resulting in a PBR of 154 striped dolphins per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NMFS 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*". Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fishery Information

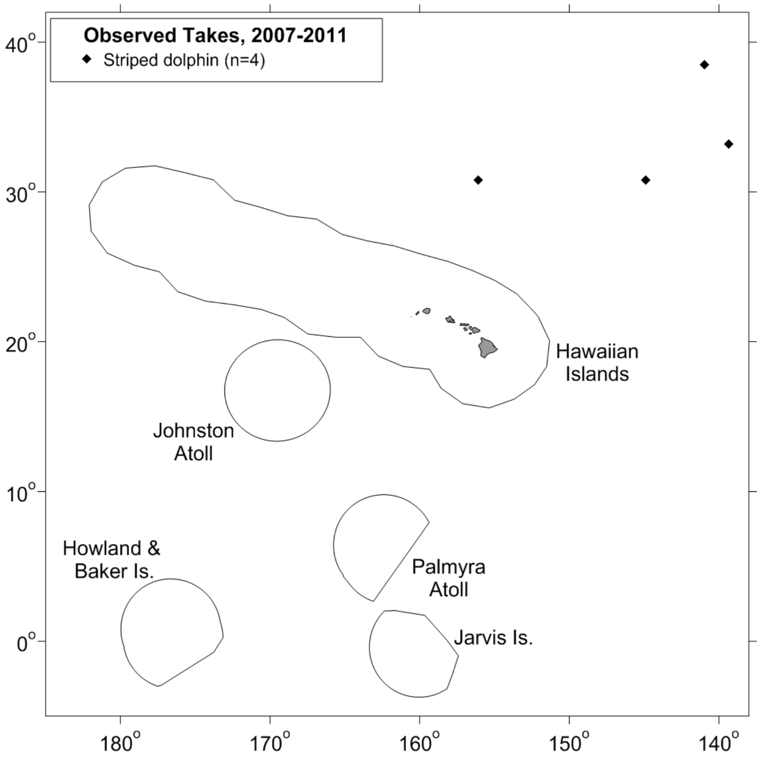

Figure 2. Locations of striped dolphin takes (filled diamonds) in Hawaii-based longline fisheries, 2007-2011 Solid lines represent the U.S. EEZs. Fishery descriptions are provided in Appendix 1.

Information on fishery-related mortality and serious injury of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Entanglement in gillnets and hooking or entanglement in various hook and line fisheries have been reported for small cetaceans in Hawaii (Nitta & Henderson, 1993). One striped dolphin stranded entangled in fishing gear in 2005, but the responsible fishery cannot be determined, as the entangled gear was not described (NMFS PIR MMRN). No estimates of human-caused mortality or serious injury are currently available for nearshore hook and line or gillnet fisheries because these fisheries are not observed or monitored for protected species bycatch.

There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2007 and 2011, one striped dolphin was killed and two seriously injured on the high seas in the SSLL fishery (100% observer coverage), and one striped dolphin was killed on the high seas in the DSLL fishery (20-22% observer coverage) (Figure 2, Bradford & Forney 2013, McCracken 2013). Average 5-yr estimates of annual mortality and serious injury for 2007-2011 are 1.4 (CV = 0.9) dolphins outside of U.S. EEZs, and zero within the Hawaiian Islands EEZ (Table 1). Eight unidentified cetaceans were taken in the DSLL fishery, and two unidentified cetaceans were taken in the SSLL fishery, some of which may have been striped dolphins.

STATUS OF STOCK

The Hawaii stock of striped dolphins is not considered strategic under the 1994 amendments to the MMPA. The status of striped dolphins in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Striped dolphins are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor designated as "depleted" under the MMPA. Given the absence of recent recorded fishery-related mortality or serious injuries in U.S. EEZ waters, total fishery mortality and serious injury for striped dolphins can be considered insignificant and approaching zero. One striped dolphin stranded in the main Hawaiian Islands tested positive for *Brucella* (Chernov, 2010) and another for *Morbillivirus* (Jacob 2012). *Brucella* is a bacterial infection that may limit recruitment by compromising male and female reproductive systems if it is common in the population, and can also cause neurological disorders that may result in death (Van Bressem et al. 2009). Although *morbillivus* is known to trigger lethal disease in cetaceans (Van Bressem et al. 2009), its impact on the health of the stranded animal is not known as it was found in only a few tested tissues (Jacob 2012). The presence of *Morbillivirus* in 10 species (Jacob 2012) and *Brucella* in 3 species (Cherbov 2010, West unpublished data) raises concerns about the history and prevalence of these diseases in Hawaii and the potential population impacts on Hawaiian cetaceans. It is not known if *Brucella or Morbillivirus* are common in the Hawaii stock.

Table 1. Summary of available information on incidental mortality and serious injury of striped dolphin (Hawaii stock) in commercial longline fisheries, within and outside of U.S. EEZs (McCracken & Forney 2010). Mean annual takes are based on 2007-2011 data unless otherwise indicated. Information on all observed takes (T) and combined mortality events & serious injuries (MSI) is included. Total takes were prorated to deaths, serious injuries, and non-serious injuries based on the observed proportions of each outcome.

				Observed total interactions (T) and mortality events, and serious injuries (MSI), and total estimated mortality and serious injury (M&SI) of striped dolphins			
				Outside U.S. EEZs		**Hawaiian EEZ**	
Fishery Name	**Year**	**Data Type**	**Percent Observer Coverage**	**Obs. T/MSI**	**Estimated M&SI (CV)**	**Obs. T/MSI**	**Estimated M&SI (CV)**
Hawaii-based deep-set longline fishery	2007	Observer data	20%	0	0 (-)	0	0 (-)
	2008		22%	0	0 (-)	0	0 (-)
	2009		21%	0	0 (-)	0	0 (-)
	2010		21%	0	0 (-)	0	0 (-)
	2011		20%	1/1	4 (1.5)	0	0 (-)
Mean Estimated Annual Take (CV)					**0.8 (0.9)**		**0 (-)**
Hawaii-based shallow-set longline fishery	2007	Observer data	100%	0	0	0	0
	2008		100%	1/1	1	0	0
	2009		100%	0	0	0	0
	2010		100%	2/2	2	0	0
	2011		100%	0	0	0	0
Mean Annual Takes (100% coverage)					**0.6**		**0**
Minimum total annual takes within U.S. EEZ							**0 (-)**

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Revised 7/15/2014

FRASER'S DOLPHIN (*Lagenodelphis hosei*): Hawaii Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Fraser's dolphins are distributed worldwide in tropical waters (Dolar 2009 in Perrin et al. 2009). They have only recently been documented within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands, during a 2002 cetacean survey (Barlow 2006), and were seen 4 times during a 2010 survey (Bradford et al. 2013, Figure 1). There have been only 2 sightings of Fraser's dolphins during 13 years of nearshore surveys in the leeward main Hawaii Islands (Baird et al 2013).

For the Marine Mammal Protection Act (MMPA) stock assessment reports, there is a single Pacific management stock including animals found both within the Hawaiian Islands EEZ and in adjacent high seas waters. Because data on abundance, distribution, and human-caused impacts are largely lacking for high seas waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

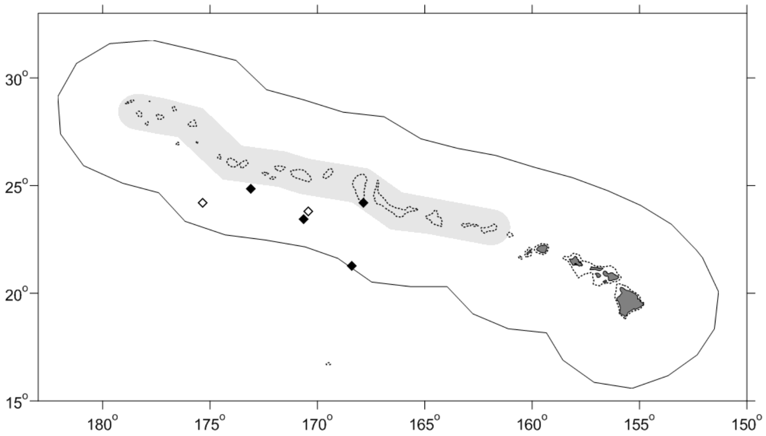

Figure 1. Fraser's dolphin sighting locations during the 2002 (open diamonds) and 2010 (black diamonds) shipboard cetacean surveys of U.S. waters surrounding the Hawaiian Islands (Barlow 2006, Bradford et al 2013; see Appendix 2 for details on timing and location of survey effort). Outer line indicates approximate boundary of survey area and U.S. EEZ. Gray shading indicates area of Papahanaumokuakea Marine National Monument. Dotted line represents the 1000m isobath.

POPULATION SIZE

Population estimates for Fraser's dolphins have been made in the eastern tropical Pacific (Wade and Gerrodette 1993), but it is not known whether these animals are part of the same population that occurs around the Hawaiian Islands and in the central North Pacific. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 10,226 (CV=1.16) Fraser's dolphins (Barlow 2006). The recent 2010 shipboard line-transect survey of the Hawaiian Islands EEZ resulted in an abundance estimate of 16,992 (CV = 0.66) Fraser's dolphins (Bradford et al 2013). This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow et al 1995) of the 2010 abundance estimate or 10,241 Fraser's dolphins.

Current Population Trend

No data are available on current population trend. The broad and overlapping confidence intervals around the 2002 and 2010 estimates preclude assessment of trend with the available data.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate for the Hawaii stock of Fraser's dolphin.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Hawaii stock of Fraser's dolphin is calculated as the minimum population size within the U.S. EEZ of the Hawaiian Islands (10,241) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a stock of unknown status with no known fishery mortality or serious injury within the Hawaiian Islands EEZ; Wade and Angliss 1997), resulting in a PBR of 102 Fraser's dolphins per year.

HUMAN CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*". Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fishery Information

Information on fishery-related mortality and serious injury of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. No interactions between nearshore fisheries and Fraser's dolphins have been reported in Hawaiian waters.

There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2007 and 2011, no Fraser's dolphins were observed hooked or entangled in the SSLL fishery (100% observer coverage) or the DSLL fishery (20-22% observer coverage) (McCracken 2013, Bradford & Forney 2013). However, eight unidentified cetaceans were taken in the DSLL fishery, and two unidentified cetaceans were taken in the SSLL fishery, some of which may have been Fraser's dolphins.

STATUS OF STOCK

The Hawaii stock of Fraser's dolphins is not considered strategic under the 1994 amendments to the MMPA. The status of Fraser's dolphins in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this stock. Fraser's dolphins are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor designated as "depleted" under the MMPA. Given the absence of recent recorded fishery-related mortality or serious injuries the total fishery mortality and serious injury can be considered to be insignificant and approaching zero.

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Revised 7/15/2014

MELON-HEADED WHALE (*Peponocephala electra*): Hawaiian Islands Stock Complex: Hawaiian Islands & Kohala Resident Stocks

STOCK DEFINITION AND GEOGRAPHIC RANGE

Melon-headed whales are found in tropical and warm-temperate waters throughout the world. The distribution of reported sightings suggests that the oceanic habitat of this species is primarily equatorial waters (Perryman et al. 1994). Small numbers have been taken in the tuna purse-seine fishery in the eastern tropical Pacific, and they are occasionally killed in direct fisheries in Japan and elsewhere in the western Pacific. Summer/fall shipboard surveys of the waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands during 2002 and 2010 resulted in only one sighting each year (Figure 1; Barlow 2006, Bradford et al. 2013). Little is known about this species elsewhere in its range, and most knowledge about its biology comes from mass strandings (Perryman et al. 1994).

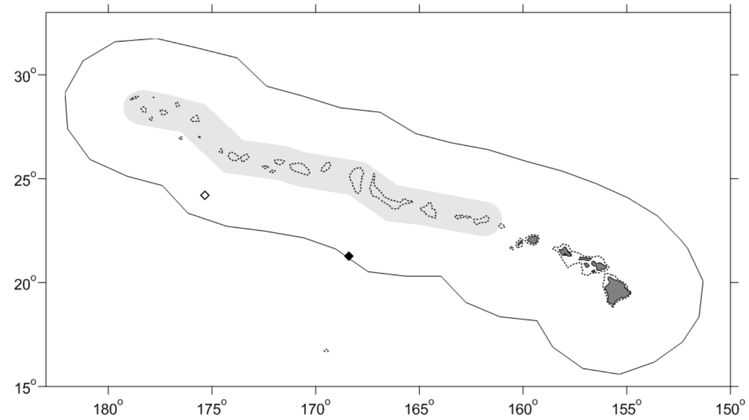

Figure 1. Melon-headed whale sighting locations during the 2002 (open diamond) and 2010 (black diamond) shipboard surveys of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006, Bradford et al 2013; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ. Gray shading indicates area of Papahanaumokuakea Marine National Monument. Dotted line represents the 1000m isobath.

Photo-identification and telemetry studies suggest there are two demographically-independent populations of melon-headed whales in Hawaiian waters, the Hawaiian Islands stock and the Kohala resident stock. Resighting data and social network analyses of photographed individuals indicate very low rates of interchange between these populations (0.0009/yr) (Aschettino et al. 2012). This finding is supported by preliminary genetic analyses that suggest restricted gene flow between the Kohala residents and other melon-headed whales sampled in Hawaiian waters (Oleson et al. 2013). Some individuals in each population have been seen repeatedly for more than a decade, implying high site-fidelity for both populations. Individuals in the larger Hawaiian Islands stock have been resighted throughout the main Hawaiian Islands. Satellite telemetry data revealed distant offshore movements, nearly to the edge of the U.S. EEZ around the Hawaiian Islands (Figure 2), with apparent foraging near cold and warm-core eddies (Woodworth et al. 2012). Individuals in the smaller Kohala resident stock have a range restricted to shallower waters of the Kohala shelf and west side of Hawaii Island (Aschettino et al. 2012, Schorr et al. unpublished data). Satellite telemetry data indicate they occur in waters less than 2500m depth around the northwest and west shores of Hawaii Island, west of 156^0 45’ W and north of 19^0 15’N (Oleson et al. 2013). The northern boundary between the two stocks provisionally runs through the Alenuihaha Channel between Hawaii Island and Maui, bisecting the distance between the 1000m depth contours (Oleson et al. 2013).

For the Marine Mammal Protection Act (MMPA) stock assessment reports, there are two Pacific management stocks within the Hawaiian Islands EEZ (Oleson et al. 2013): 1) the Kohala resident stock, which includes melon-headed whales off the Kohala Peninsula and west coast of Hawaii Island and in less than 2500m of water, and 2) the Hawaiian Islands stock, which includes melon-headed whales inhabiting waters throughout the U.S. EEZ of the Hawaiian Islands, including the area of the Kohala resident stock, and adjacent high seas waters. At this time, assignment of individual melon-headed whales within the overlap area to either stock requires photographic-identification of the animal. Because data on abundance, distribution, and human-caused impacts are largely lacking for high seas waters, the status of the Hawaiian Islands stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

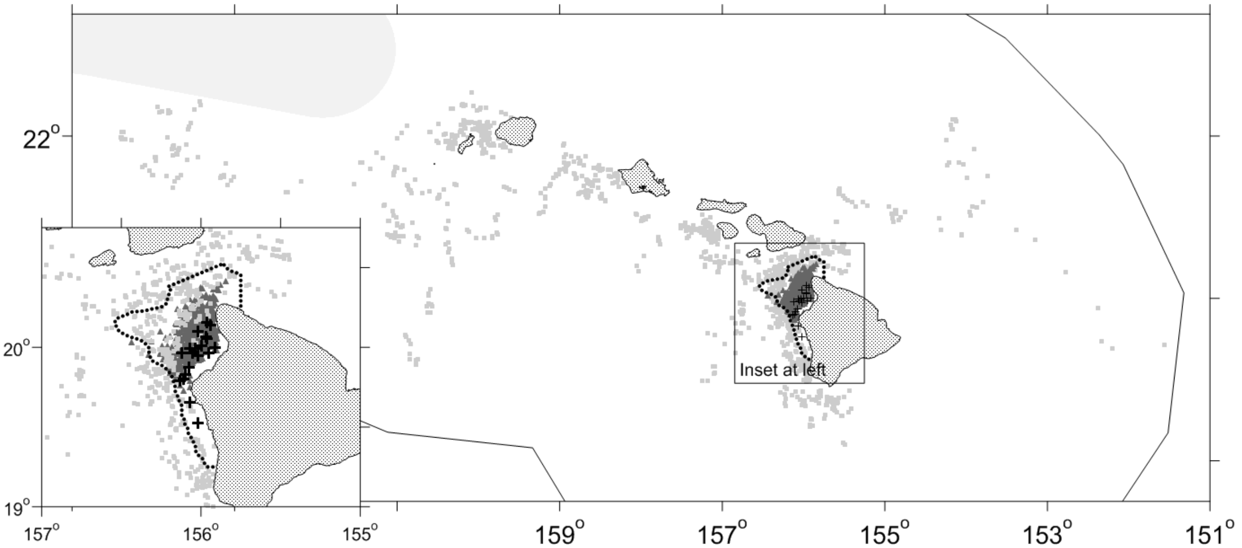

Figure 2. Sighting locations of melon-headed whales identified as being part of the Kohala resident stock (crosses) and telemetry records of Kohala resident (dark gray triangles) and Hawaiian Islands (light gray squares) melon-headed whale stocks (Schorr et al., unpublished data). The dotted line around waters adjacent to the northwest and west shores of Hawaii Island represents the provisional stock boundary for the Kohala resident stock (Oleson et al. 2013). The Kohala resident stock and the Hawaiian Islands stocks overlap throughout the range of the Kohala resident stock**.** Outer line represents U.S. EEZ. Gray shading indicates area of Papahanaumokuakea Marine National Monument.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*". Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fishery Information

Information on fishery-related mortality and serious injury of cetaceans in U.S. EEZ of the Hawaiian Islands waters is limited, but the gear types used in Hawaii fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Entanglement in gillnets and hooking or entanglement in various hook and line fisheries have been reported for small cetaceans in Hawaii (Nitta & Henderson, 1993). No interactions between nearshore fisheries and melon-headed whales have been reported in Hawaiian waters. No estimates of human-caused mortality or serious injury are currently available for nearshore hook and line or gillnet fisheries because these fisheries are not observed or monitored for protected species bycatch. Long-term photo-identification studies have noted individuals from both the Kohala Resident and Hawaiian Islands stocks with bullet holes in their dorsal fin or with linear scars on their fins or bodies (Aschettino 2010) which may be consistent fisheries interactions.

There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2007 and 2011, no melon-headed whales were observed hooked or entangled in the SSLL fishery (100% observer coverage) or the DSLL fishery (20-22% observer coverage) (Bradford & Forney 2013, McCracken 2013). However, eight unidentified cetaceans were taken in the DSLL fishery, and two unidentified cetaceans were taken in the SSLL fishery, some of which may have been melon-headed whales.

Other Mortality

In recent years, there has been increasing concern that loud underwater sounds, such as active sonar and seismic operations, may be harmful to beaked whales (Cox et al. 2006) and other cetaceans, including melon-headed whales (Southall et al. 2006) and pygmy killer whales (*Feresa attenuata*) (Wang and Yang 2006). The use of active sonar from military vessels has been implicated in mass strandings of beaked whales and recent mass-stranding reports suggest some delphinids may be impacted as well. A 2004 mass-stranding of 150-200 melon-headed whales in Hanalei Bay, Kauai occurred during a multi-national sonar training event around Hawaii (Southall et al. 2006). Although data limitations regarding the position of the whales prior to their arrival in the Bay, the magnitude of sonar exposure, behavioral responses of melon-headed whales to acoustic stimuli, and other possible relevant factors preclude a conclusive finding regarding the role of Navy sonar in triggering this event, sonar transmissions were considered a plausible cause of the mass stranding based on the spatiotemporal link between the sonar exercises and the stranding, the direction of movement of the transmitting vessels near Hanalei Bay, and propagation modeling suggesting the sonar transmissions would have been audible at the mouth of Hanalei Bay (Southall et al. 2006; Brownell et al. 2009). In 2008 approximately 100 melon-headed whales stranded within a lagoon off Madagascar during high-frequency multi-beam sonar use by oil and gas companies surveying offshore. Although the multi-beam sonar cannot be conclusively deemed the cause of the stranding event, the very close temporal and spatial association and directed movement of the sonar use with the stranding event, the unusual nature of the stranding event, and that all other potential causal factors were considered unlikely to have contributed, an Independent Scientific Review panel found that multi-beam sonar transmissions were a “plausible, if not likely” contributing factor (Southall et al. 2013) in this mass stranding event. This examination together with that of Brownell et al. (2009) suggests melon-headed whale may be particularly sensitive to impacts from anthropogenic sounds. No estimates of potential mortality or serious injury are available for U.S. waters.

KOHALA RESIDENT STOCK

POPULATION SIZE

Using the photo-ID catalog of individuals encountered between 2002 and 2009, Achettino (2010) used a POPAN open-population model to produce a mark-recapture abundance estimate of 447 (CV=0.12) individuals. A portion of the data used in that analysis is more than 8 years old; however, full sighting histories were required to produce a valid model for mark-recapture analyses, such that an estimate restricted to only the later years of the period is not available. Although this estimate includes individuals that have died since 2002, it should be considered an overestimate; however, it is currently the best available abundance estimate for the resident stock.

Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow et al 1995) around the 2002-2009 mark-recapture abundance estimate (Aschettino 2010), or 404 melon-headed whales in the Kohala resident stock.

Current Population Trend

Photographic mark-recapture data will be evaluated in the future to assess whether sufficient data exists to assess trends.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population estimate (404) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no known fishery mortality; Wade and Angliss 1997), resulting in a PBR of 4.0 Kohala resident melon-headed whales per year.

STATUS OF STOCK

The Kohala resident stock of melon-headed whales is not considered strategic under the MMPA. The status of this stock relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Melon-headed whales are not listed as “threatened” or “endangered” under the Endangered Species Act (1973), nor designated as “depleted” under the MMPA. There have been no reports of recent mortality or serious injuries; however, there is no systematic monitoring of takes in near-shore fisheries that may take this species. Given noted bullet holes and potential line injuries on individuals from this stock, insufficient information is available to determine whether the total fishery mortality and serious injury for Kohala Resident melon-headed whales is insignificant and approaching zero mortality and serious injury rate. The restricted range and small population size of Hawaii Island resident melon-headed whales suggests this population may be at risk due to its proximity to U.S. Navy training, including sonar transmissions, in the Alenuihaha Channel between Hawaii Island and Maui (Anonymous 2006). Although a 2004 mass-stranding in Hanalei Bay, Kauai could not be conclusively linked to Naval training events in the region (Southall et al. 2006), the spatiotemporal link between sonar exercises and the stranding does raise concern on the potential impact on the Kohala Resident population due to of sonar training nearby.

HAWAIIAN ISLANDS STOCK

POPULATION SIZE

An abundance estimate of melon-headed whales is available for the eastern tropical Pacific (Wade and Gerrodette 1993), but it is not known whether any of these animals are part of the same population that occurs around the Hawaiian Islands. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 2,950 (CV=1.17) melon-headed whales (Barlow 2006). The recent 2010 shipboard line-transect survey of the Hawaiian Islands EEZ resulted in an abundance estimate of 2,860 (CV=1.04) melon-headed whales (Bradford et al. 2013). Using the photo-ID catalog of individuals encountered between 2002 and 2009 near the main Hawaiian Islands, Achettino (2010) used a POPAN open-population model to produce a mark-recapture abundance estimate of 5,794 (CV=0.20) individuals. A portion of the data used in that analysis is more than 8 years old; however, full sighting histories were required to produce a valid model for mark-recapture analyses, such that an estimate restricted to only the later years of the period is not available. Although this estimate includes individuals that have died since 2002, the mark-recapture estimate is the best available abundance estimate for the Hawaiian Islands stock given the significantly larger dataset used to produce the estimate versus a single line-transect encounter.

Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow et al 1995) of the 2002-2009 mark-recapture abundance estimate (Aschettino 2010) or 4,904 melon-headed whales in the Hawaii pelagic stock. This log-normal 20th percentile minimum population size is greater than the number of photo-identified individuals within the population (820) (Aschettino et al 2012) and greater than the log-normal 20th percentile line-transect estimate (1,326) (Bradford et al. 2013).

Current Population Trend

No trend analyses have been conducted on Hawaiian Islands melon-headed whales from line-transect surveys because only two estimates exist. Photographic mark-recapture data will be evaluated in the future to assess whether sufficient data exists to assess trends.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population estimate for the U.S. EEZ of the Hawaiian Islands (4,904) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no known fishery mortality; Wade and Angliss 1997), resulting in a PBR of 49 melon-headed whales per year.

STATUS OF STOCK

The Hawaiian Islands stock of melon-headed whales is not considered strategic under the 1994 amendments to the MMPA. The status of this stock relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Melon-headed whales are not listed as “threatened” or “endangered” under the Endangered Species Act (1973), nor designated as “depleted” under the MMPA. There have been no reports of recent mortality or serious injuries; however, there is no systematic monitoring of takes in near-shore fisheries that may take this species. Given noted bullet holes and potential line injuries on individuals from this stock, insufficient information is available to determine whether the total fishery mortality and serious injury for Hawaiian Islands melon-headed whales is insignificant and approaching zero mortality and serious injury rate. A 2004 mass-stranding of melon-headed whales in Hanalei Bay, Kauai occurred during a multi-national sonar training event around Hawaii (Southall et al. 2006). Although the event could not be conclusively linked to Naval training events in the region (Southall et al. 2006), the spatiotemporal link between sonar exercises and the stranding does raise concern on the potential impact on the Hawaiian Islands population due to its frequent use of nearshore areas within the main Hawaiian Islands.

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PYGMY KILLER WHALE (*Feresa attenuata*): Hawaii Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

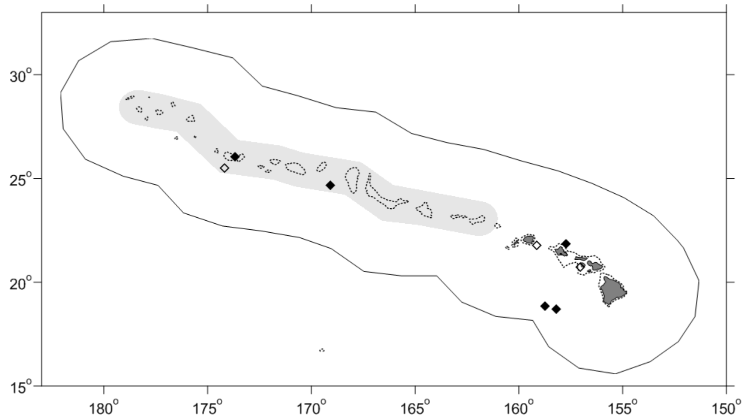

Figure 1. Pygmy killer whale sighting locations during the 2002 (open diamonds) and 2010 (black diamonds) shipboard surveys of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006, Bradford et al. 2013; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ. Gray shading indicates area of Papahanaumokuakea Marine National Monument. Dotted line represents the 1000m isobath.

Pygmy killer whales are found in tropical and subtropical waters throughout the world (Ross and Leatherwood 1994). They are poorly known in most parts of their range. Small numbers have been taken directly and incidentally in both the western and eastern Pacific. Most knowledge of this species is from stranded or live-captured specimens. Pryor et al. (1965) stated that pygmy killer whales have been observed several times off the lee shore of Oahu, and that "they seem to be regular residents of the Hawaiian area." More recently, pygmy killer whales have also been seen off the islands of Niihau and Lanai (McSweeney et al. 2009). Summer/fall shipboard surveys of the waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands, resulted in three sightings of pygmy killer whales in 2002 and five in 2010 (Figure 1; Barlow 2006, Bradford et al. 2013).

Several recent studies suggest that while pygmy killer whales are relatively rare in Hawaiian waters, a small resident population occurs in the main Hawaiian Islands (MHI). A 22-year study off the Hawaii Island indicates that pygmy killer whales occur there year-round and in stable social groups. Over 80% of pygmy killer whales seen off Hawaii Island have been resighted and 92% have been linked into a single social network (McSweeney *et al.* 2009). Movements have also been documented between Hawaii Island and Oahu and between Oahu and Lanai (Baird et al 2011a). Satellite telemetry data from four tagged pygmy killer whales suggest this resident group remains within 20km of shore (Baird et al. 2011a,b). Encounter rates for pygmy killer whales during near shore surveys are rare, representing less only 1.7% of all cetacean encounters to since 2000 (Baird et al. 2013). Division of this population into a separate island-associated stock may be warranted in the future.

For the Marine Mammal Protection Act (MMPA) stock assessment reports, there is a single Pacific management stock including animals found both within the Hawaiian Islands EEZ and in adjacent high seas waters. Because data on abundance, distribution, and human-caused impacts are largely lacking for high seas waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

POPULATION SIZE

A population estimate is available from the eastern tropical Pacific (Wade and Gerrodette 1993), but it is not known whether any of these animals are part of the same population that occurs around the Hawaiian Islands. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 956 (CV=0.83) pygmy killer whales (Barlow 2006). The recent 2010 shipboard line-transect survey of the Hawaiian Islands EEZ resulted in an abundance estimate of 3,433 (CV=0.52) pygmy killer whales (Bradford et al. 2013).This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow et al. 1995) of the 2010 abundance estimate or 2,274 pygmy killer whales within the Hawaiian EEZ.

Current Population Trend

The broad and overlapping confidence intervals around the 2002 and 2010 estimates preclude assessment of pygmy killer whales trends with the available data.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for pygmy killer whales stock is calculated as the minimum population estimate for the U.S. EEZ of the Hawaiian Islands (2,274) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a stock of unknown status with no known fishery mortality or serious injury within the Hawaiian Islands EEZ; Wade and Angliss 1997), resulting in a PBR of 23 pygmy killer whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*". Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fishery Information

Information on fishery-related mortality and serious injury of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaii fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Entanglement in gillnets and hooking or entanglement in various hook and line fisheries have been reported for small cetaceans in Hawaii (Nitta & Henderson, 1993). A stranded pygmy killer whale from Oahu showed signs of hooking injury (Schofield 2007) and mouthline injuries have also been noted in some individuals (Baird unpublished data), though it is not known if these interactions result in serious injury or mortality. No estimates of human-caused mortality or serious injury are currently available for nearshore hook and line or gillnet fisheries because these fisheries are not observed or monitored for protected species bycatch.

There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2007 and 2011, no pygmy killer whales were observed hooked or entangled in the SSLL fishery (100% observer coverage) or the DSLL fishery (20-22% observer coverage) (Bradford & Forney 2013, McCracken 2013). However, eight unidentified cetaceans were taken in the DSLL fishery, and two unidentified cetaceans were taken in the SSLL fishery, some of which may have been pygmy killer whales.

Other Mortality

In recent years, there has been increasing concern that loud underwater sounds, such as active sonar and seismic operations, may be harmful to beaked whales (Cox et al. 2006) and other cetaceans, including melon-headed whales (Southall et al. 2006, 2013, Brownell et al. 2009) and pygmy killer whales (Wang and Yang 2006). The use of active sonar from military vessels has been implicated in mass strandings of beaked whales, and recent mass-stranding reports suggest some delphinids may be impacted as well. Two mass-strandings of pygmy killer whales occurred in the coastal areas of southwest Taiwan in February 2005, possibly associated with offshore naval training exercises (Wang and Yang 2006). A necropsy of one of the pygmy killer whales revealed hemorrhaging in the cranial tissues of the animal. Additional research on the behavioral response of delphinids in the presence of sonar transmissions is needed in order to understand the level of impact. No estimates of potential mortality or serious injury are available for U.S. waters.

STATUS OF STOCK

The Hawaii stock of pygmy killer whales is not considered strategic under the 1994 amendments to the MMPA. The status of pygmy killer whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Pygmy killer whales are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor designated as "depleted" under the MMPA. Given the absence of recent recorded fishery-related mortality or serious injuries, the total fishery mortality and serious injury can be considered to be insignificant and approaching zero.

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Revised 7/5/2016

FALSE KILLER WHALE (*Pseudorca crassidens*): Hawaiian Islands Stock Complex – Main Hawaiian Islands Insular, Northwestern Hawaiian Islands, and Hawaii Pelagic Stocks

STOCK DEFINITION AND GEOGRAPHIC RANGE

False killer whales are found worldwide in tropical and warm-temperate waters (Stacey *et al.* 1994). In the North Pacific, this species is well known from southern Japan, Hawaii, and the eastern tropical Pacific. False killer whales were encountered during two shipboard line-transect surveys of the U.S. Exclusive Economic Zone (EEZ) around the Hawaiian Islands in 2002 and 2010 (Figure 1; Barlow 2006, Bradford *et al.* 2014) and focused studies near the main and Northwestern Hawaiian Islands indicate that false killer whales occur in near shore waters throughout the Hawaiian archipelago (Baird et al 2008, 2013). This species also occurs in U.S. EEZ waters around Palmyra and Johnston Atolls (e.g., Barlow *et al.* 2008, Bradford & Forney 2013) and American Samoa (Johnston *et al.* 2008, Oleson 2009).

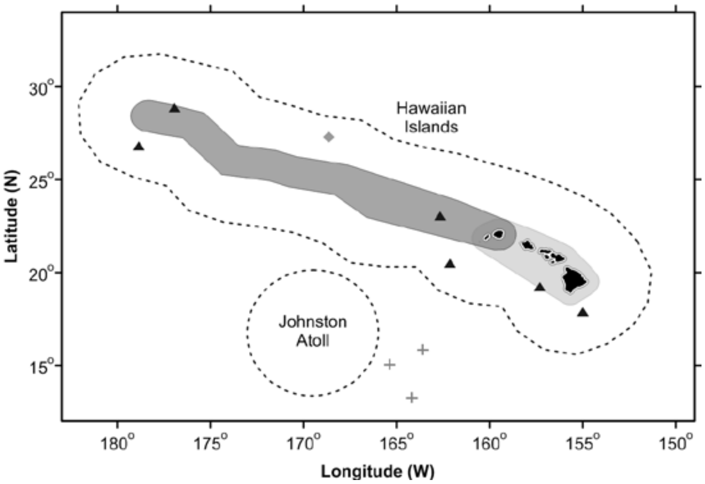

Figure 1. False killer whale on-effort sighting locations during standardized shipboard surveys of the Hawaiian Islands U.S. EEZ (2002, gray diamond, Barlow 2006; 2010, black triangles, Bradford *et al.* 2014, pelagic waters of the central Pacific south of the Hawaiian Islands (2005, gray crosses, Barlow and Rankin 2007) and the Johnston Atoll EEZ. Outer dashed lines represent approximate boundary of U.S. EEZs; light shaded gray area is the main Hawaiian Islands insular false killer whale stock area, including overlap zone between MHI insular and pelagic false killer whale stocks; dark shaded gray area is the Northwestern Hawaiian Islands stock area, which overlaps the pelagic false killer whale stock area and part of the MHI insular false killer whale stock area. Detail of stock boundaries shown in Figure 2.

Genetic, photo-identification, and telemetry studies indicate there are three demographically-independent populations of false killer whales in Hawaiian waters. Genetic analyses indicate restricted gene flow between false killer whales sampled near the main Hawaiian Islands (MHI), the Northwestern Hawaiian Islands (NWHI), and in pelagic waters of the Eastern (ENP) and Central North Pacific (CNP) (Chivers *et al.* 2010; Martien *et al.* 2011, 2014). Martien *et al.* (2014) analyzed mitochondrial DNA (mtDNA) control region sequences and genotypes from 16 nuclear DNA (nuDNA) microsatellite loci from 206 individuals from the MHI, NWHI, and offshore waters of the CNP and ENP and showed highly significant differentiation between populations confirming limited gene flow in both sexes. Their analysis using mtDNA reveals strong phylogeographic patterns consistent with local evolution of haplotypes unique to false killer whales occurring nearshore within the Hawaiian Archipelago and their assessment of nuDNA suggests that NWHI false killer whales are at least as differentiated from MHI animals as they are from offshore animals. Photographic–identification and social network analyses of individuals seen near the MHI indicate a tight social network with no connections to false killer whales seen near the NWHI or in offshore waters, and assessment of satellite telemetry collected from 27 tagged MHI false killer whales shows movements restricted to the MHI (Baird *et al.* 2010, 2012). Further evaluation of photographic and genetic data from individuals seen near the MHI suggests the occurrence of three separate social clusters (Baird *et al.* 2012, Martien *et al.* 2011), where mating occurs primarily, though not exclusively within clusters (Martien *et al.* 2011). Additional details on data and analyses supporting the separation of false killer whales in Hawaiian waters into three separate stocks are summarized within Oleson *et al.* (2010, 2012).

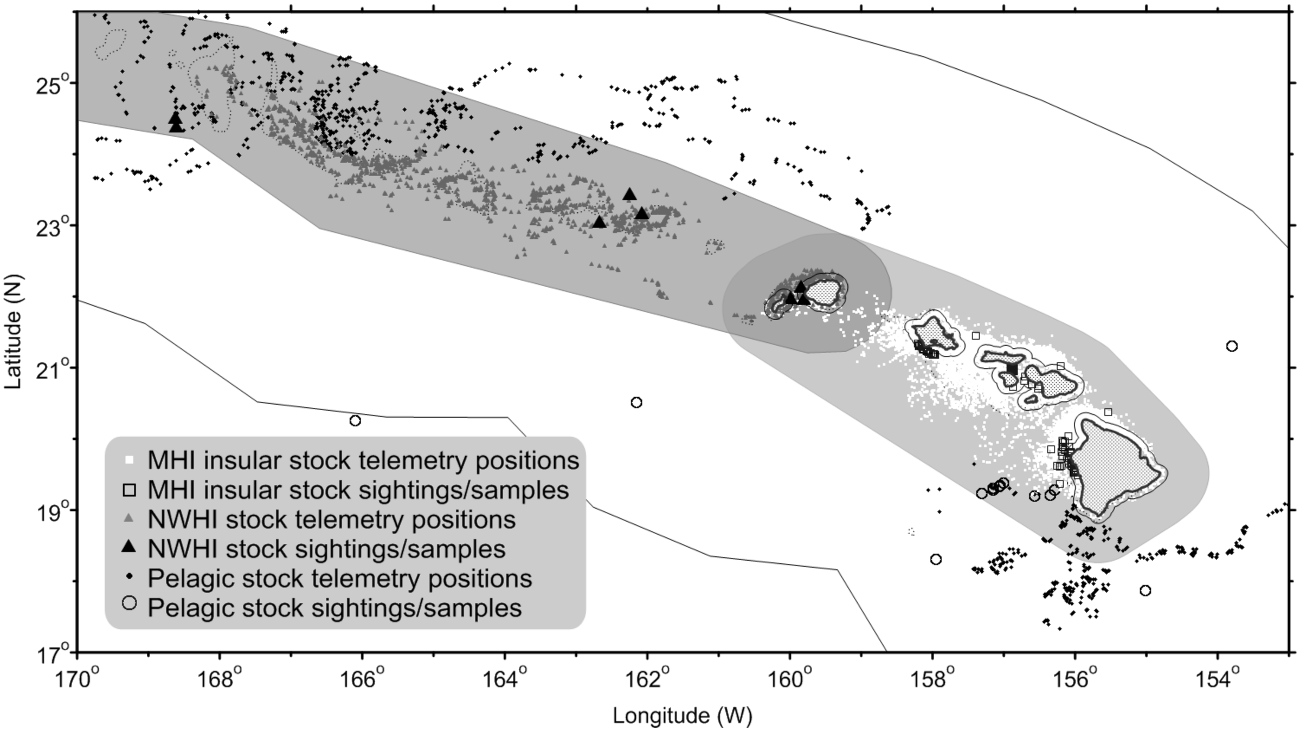

Figure 2. Sighting, biopsy sample, and telemetry record locations of false killer whale identified as being part of the MHI insular (square symbols), NWHI (triangle symbols), or pelagic (circle symbols) stocks. The MHI stock area is shown in light gray; the NWHI stock area is shown in dark gray; the pelagic stock area includes the entire EEZ excluding the region delineated by the black line around each of the MHI (reproduced from Bradford et al. 2015). The MHI insular, pelagic, and NWHI stocks overlap around Kauai and Niihau.

Fishery observers have collected tissue samples for genetic analysis from cetaceans incidentally caught in the Hawaii-based longline fishery since 2003. Between 2003 and 2010, eight false killer whale samples, four collected outside the Hawaiian EEZ and four collected within the EEZ but more than 100 nautical miles (185km) from the main Hawaiian Islands were determined to have Pacific pelagic haplotypes (Chivers *et al.* 2010). At the broadest scale, significant differences in both mtDNA and nuDNA are evident between pelagic false killer whales in the ENP and CNP strata (Chivers *et al.* 2010), although the sample distribution to the east and west of Hawaii is insufficient to determine whether the sampled strata represent one or more stocks, and where pelagic stock boundaries would be drawn.

The stock range and boundaries of the three Hawaiian stocks of false killer whales were recently reevaluated, given significant new information on the occurrence and movements of each stock and are reviewed in detail in Bradford *et al.* (2015) and shown in Figure 2. The stocks have partially overlapping ranges. MHI insular false killer whales have been satellite tracked as far as 115 km from the main Hawaiian Islands, while pelagic stock animals have been tracked to within 11 km of the main Hawaiian Islands and throughout the NWHI. NWHI false killer whales have been seen as far as 93 km from the NWHI and near-shore around Kauai and Oahu (Baird *et al.* 2012, Bradford *et al.* 2015). Stock boundary descriptions are complex, but can be summarized as follows. The MHI insular stock boundary is derived from a Minimum Convex Polygon (MCP) of a 72-km radius extending around the main Hawaiian Islands, with the offshore extent of the radii connected on the leeward sides of Hawaii Island and Niihau to encompass the offshore movements of MHI individuals within that region. The NWHI stock boundary is defined by a 93-km radius around the NWHI, or the boundary of the Papahānaumokuākea Marine National Monument, with this radial boundary extended to the southeast to encompass Kauai and Niihau. The NWHI boundary is latitudinally expanded at the eastern end of the NWHI to encompass animal movements observed outside of the 93-km radius (see Figure 2). The pelagic stock has no outer boundary. Throughout the MHI the pelagic stock inner boundary is placed at 11 km from shore. There is no inner boundary within the NWHI. The construction of these stock boundaries results in a number of stock overlap zones. The waters outside of 11km from shore from Oahu to Hawaii Island out to the MHI insular stock boundary are an overlap zone between the MHI insular and pelagic stocks. The entirety of the NWHI stock range, with the exception of the area within 11km around

Kauai and Niihau is an overlap zone between NWHI and pelagic false killer whales. All three stocks overlap between 11 km from shore around Kauai and Niihau out to the MHI insular stock boundary between Kauai and Nihoa and to the NWHI stock boundary between Kauai and Oahu (see Figure 2).

The pelagic stock includes animals found within the Hawaiian Islands EEZ and in adjacent international waters; however, because data on false killer whale abundance, distribution, and human-caused impacts are largely lacking for international waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005). The Palmyra Atoll stock of false killer whales is still considered to be a separate stock because comparisons amongst false killer whales sampled at Palmyra Atoll and those sampled from the MHI insular stock and the pelagic ENP reveal restricted gene flow, although the sample size remains too low for robust comparisons (Chivers *et al.* 2010). NMFS will obtain and analyze additional samples for genetic studies of Hawaii pelagic and Palmyra stock structure, and will evaluate new information on stock ranges as it becomes available.

For the Marine Mammal Protection Act (MMPA) stock assessment reports, there are currently five Pacific Islands Region management stocks : 1) the Main Hawaiian Islands insular stock, which includes animals inhabiting waters within a modified 72km radius around the main Hawaiian Islands, 2) the Northwestern Hawaiian Islands stock, which includes animals inhabiting waters within the 93-km radius of the Papahānaumokuākea Marine National Monument and around Kauai, with a slight latitudinal expansion of this area at the eastern end of the range, 3) the Hawaii pelagic stock, which includes false killer whales inhabiting waters greater than 11 km from the main Hawaiian Islands, including adjacent high seas waters, 4) the Palmyra Atoll stock, which includes animals found within the U.S. EEZ of Palmyra Atoll, and 5) the American Samoa stock, which includes animals found within the U.S. EEZ of American Samoa. Estimates of abundance, potential biological removal, and status determinations for the first three stocks are presented below; the Palmyra Atoll and American Samoa stocks are covered in separate reports.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Interactions with false killer whales, including depredation of catch of a variety of pelagic fishes, have been identified in logbooks and NMFS observer records from Hawaii pelagic longline fishing trips (Nitta and Henderson 1993, Oleson *et al.* 2010, PIRO 2015). False killer whales have been observed feeding on mahi mahi, *Coryphaena hippurus*, and yellowfin tuna, *Thunnus albacares* (Baird 2009), and they have been reported to take large fish from the trolling lines of commercial and recreational fishermen (Shallenberger 1981). There are anecdotal reports of marine mammal interactions in the commercial Hawaii shortline fishery which sets gear at Cross Seamount and possibly around the main Hawaiian Islands. The commercial shortline fishery is licensed to sell their catch through the State of Hawaii Commercial Marine License program, and until recently, no reporting systems existed to document marine mammal interactions. Baird and Gorgone (2005) documented high rates of dorsal fin disfigurements consistent with injuries from unidentified fishing line for false killer whales belonging to the MHI insular stock. A recent report included evaluation of additional individuals with dorsal fin injuries and suggested that the rate of interaction between false killer whales and various forms of hook and line gear may vary by population and social cluster, with the MHI insular stock showing the highest rate of dorsal fin disfigurements (Baird *et al.* 2014). The commercial or recreational fishery or fisheries responsible for these injuries is unknown. Examination of a stranded MHI insular false killer whale in October 2013 revealed that this individual had five fishing hooks and fishing line in its stomach (NMFS PIR Marine Mammal Response Network). Although the fishing gear is not believed to have caused the death of the whale, the finding confirms that MHI insular false killer whales are consuming previously hooked fish or are interacting with hook and line fisheries in the MHI. Many of the hooks within the whale’s stomach were not consistent with those currently allowed for use within the commercial longline fisheries and could have come from a variety of near-shore fisheries. No estimates of human-caused mortality or serious injury are currently available for near-shore hook and line or other fisheries because these fisheries are not observed or monitored for protected species bycatch.

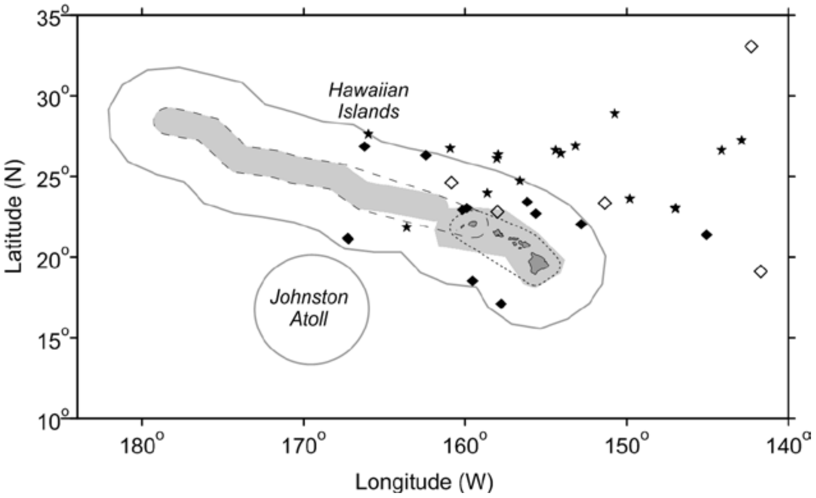

Figure 3. Locations of observed false killer whale takes (black symbols) and possible takes (blackfish) of this species (open symbols) in the Hawaii-based longline fisheries, 2009-2013. Takes occurring prior to the implementation of Take-Reduction Plan (2010-2012) regulations are shown as diamonds, and those since the TRP regulations (2013-2014) are shown as stars. Some take locations overlap. Solid gray lines represent the U.S. EEZ; the dotted line is the MHI insular stock area; the dashed line is the NWHI stock area; both MHI and NWHI stocks overlap with the pelagic stock. The gray shaded area represents the longline exclusion zone, implemented year-round since December 31, 2012, and Papahānaumokuākea Marine National Monument. Both areas are currently closed to longline fishing.

Because of high rates of false killer whale mortality and serious injury in Hawaii-based longline fisheries, a Take Reduction Team was established in January 2010 (75 FR 2853, 19 January, 2010). The Team was charged with developing recommendations to reduce incidental mortality and serious injury of the Hawaii pelagic, MHI insular and Palmyra stocks of false killer whales in Hawaii-based longline fisheries. The Team submitted a draft Take Reduction Plan (TRP) to NMFS (http://www.nmfs.noaa.gov/pr/pdfs/interactions/fkwtrp_draft.pdf), and NMFS published a final TRP based on the Team's recommendations (77 FR 71260, 29 November, 2012). Take reduction measures include gear requirements, time-area closures, and measures to improve captain and crew response to hooked and entangled false killer whales. The seasonal contraction of the Longline Exclusion Zone (LLEZ) around the MHI was also eliminated. The TRP became effective December 31, 2012, with gear requirements effective February 27, 2013. These measures were not in effect during 2008-2012, the majority of the period for which bycatch was estimated in this report. Adjustments to bycatch estimation methods are implemented for 2013 to account for changes in fishing gear and captain training intended to reduce the false killer whale serious injury rate (see below, McCracken 2015).

There are two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas, but are prohibited from operating within the Papahānaumokuākea Marine National Monument and within the LLEZ around the main Hawaiian Islands. Stock Assessment Reports generally describe fishery interaction details for the most recent five years, and as such, only years 2010 through 2014 are described here. Years 2008 and 2009 are also included in Table 1 to allow for computation of a 5-yr annual bycatch estimate for the period prior to the implementation of the TRP. Between 2010 and 2014, three false killer whales were observed hooked or entangled in the SSLL fishery (100% observer coverage) within the U.S. EEZ of the Hawaiian Islands, and 25 false killer whales were observed taken in the DSLL fishery (20-22% observer coverage) within Hawaiian waters or adjacent high-seas waters (excluding Palmyra Atoll EEZ waters) (Bradford & Forney 2016). The severity of injuries resulting from interactions with longline gear is determined based on an evaluation of the observer's description of each interaction and following the most recently developed criteria for assessing serious injury in marine mammals (NMFS 2012). Of the three animals taken in the SSLL fishery, two were considered not seriously injured and one could not be determined based on the information provided by the observer. In the DSLL fishery, 12 false killer whales were taken within the Hawaiian EEZ. Two of those takes occurred in 2012 within the pelagic-NWHI overlap zone north of Kauai before this area was closed to longline fishing. Both animals were considered to be seriously injured. Of the remaining 10 interactions within the Hawaiian EEZ, all were within the range of the pelagic stock, with six considered seriously injured, one not considered seriously injured, and three could not be determined based on the information provided by the observer. Outside of the Hawaii EEZ, ten were considered seriously injured, and three were considered not seriously injured. Five additional unidentified "blackfish" (unidentified cetaceans known to be either false killer whales or short-finned pilot whales) were also taken, one within the SSLL fishery and four in the DSLL fishery. The single SSLL interaction occurred outside the Hawaiian EEZ and the animal was considered seriously injured. Of the four DSLL interactions, two occurred inside the Hawaii EEZ, with both considered seriously injured, and two occurred outside the Hawaii EEZ, with one considered seriously injured and one considered not seriously injured.

Table 1. Summary of available information on incidental mortality and serious injury (MSI) of false killer whales and unidentified blackfish (false killer whale or short-finned pilot whale) in commercial longline fisheries, by stock and EEZ area, as applicable (McCracken 2016). 5-yr mean annual takes are presented for 2008-2012, prior to the implementation of the TRP, for 2013-2014 due to changes in fishing gear under the TRP intended to reduce serious injury rate, and for 2010-2014, ignoring any change in mortality rate. Information on all observed takes (T) and combined mortality & serious injury is included. Unidentified blackfish are pro-rated as either false killer whales or short-finned pilot whales according to their distance from shore (McCracken 2010). CVs are estimated based on the combined variances of annual false killer whale and blackfish take estimates and the relative density estimates for each stock within the overlap zones. Values of '0' presented with no further precision are based on observation at 100% coverage and are not estimates.

				Observed takes		**Estimated M&SI (CV)**			
				FKW T/MSI UB T/MSI		**Pelagic Stock**			
Fishery Name	**Year**	**Data Type**	**Percent Observer Coverage**	**Outside U.S EEZ**	**Within Hawaii EEZ**	**Outside U.S EEZ**	**Within Hawaii EEZ**	**MHI insular Stock**	**NWHI Stock**
Hawaii-based deep-set longline fishery	2008	Observer data	22%	0 0	3/3 3/3	0 (-)	16.2 (0.4)	0.3 (0.4)	0.5 (1.1)
	2009		21%	7/7 0	3/3 0	38.5 (0.2)	11.8 (0.9)	0.2 (0.8)	0.4 (1.3)
	2010		21%	1/1 0	3/2 1/1	5.6 (1.5)	13.2 (0.4)	0.4 (0.5)	0.2 (1.0)
	2011		20%	0 1/0	3/3† 1/1	2.2 (3.6)	12.2 (0.4)	0.1 (0.6)	0.3 (1.2)
	2012		20%	0 1/1	3/3*† 0	3.6 (2.3)	13.0 (0.4)	0.1 (3.9)	1.6 (1.3)
	2013		20%	3/1 0	1/1 0	6.6 (0.9)	4.1 (1.4)	0.0 (1.9)	0.0 (-)
	2014		21%	9/8 0	2/1† 0	35.8 (0.5)	8.4 (0.7)	0.0 (0.8)	0.0 (1.5)
Pre-TRP Mean Estimated Annual Take (CV) 2008-2012						**10.0 (0.4)**	**13.3 (0.2)**	**0.2 (0.4)**	**0.6 (0.8)**
Estimated Annual Take (CV) under TRP 2013-2014						**21.2 (0.5)**	**6.2 (0.7)**	**0.0 (0.7)**	**0.0 (1.3)**
Mean Estimated Annual Take (CV) 2010-2014						**10.7 (0.4)**	**10.2 (0.2)**	**0.1 (0.6)**	**0.4 (1.0)**
Hawaii-based shallow-set longline fishery	2008	Observer data	100%	0 1/1	1/0 0	0.6	0.0	0	0.0
	2009		100%	0 0	1/1 0	0	1.0	0	0.0
	2010		100%	0 0	0 0	0	0	0	0
	2011		100%	0 1/1	1/0 0	0.7	0.0	0	0
	2012		100%	0 0	1/1† 0	0	0.3	0	0.0
	2013		100%	0 0	0 0	0	0	0	0
	2014		100%	0 0	1/0 0	0	0	0	0
Mean Annual Takes (100% coverage) 2008-2012						**0.3**	**0.3**	**0**	**0.0**
Mean Annual Take (CV) under TRP 2013-2014						**0**	**0**	**0**	**0**

Mean Annual Takes (100% coverage) 2010-2014	**0.1**	**0.1**	**0**	**0.0**
Pre-TRP Minimum total annual takes within U.S. EEZ (2008-2012)		**13.6 (0.2)**	**0.2 (0.4)**	**0.6 (0.8)**
Minimum total take under TRP within U.S. EEZ 2013-2014		**6.2 (0.7)**	**0.0 (0.7)**	**0.0 (1.3)**
Minimum total annual takes within U.S EEZ (2010-2014)		**10.3 (0.2)**	**0.1 (0.6)**	**0.4 (1.0)**

* Two observed takes occurred within the NWHI-pelagic overlap zone and are therefore allocated for proration between NWHI and pelagic stocks. Remaining estimated takes are prorated among stocks as described for each overlap zone.

† Injury status could not be determined based on information collected by the observer. Injury status is prorated (see text).

The injury status of estimated takes is prorated to serious versus non-serious using the historic rate of serious injury within the observed takes. For the period 2008 to 2012, the rate of serious injury for false killer whales was 93% (McCracken 2014). Because the implementation of weak hooks under the TRP was intended to reduce the serious injury rate, these historic averages were not used for 2013-2014. The allocation of estimated serious versus non-serious injuries in 2013-2014 takes was based on the proportion of serious versus non-serious injuries of observed takes in those years (McCracken 2016). The proration of serious injury status will be updated as additional data become available to better estimate serious versus non-serious injury proportion under TRP measures.

Takes of false killer whales of unknown stock within the stock overlap zones must be prorated to MHI insular, pelagic, or NWHI stocks. No genetic samples are available to establish stock identity for the two takes inside the NWHI-pelagic overlap zone north of Kauai, but both stocks are considered at risk of interacting with longline gear. The pelagic stock is known to interact with longline fisheries in waters offshore of the overlap zone, based on two genetic samples obtained by fishery observers (Chivers *et al.* 2010). MHI insular and NWHI false killer whales have been documented via telemetry to move far enough offshore to reach longline fishing areas (Bradford *et al.* 2015), and animals from the MHI insular stock have a high rate of dorsal fin disfigurements consistent with injuries from unidentified fishing line (Baird and Gorgone 2005, Baird *et al.* 2014). Annual bycatch estimates are prorated to stock using the following process. Takes of unidentified blackfish are prorated to false killer whale and short-finned pilot whale based on distance from shore (McCracken 2010). The distance-from-shore model was chosen following consultation with the Pacific Scientific Review Group, based on the model's logic and performance relative to a number of other models with similar output (McCracken 2010). Following proration of unidentified blackfish takes to species, Hawaii EEZ and high-seas estimates of false killer whale take are calculated by summing the annual false killer whale take and the annual blackfish take prorated as false killer whale within each region (McCracken 2016). For the deep-set fishery within the Hawaii EEZ, annual takes are apportioned to each stock overlap zone and the pelagic-only stock area based on relative annual fishing effort in each zone. The total annual EEZ bycatch estimate is multiplied by the proportion of total fishing effort (by set) within each zone to estimate the bycatch within that zone. Because the shallow-set longline fishery is fully observed, takes are assigned to the zone in which they were observed and there is no further apportionment based on fishing effort. For each longline fishery, the zonal bycatch estimates are then multiplied by the relative density of each stock in the respective zone to prorate bycatch to stock. For the deep-set fishery, if bycatch was observed within a specific overlap zone, the observed takes were assigned to that zone and the remaining estimated bycatch was assigned among zones and stocks according to the described process. Following proration by fishing effort and stock density within each zone, stock-specific bycatch estimates are summed across zones to yield the total stock-specific annual bycatch by fishery. Uncertainty in stock-specific bycatch estimates combines variances of total annual false killer whale bycatch and the fractional variance of false killer whale density according to which stock is being estimated. Enumeration of fishing effort within stock overlap zones is assumed to be known without error.

Based on this approach, estimates of annual mortality and serious injury of false killer whales, by stock and EEZ area, are shown in Table 1. Three mortality and serious injury estimates are provided (Table 1): a 5-yr average for the period prior to TRP-implementation (2008-2012), a 2-yr average for the period following TRP implementation (2013-2014), and a 5-yr average for the most recent 5 years assuming no significant change in mortality rate within the fishery (2010-2014). The bycatch rate (per 1000 sets) and of the proportion of non-serious injuries prior to and following TRP implementation were examined as part of the FKW TRT monitoring strategy.

Proration of false killer whale takes within the overlap zones and of unidentified blackfish takes introduces unquantified uncertainty into the bycatch estimates, but until methods of determining stock identity for animals observed taken within the overlap zone are available, and all animals taken can be identified to species (e.g., photos, tissue samples), these proration approaches are needed ensure that potential impacts to all stocks are assessed in the overlap zones.

MAIN HAWAIIAN ISLANDS INSULAR STOCK

POPULATION SIZE

A Status Review for the MHI insular stock in 2010 (Oleson *et al.* 2010) used recent, unpublished estimates of abundance for two time periods, 2000-2004 and 2006-2009 in a Population Viability Analysis (PVA). These estimates were based on open population models, for the two time periods. The abundance estimate for the 2000-2004 period is 162 (CV=0.23) animals. Two separate estimates for 2006-2009 were presented in the Status Review; 151 (CV=0.20) and 170 (CV=0.21), depending on whether animals photographed near Kauai are included in the estimate. The animals seen near Kauai included in the higher estimate have now been associated with the NWHI stock (Baird *et al.* 2013), such that the best estimate of population size for the MHI insular stock is the smaller estimate of 151 animals. Half the data used in the derivation of this population estimate are more than 8 years old and are now considered outdated under NMFS Guidelines for Assessing Marine Mammal Stocks (NMFS 2005).

Minimum Population Estimate

The minimum population estimate for the MHI insular stock of false killer whales is the number of distinctive individuals identified during 2011 to 2014 photo-identification studies, or 92 false killer whales (Baird *et al.* 2015). A portion of the data used in 2006-2009 mark-recapture estimates (Oleson *et al.* 2010) of abundance are considered outdated, and therefore are not suitable for deriving a minimum abundance estimate.

Current Population Trend

Reeves *et al.* (2009) suggested that the MHI insular stock of false killer whales may have declined during the last two decades, based on sightings data collected near Hawaii using various methods between 1989 and 2007. Baird (2009) reviewed trends in sighting rates of false killer whales from aerial surveys conducted using consistent methodology around the main Hawaiian Islands between 1994 and 2003 (Mobley *et al.* 2000). Sighting rates during these surveys showed a statistically significant decline that could not be attributed to any weather or methodological changes. The Status Review of MHI insular false killer whales (Oleson *et al.* 2010) presented a quantitative analysis of extinction risk using a Population Viability Analysis (PVA). The modeling exercise was conducted to evaluate the probability of actual or near extinction, defined as a population reduced to fewer than 20 animals, given measured, estimated, or inferred information on population size and trends, and varying impacts of catastrophes, environmental stochasticity and Allee effects. All plausible models indicated the probability of decline to fewer than 20 animals within 75 years was greater than 20%. Though causation was not evaluated, all plausible models indicated the population has declined since 1989, at an average rate of -9% per year (95% probability intervals -5% to -12.5%), though some two-stage models suggested a lower rate of decline over the past decade (Oleson *et al.* 2010).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate for this species in Hawaiian waters.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the MHI insular false killer whale stock is calculated as the minimum population estimate (92) <u>times</u> one half the default maximum net growth rate for cetaceans (½ of 4%) <u>times</u> a recovery factor of 0.1 (for a stock listed as Endangered under the ESA and with minimum population size less than 1500 individuals; Taylor *et al.* 2000) resulting in a PBR of 0.18 false killer whales per year, or approximately one animal every 5.5 years.

STATUS OF STOCK

The status of MHI insular stock false killer whales relative to OSP is unknown, although this stock appears to have declined during the past two decades (Oleson *et al.* 2010, Reeves *et al.* 2009; Baird 2009). MHI insular false killer whales are listed as “endangered” under the Endangered Species Act (1973) (77 FR 70915, 28 November, 2012). The Status Review report produced by the Biological Review Team (BRT) (Oleson *et al.* 2010) found that Hawaiian insular false killer whales are a Distinct Population Segment (DPS) of the global false killer whale taxon. Of the 29 identified threats to the population, the BRT considered the effects of small population size, including inbreeding depression and Allee effects, exposure to environmental contaminants (Ylitalo *et al.* 2009), competition for food with commercial fisheries (Boggs & Ito, 1993, Reeves *et al.* 2009), and hooking, entanglement, or intentional harm by fishermen to be the most substantial threats to the population. The BRT concluded that Main Hawaiian Islands insular false killer whales were at high risk of extinction. Following additional information on the occurrence of another island-associated stock in the NWHI, the BRT reevaluated the DPS decision and concluded that the population still met the standard to be listed as a DPS (Oleson *et al.* 2012). Because MHI insular false killer whales are formally listed as "endangered" under the ESA, they are automatically considered as a "depleted" and "strategic" stock under the MMPA. For the 5-yr period prior to the implementation of the TRP, the average estimated mortality and serious injury to MHI insular stock false killer whales (0.21 animals per year) exceeded the PBR (0.18 animals per year). For years 2013-2014, the estimate of mortality and serious injury (0) is below the PBR (0.18), and ignoring any change in mortality rates is assumed under the TRP, the mortality and serious injury to MHI insular false killer whales for the most recent 5-yr period, 2010-2014 (0.1) is less than PBR (0.18). The total fishery mortality and serious injury for the MHI insular stock of false killer whales cannot be considered to be insignificant and approaching zero, as it is greater than 10% of PBR. Following implementation of the TRP a significant portion of the recognized stock range is inside of the expanded year-round LLEZ around the MHI, providing significant protection for this stock from longline fishing. Prior to that time, a seasonal contraction to the LLEZ potentially exposed a significant portion of the offshore range of the stock to longline fishing. Additional monitoring of bycatch rates for this stock will be required before assessing whether the expansion of the LLEZ and other take-reduction measures have reduced fishery takes below PBR. Effects of other threats have yet to be assessed, e.g., nearshore hook and line fishing and environmental contamination. There is significant geographic overlap between various nearshore fisheries and evidence of interactions with hook-and-line gear (e.g. Baird *et al.* 2015), such that these fisheries may pose a threat to the stock. Recent research has indicated that concentrations of polychlorinated biphenyls (PCBs) exceeded proposed threshold levels for health effects in 84% of sampled MHI insular false killer whales (Foltz *et al.* 2014).

HAWAII PELAGIC STOCK

POPULATION SIZE

Analyses of a 2002 shipboard line-transect survey of the Hawaiian Islands EEZ resulted in an abundance estimate of 484 (CV = 0.93) false killer whales within the Hawaiian Islands EEZ outside of about 75 nmi of the main Hawaiian Islands (Barlow & Rankin 2007). A new abundance survey was completed in 2010 within the Hawaiian Islands EEZ and resulted in five on-effort detections of false killer whales attributed to the Hawaii pelagic stock. Analysis of the 2010 HICEAS shipboard line-transect data resulted in an abundance estimate of 1,540 (CV=0.66) false killer whales outside of 11 km of the main Hawaiian Islands (Bradford *et al.* 2014, 2015). Bradford *et al.* (2014) reported that most (64%) false killer whale groups seen during the 2010 HICEAS survey were seen moving toward the vessel when detected by the visual observers. Together with an increase in sightings close to the trackline, these behavioral data suggest vessel attraction is likely occurring and may be significant. Although Bradford *et al.* (2014, 2015) employed a half-normal model to minimize the effect of vessel attraction, the abundance estimate may still be positively biased as a result of vessel attraction because groups originally outside of the survey strip, and therefore unavailable for observation by the visual survey team, may have moved within the survey strip and been sighted. There is some suggestion of such attractive movement within the acoustic data and visual data (Bradford *et al.* 2014), though the extent of any bias created by this movement is unknown. A 2005 survey (Barlow and Rankin 2007) resulted in a separate abundance estimate of 906 (CV=0.68) false killer whales in international waters south of the Hawaiian Islands EEZ and within the EEZ of Johnston Atoll, but it is unknown how many of these animals might belong to the Hawaii pelagic stock.

Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow *et al.* 1995) of the 2010 abundance estimate for the Hawaiian Islands EEZ outside of 11 km from the main Hawaiian Islands (Bradford *et al.* 2014, 2015) or 928 false killer whales. The minimum abundance estimate has not been corrected for vessel attraction and may be positively-biased.

Current Population Trend

No data are available on current population trend. It is incorrect to conclude that the increase in the abundance estimate from 2002 to 2010 represents an increase in population size, given changes to the survey design in 2010 and the analytical framework specifically intended to better enumerate and account for overall group size (Bradford *et al.* 2014), the low precision of each estimate, and a lack of understanding of the oceanographic processes that may drive the distribution of this stock over time. Further, estimation of the detection function for the 2002 and 2010 estimates relied on shared data, such that the resulting abundance estimates are not statistically independent and cannot be compared in standard statistical tests. Only a portion of the overall range of this population has been surveyed, precluding evaluation of abundance of the entire stock.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate for this species in Hawaiian waters.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Hawaii pelagic stock of false killer whales is calculated as the minimum population estimate for the U.S. EEZ of the Hawaiian Islands (928) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a stock of unknown status with a Hawaiian Islands EEZ mortality and serious injury rate CV <= 0.30; Wade and Angliss 1997), resulting in a PBR of 9.3 false killer whales per year.

STATUS OF STOCK

The status of the Hawaii pelagic stock of false killer whales relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Concentrations of polychlorinated biphenyls (PCBs) exceeded proposed threshold levels for health effects in 84% of sampled MHI insular false killer whales (Foltz *et al.* 2014), and elevated concentrations are also expected in pelagic false killer whales given the amplification of these contaminants through the food chain and likely similarity in false killer whale diet across the region. This stock is not listed as “threatened” or “endangered” under the Endangered Species Act (1973), nor designated as “depleted” under the MMPA. Following the NMFS Guidelines for Assessing Marine Mammal Stocks (NMFS 2005), the status of this transboundary stock of false killer whales is assessed based on the estimated abundance and estimates of mortality and serious injury within the U.S. EEZ of the Hawaiian Islands because estimates of human-caused mortality and serious injury from all U.S. and non-U.S. sources in high seas waters are not available, and because the geographic range of this stock beyond the Hawaiian Islands EEZ is poorly known. For the 5-yr period prior to the implementation of the TRP, the average rate of mortality and serious injury to pelagic stock false killer whales within the Hawaiian Islands EEZ (13.6 animals per year) exceeded the PBR (9.3 animals per year). In most cases, the NMFS Guidelines for Assessing Marine Mammal Stocks (NMFS 2005) suggest pooling estimates of mortality and serious injury across 5 years to reduce the effects of sampling variation. If there have been significant changes in fishery operation that are expected to affect take rates, such as the 2013 implementation of the TRP, the guidelines recommend using only the years since regulations were implemented. Using only bycatch information from 2013-2014, the estimated mortality and serious injury of false killer whales within the HI EEZ (6.2) is below the PBR (9.3). Of note, in 2014 the total number of false killer whales taken in the deep-set fishery (55) is the highest recorded since 2003 and the total estimated mortality and serious injury of false killer whales (44) is the second highest since 2003. The proportion of non-serious injuries is lower in 2013-2014 than the aggregate of all prior years; however, similar 2-year average non-serious injury rates have been observed previously. Further, recent studies (Carretta and Moore 2014) have argued that estimates from a single year of data can be biased when take events are rare, as are takes of false killer whales in the Hawaii-based longline fisheries, and that several years of data may need to be pooled to reduce error. For these reasons, the strategic status for this stock has been evaluated relative to the most recent 5 years of estimated mortality and serious injury. The total 5-year mortality and serious injury for 2010-2014 (10.3) exceeds PBR (9.3), and this stock is considered a “strategic stock” under the MMPA. Additional monitoring of bycatch rates for this stock will be required before assessing whether TRP measures have reduced fishery takes below PBR. The total fishery mortality and serious injury for the Hawaii pelagic stock of false killer whales cannot be considered to be insignificant and approaching zero.

NORTHWESTERN HAWAIIAN ISLANDS STOCK

POPULATION SIZE

A 2010 line transect survey that included the waters surrounding the Northwestern Hawaiian Islands produced an estimate of 617 (CV = 1.11) false killer whales attributed to the Northwestern Hawaiian Islands stock (Bradford *et al.* 2014, 2015). This is the best available abundance estimate for false killer whales within the Northwestern Hawaiian Islands. Bradford *et al.* (2014) reported that most (64%) false killer whale groups seen during the 2010 HICEAS survey were seen moving toward the vessel when detected by the visual observers. Together with an increase in sightings close to the trackline, these behavioral data suggest vessel attraction is likely occurring and may be significant. Bradford *et al.* (2014, 2015) employed a half-normal model to minimize the effect of vessel attraction, because groups originally outside of the survey strip, and therefore unavailable for observation by the visual survey team, may have moved within the survey strip and been sighted. There is some suggestion of such attractive movement within the acoustic and visual data (Bradford *et al.* 2014) though the extent of any bias created by this movement is unknown.

Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow *et al.* 1995) of the 2010 abundance estimate for the Northwestern Hawaiian Islands stock (Bradford *et al.* 2015) or 290 false killer whales. This estimate has not been corrected for vessel attraction and may be positively-biased.

Current Population Trend

No data are available on current population trend because there is only one estimate of abundance from 2010.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate for this species in the waters surrounding the Northwestern Hawaiian Islands.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Northwestern Hawaiian Islands false killer whale stock is calculated as the minimum population estimate (290) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.40 (for a stock of unknown status, with a Hawaiian Islands EEZ mortality and serious injury rate CV > 0.8; Wade and Angliss 1997), resulting in a PBR of 2.3 false killer whales per year.

STATUS OF STOCK

The status of false killer whales in Northwestern Hawaiian Islands waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Concentrations of polychlorinated biphenyls (PCBs) exceeded proposed threshold levels for health effects in 84% of sampled MHI insular false killer whales (Foltz et al 2014), and elevated concentrations are also expected in NWHI false killer whales given the amplification of these contaminants through the food chain and likely similarity in false killer whale diet across the region. Biomass of some false killer whale prey species may have declined around the Northwestern Hawaiian Islands (Oleson *et al.* 2010, Boggs & Ito 1993, Reeves *et al.* 2009), though waters within the Papahānaumokuākea Marine National Monument have been closed to commercial longlining since 1991 and to other fishing since 2006. This stock is not listed as “threatened” or “endangered” under the Endangered Species Act (1973), nor as “depleted” under the MMPA. The rate of mortality and serious injury to NWHI false killer whales, (0.6 for 2008-2012, 0 for 2013-2014, 0.4 for 2010-2014) is less than the PBR (2.3 animals per year), but is not approaching zero mortality and serious injury rate because it exceeds 10% of PBR (NMFS 2004). A significant portion of the recognized stock range is within the Marine National Monument and the expanded LLEZ, such that this stock is likely not exposed to high levels of fishing effort because commercial and recreational fishing is prohibited within Monument waters and longlines are excluded from the majority of the stock range. Additional monitoring of bycatch rates for this stock will be required before assessing whether TRP measures have reduced fishery takes to below 10% of PBR.

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Revised 12/18/2012

FALSE KILLER WHALE (*Pseudorca crassidens*): Palmyra Atoll Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

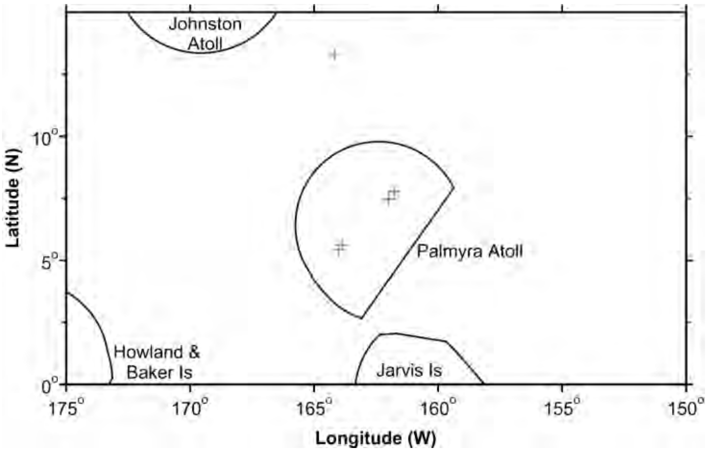

Figure 1. False killer whale on-effort sighting locations during a 2005 standardized shipboard survey of the Palmyra U.S. EEZ and pelagic waters of the central Pacific south of the Hawaiian Islands (gray crosses, Barlow and Rankin 2007). Solid lines represent approximate boundary of U.S. EEZs.

False killer whales are found worldwide mainly in tropical and warm-temperate waters (Stacey et al. 1994). In the North Pacific, this species is known from southern Japan, Hawaii, and the eastern tropical Pacific. Four on-effort sightings of false killer whales were recorded during a 2005 shipboard survey of the U.S. Exclusive Economic Zone (EEZ) of Palmyra Atoll (Figure 1; Barlow & Rankin 2007). This species also occurs in U.S. EEZ waters around Hawaii (Barlow 2006, Bradford et al. 2012), Johnston Atoll (NMFS/PIR/PSD unpublished data), and American Samoa (Johnston et al. 2008, Oleson 2009).

Genetic analyses indicate restricted gene flow between false killer whales sampled near the main Hawaiian Islands (MHI), the Northwestern Hawaiian Islands (NWHI), and in pelagic waters of the Eastern (ENP) and Central North Pacific (CNP) (Chivers et al. 2007, 2010, Martien et al. 2011). The Palmyra Atoll stock of false killer whales remains a separate stock, because comparisons amongst false killer whales sampled at Palmyra Atoll and those sampled from the insular stock of Hawaii and the pelagic ENP revealed restricted gene flow, although the sample size remains low for robust comparisons (Chivers et al. 2007, 2010). NMFS will obtain and analyze additional tissue samples from Palmyra and the broader tropical Pacific for genetic studies of stock structure, and will evaluate new information on stock ranges as it becomes available.

For the Marine Mammal Protection Act (MMPA) stock assessment reports, there are currently five Pacific Islands Region management stocks (Chivers et al. 2008, Martien et al. 2011): 1) the Hawaii insular stock, which includes animals inhabiting waters within 140 km (approx. 75 nmi) of the main Hawaiian Islands, 2) the Northwestern Hawaiian Islands stock, which includes false killer whales inhabiting waters within 93 km (50 nmi) of the NWHI and Kauai, 3) the Hawaii pelagic stock, which includes false killer whales inhabiting waters greater than 40 km (22 nmi) from the main Hawaiian Islands, 4) the Palmyra Atoll stock, which includes false killer whales found within the U.S. EEZ of Palmyra Atoll, and 5) the American Samoa stock, which includes false killer whales found within the U.S. EEZ of American Samoa. Estimates of abundance, potential biological removal, and status determinations for the Palmyra Atoll stock are presented below; the Hawaii Stock Complex and American Samoa Stocks are presented in separate reports.

POPULATION SIZE

A 2005 line transect survey in the U.S. EEZ waters of Palmyra Atoll produced an estimate of 1,329 (CV = 0.65) false killer whales (Barlow & Rankin 2007). This is the best available abundance estimate for false killer whales within the Palmyra Atoll EEZ.

Minimum Population Estimate

The log-normal 20th percentile of the 2005 abundance estimate for the Palmyra Atoll EEZ (Barlow & Rankin 2007) is 806 false killer whales.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate for this species in Palmyra Atoll waters.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Palmyra Atoll false killer whale stock is calculated as the minimum population size (806) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.40 (for a stock of unknown status with a mortality and serious injury rate CV >0.80; Wade and Angliss 1997), resulting in a PBR of 6.4 false killer whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Interactions with false killer whales, including depredation of catch, have been identified in logbooks and NMFS observer records from Hawaii pelagic longlines (Nitta and Henderson 1993, NMFS/PIR unpublished data). False killer whales have also been observed feeding on mahi mahi, *Coryphaena hippurus*, and yellowfin tuna, *Thunnus albacares*, and they have been reported to take large fish from the trolling lines of both commercial and recreational fishermen (Shallenberger 1981).

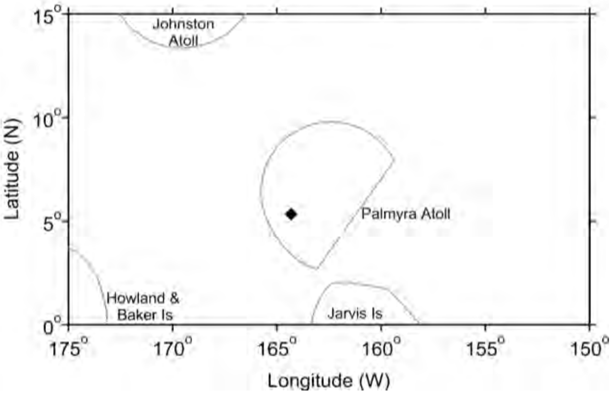

Figure 2. Locations of observed false killer whale takes in the Hawaii-based deep-set longline fishery, 2006-2010. Solid gray lines represent the U.S. EEZ. Fishery descriptions are provided in Appendix 1.

The Hawaii-based deep-set longline (DSLL) fishery targets primarily tunas and operate within U.S. waters and on the high seas near Palmyra Atoll. Between 2006 and 2010, one false killer whale was observed taken in the DSLL fishery within the Palmyra EEZ (≥20% observer coverage) (Forney 2011). Based on an evaluation of the observer's description of each interaction and following the most recently developed criteria for assessing serious injury in marine mammals (Andersen et al. 2008), the single false killer whale taken in the Palmyra EEZ was considered seriously injured (Forney 2011). The total estimated annual and 5-yr average mortality and serious injury of cetaceans in the DSLL fishery operating around Palmyra (with approximately 20% coverage) are reported by McCracken (2011) (Table 1). Although M&SI estimates are shown as whole numbers of animals, the 5-yr average M&SI is calculated based on the unrounded annual estimates.

Because of high rates of false killer whale mortality and serious injury in Hawaii-based longline fisheries, a Take-Reduction Team (TRT) was established in January 2010 (75 FR 2853, 19 January 2010). The scope of the TRT was to reduce mortality and serious injury in the Hawaii pelagic, main Hawaiian Islands insular, and Palmyra stocks of false killer whales and across the DSLL and SSLL fisheries. The Team submitted a Draft Take-Reduction Plan to NMFS for consideration (Available at: http://www.nmfs.noaa.gov/pr/pdfs/interactions/fkwtrp_draft.pdf), and NMFS has recently published regulations based on this TRP (77 FR 71260, 29 November, 2012). The Team chose to exclude the Palmyra Atoll stock in the final implementation of the Plan due to low levels of M&SI of this stock for the past 5 years.

Table 1. Summary of available information on incidental mortality and serious injury of false killer whales (Palmyra Atoll stock) in the Hawaii-based longline fishery (McCracken 2011). Mean annual takes are based on 2006-2010 estimates unless otherwise indicated. Information on all observed takes (T) and combined mortality events & serious injuries (MSI) is included. Total takes were prorated to deaths, serious injuries, and non-serious injuries based on the observed proportions of each outcome.

Fishery Name	Year	Data Type	Percent Observer Coverage	Observed total interactions (T) and mortality events and serious injuries (MSI), and total estimated mortality and serious injury (M&SI) of false killer whales in the Palmyra Atoll EEZ	
				Observed T/MSI	Estimated Mean Annual Takes (CV)
Hawaii-based deep-set longline fishery	2006	observer data	22%	0/0	0 (-)
	2007		20%	1/1	2 (0.7)
	2008		22%	0/0	0 (-)
	2009		20%	0/0	0 (-)
	2010		21%	0/0	0 (-)
Minimum total annual takes within U.S. EEZ					**0.3 (1.7)**

STATUS OF STOCK

The status of false killer whales in Palmyra Atoll EEZ waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this stock. They are not listed as “threatened” or “endangered” under the Endangered Species Act (1973), nor as “depleted” under the MMPA. The rate of mortality and serious injury to false killer whales within the Palmyra Atoll EEZ in the Hawaii-based longline fishery (0.3 animals per year) does not exceed the PBR (6.4) for this stock and thus, this stock is not considered “strategic” under the MMPA. The total fishery mortality and serious injury for Palmyra Atoll false killer whales is less than 10% of the PBR and, therefore, can be considered to be insignificant and approaching zero. Additional injury and mortality of false killer whales is known to occur in U.S and international longline fishing operations in international waters, and the potential effect on the Palmyra stock is unknown.

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Revised 01/15/2011

FALSE KILLER WHALE *(Pseudorca crassidens)*:
American Samoa Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

False killer whales are found worldwide mainly in tropical and warm-temperate waters (Stacey et al. 1994). The species is well-documented throughout the tropical and sub-tropical south Pacific, from Papua New Guinea and Australia to the line islands (Reeves et al. 1999). The species has been taken in the drive hunt in the Solomon Islands (Reeves et al 1999).). During small-boat surveys from 2003 to 2006 in the waters surrounding the island of Tutuila, American Samoa, false killer whales were observed during summer surveys on five occasions (Johnston et al 2008). During a shipboard survey in 2006 false killer whales were also encountered just north of the island of Ta‘u, in the Manu’a Group within American Samoa (Johnston et al. 2008). Two false killer whales were entangled near 40-Fathom Bank south of the islands by the American Samoa-based longline fishery in 2008 (Oleson 2009), indicating some false killer whales maintain a more pelagic distribution. Five genetic samples collected near Tutuila are available for comparison to other false killer whale populations throughout the Pacific (Johnston et al 2008). For the Marine Mammal Protection Act (MMPA) stock assessment reports, there are four Pacific management stocks: 1) The Hawaii Insular Stock, which includes animals found within the 25-75 nmi longline exclusion boundary surrounding the main Hawaiian Islands, 2) The Hawaii Pelagic Stock, which includes animals found within the U.S. EEZ of the Hawaiian Islands but outside the 25-75 nmi longline exclusion zone, 3) The Palmyra Stock, which includes animals found within the U.S. EEZ of the Palmyra Atoll, and 4) The American Samoa Stock, which includes animals found within the U.S. EEZ American Samoa (this report).

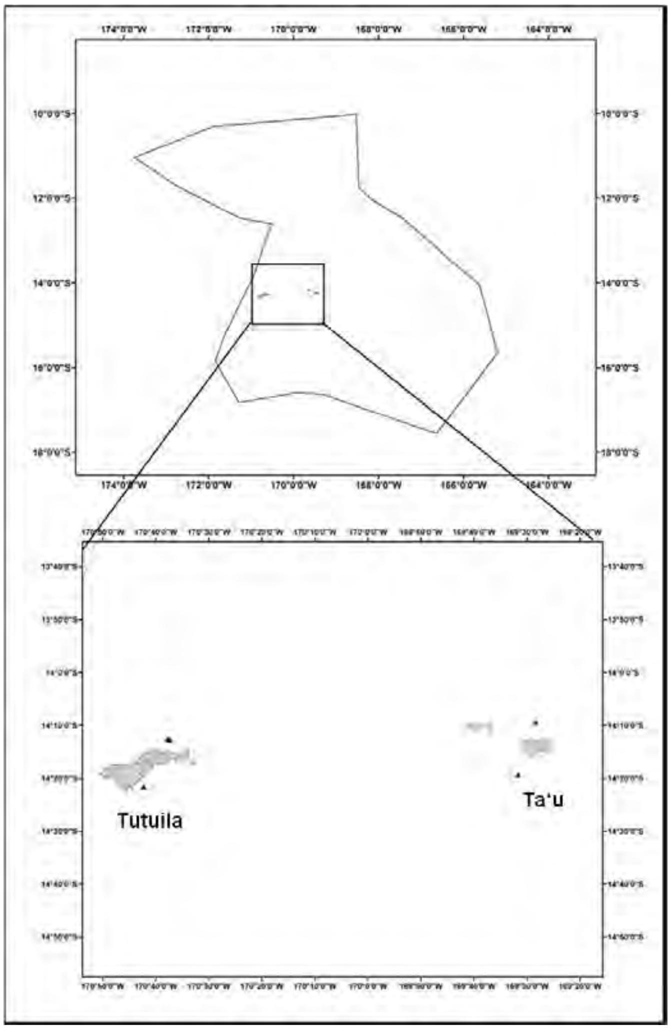

Figure 1. False killer whale sightings during visual surveys from 2003-2006 (Johnston et al 2008).

POPULATION SIZE

No abundance estimates are currently available for false killer whales in U.S. EEZ waters of American Samoa; however, density estimates for false killer whales in other tropical Pacific regions can provide a range of likely abundance estimates in this unsurveyed region. Published estimates of false killer whales (animals per km^2) in the Pacific are: 0.0002 (CV= 0.93) for the U.S. EEZ of the Hawaiian Islands (Barlow and Rankin 2007); 0.0038 (CV=0.65) for the U.S. EEZ around Palmyra, (Barlow and Rankin 2007), 0.0021 (CV=0.64) and 0.0016 (CV=0.31) for the eastern tropical Pacific Ocean (Wade and Gerrodette 1993; Ferguson and Barlow 2003). Applying the lowest and highest of these density estimates to U.S. EEZ waters surrounding American Samoa (area size = 404,578 km^2) yields a range of plausible abundance estimates of 87 – 1,538 false killer whales.

Minimum Population Estimate

No minimum population estimate is currently available for waters surrounding American Samoa, but the false killer whale density estimates from other tropical Pacific regions (Barlow and Rankin 2007, Wade and Gerrodette 1993, Ferguson and Barlow 2003, see above) can provide a range of likely values. The lognormal 20th percentiles of plausible abundance estimates for the American Samoa EEZ, based on the densities observed elsewhere, range from 45 – 936 false killer whales.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

No PBR can presently be calculated for false killer whales within the American Samoa EEZ, but based on the range of plausible minimum abundance estimates (45 - 936), a recovery factor of 0.40 (for a species of unknown status with a fishery mortality and serious injury rate CV > 0.80 within the American Samoa EEZ; Wade and Angliss 1997), and the default growth rate (½ of 4%), the PBR would likely fall between 0.4 and 7.5 false killer whales per year.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Information on fishery-related mortality of cetaceans in American Samoan waters is limited, but the gear types used in American Samoas fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Gillnets appear to capture marine mammals wherever they are used, and float lines from lobster traps and longlines can be expected to occasionally entangle cetaceans (Perrin et al. 1994). The primary fishery in American Samoa is the commercial pelagic longline fishery that targets tunas, which was introduced in 1995 (Levine and Allen 2009). In 2008, there were 28 federally permitted vessels within the longline fishery in American Samoa. The fishery has been monitored since March 2006 under a mandatory observer program, which records all interactions with protected species (Pacific Islands Regional Office 2009). Two false killer whales were killed or seriously injured by the fishery in 2008 (Oleson 2009). The average annual serious injury and mortality in commercial fisheries for false killer whales in American Samoa waters is 7.8 (CV=1.7) animals per year (Table 1).

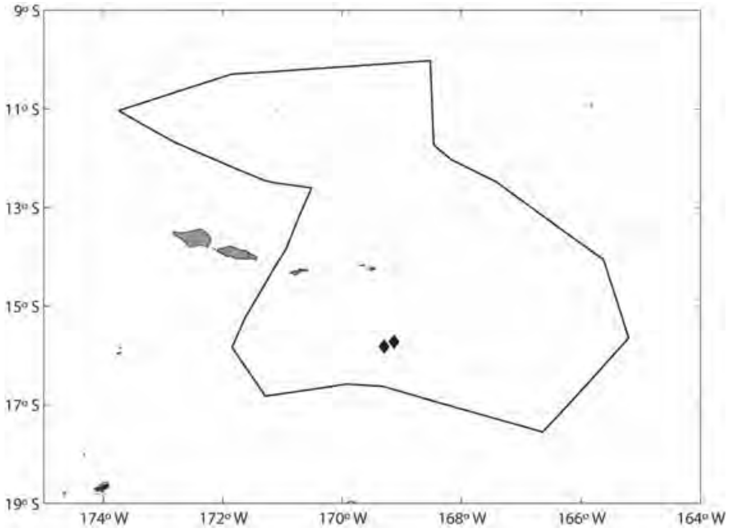

Figure 2. Locations of observed false killer whale takes (filled diamonds) in the American Samoa longline fishery, 2006-2008. Solid line represents the U.S. EEZ. Set locations in this fishery are summarized in Appendix 1.

Prior to 1995, bottomfishing and trolling were the primary fisheries in American Samoa but became less prominent after longlining was introduced (Levine and Allen 2009). Nearshore subsistence fisheries include spear fishing, rod and reel, collecting, gill netting, and throw netting (Craig 1993, Levine and Allen 2009). Information on fishery-related mortality of cetaceans in the nearshore fisheries is unknown, but the gear types used in American Samoan fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Gillnets appear to capture marine mammals wherever they are used. Although boat-based nearshore fisheries have been randomly monitored since 1991, by the American Samoa Department of Marine and Wildlife Sources (DMWR), no estimates of annual human-caused mortality and serious injury of cetaceans are available.

STATUS OF STOCK

The status of false killer whales in American Samoan waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this stock. False killer whales are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The status of the American Samoa stock of false killer whales under the 1994 amendments to the MMPA cannot be determined at this time because no abundance estimates are available and PBR cannot be calculated. However, the estimated rate of fisheries related mortality and serious injury within the American Samoa EEZ (7.8 animals per year) exceeds the range of likely PBRs (0.4 – 7.5) for this region, suggesting that this stock would probably be strategic if abundance estimates were available. Additional research on the abundance of false killer whales in American Samoa is required to resolve this stock's status. Insufficient information is available to determine whether the total fishery mortality and serious injury for false killer whales is insignificant and approaching zero, but this appears unlikely given the estimated takes and likely PBR range.

Table 1. Summary of available information on incidental mortality and serious injury of false killer whales (American Samoa stock) in commercial fisheries operating within the U.S. EEZs (Oleson 2009). Longline fishery take estimates represent only those trips with at least 10 sets/trip (Oleson 2009). Mean annual takes are based on 2006-2008 data unless otherwise indicated.

Fishery Name	Year	Data Type	Percent Observer Coverage	Observed and estimated mortality and serious injury of false killer whales in the American Samoa EEZ		
				American Samoa EEZ		
				Obs.	Estimated (CV)	Mean Annual Takes (CV)
American Samoa-based longline fishery	2006 2007 2008	observer data	9.0% 7.7% 8.5%	0 0 2	0 (-) 0 (-) 23.5 (1.9)	7.8 (1.7)
Minimum total annual takes within U.S. EEZ waters						7.8 (1.7)

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Revised 6/4/2014

KILLER WHALE (*Orcinus orca*): Hawaii Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

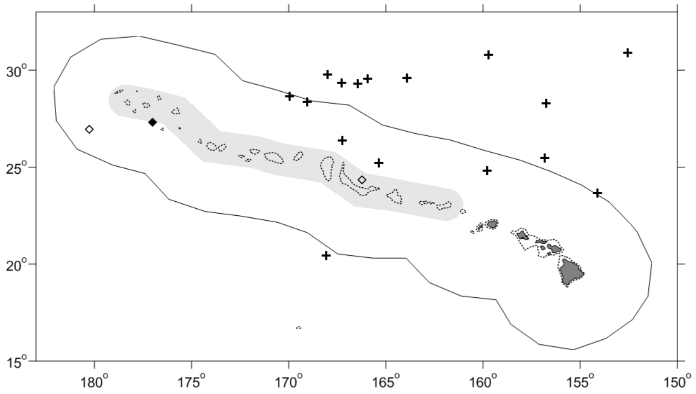

Figure 1. Locations of killer whale sightings from longline observer records (crosses; NMFS/PIR, unpublished data) and sighting locations during the 2002 (open diamonds) and 2010 (black diamonds) shipboard surveys of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006, Bradford et al. 2013; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ. Gray shading indicates area of Papahanaumokuakea Marine National Monument. Dotted line represents the 1,000m isobath.

Killer whales have been observed in all oceans and seas of the world (Leatherwood and Dahlheim 1978). Although reported from tropical and offshore waters (Heyning and Dahlheim 1988), killer whales prefer the colder waters of both hemispheres, with greatest abundances found within 800 km of major continents (Mitchell 1975). They are considered rare in Hawaiian waters. No killer whales were seen during 1993-98 aerial surveys within about 25 nmi of the main Hawaiian Islands, but one sighting was reported during subsequent surveys (Mobley et al. 2000, 2001). Baird et al. (2006) reported 21 sighting records in Hawaiian waters between 1994 and 2004. Summer/fall shipboard surveys of U.S. Exclusive Economic Zone (EEZ) Hawaiian waters resulted in two sightings in 2002 and one in 2010 (Figure 1; Barlow 2006; Bradford et al. 2013). Three strandings have been reported since 1950 (Richards 1952, NMFS PIR Marine Mammal Reponses Network database), including one since 2007. Eighteen additional sightings were reported around the main Hawaiian Islands, French Frigate Shoals, and offshore of the Hawaiian islands (Baird *et al.* 2006). Except in the northeastern Pacific where "resident", "transient", and “offshore” stocks have been described for coastal waters of Alaska, British Columbia, and Washington to California (Bigg 1982; Leatherwood et al. 1990, Bigg et al. 1990, Ford et al. 1994), little is known about stock structure of killer whales in the North Pacific. A global-scale analysis of killer whale phylogeographic structure clustered one animal sampled near Hawaii with eastern and western North Pacific transients. The other Hawaii sample within that analysis did not cluster with any known ecotype, but had divergence time between that of transient and offshore forms (Morin et al 2010).

For the Marine Mammal Protection Act (MMPA) stock assessment reports, eight killer whale stocks are recognized within the Pacific U.S. EEZ: 1) the Eastern North Pacific Alaska Resident stock - occurring from southeastern Alaska to the Aleutian Islands and Bering Sea, 2) the Eastern North Pacific Northern Resident stock - occurring from British Columbia through part of southeastern Alaska, 3) the Eastern North Pacific Southern Resident stock – occurring mainly within the inland waters of Washington State and southern British Columbia, but also in coastal waters from British Columbia through California, 4) the Eastern North Pacific Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock - occurring mainly from Prince William Sound through the Aleutian Islands and Bering Sea, 5) the AT1 Transient stock - occurring in Alaska from Prince William Sound through the Kenai Fjords, 6) the West Coast Transient stock - occurring from California through southeastern Alaska, 7) the Eastern North Pacific Offshore stock - occurring from California through Alaska, and 8) the Hawaiian stock (this report). The Hawaii stock includes animals found both within the Hawaiian Islands EEZ and in adjacent high seas waters. Because data on abundance, distribution, and human-caused impacts are largely lacking for high seas waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005). Stock assessment reports for the Southern Resident, Eastern North Pacific Offshore, and Hawaiian stocks can be found in the Pacific Region stock assessment reports; all other killer whale stock assessments are included in the Alaska Region stock assessments.

POPULATION SIZE

A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 349 (CV=0.98) killer whales (Barlow 2006). The recent 2010 shipboard line-transect survey of the

Hawaiian Islands EEZ resulted in an abundance estimate of 101 (CV = 1.0) killer whales (Bradford et al 2013). This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow et al 1995) of the 2010 abundance estimate or 50 killer whales within the Hawaiian Islands EEZ.

Current Population Trend

No data are available on current population trend. The broad and overlapping confidence intervals around the 2002 and 2010 estimates preclude assessment of trend with the available data.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current and maximum net productivity rate in Hawaiian waters.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size within the U.S. EEZ of the Hawaiian Islands (50) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a stock of unknown status with no known fishery mortality or serious injury within the Hawaiian Islands EEZ; Wade and Angliss 1997), resulting in a PBR of 1.0 killer whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*". Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fishery Information

Information on fishery-related mortality and serious injury of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. No interactions between nearshore fisheries and killer whales have been reported in Hawaiian waters. No estimates of human-caused mortality or serious injury are currently available for nearshore hook and line or gillnet fisheries because these fisheries are not observed or monitored for protected species bycatch. Killer whale interactions with Hawaii fisheries appear to be rare. In 1990, a solitary killer whale was reported to have removed the catch from a longline in Hawaii (Dollar 1991). There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2007 and 2011, no killer whales were observed hooked or entangled in the SSLL fishery (100% observer coverage) or the DSLL fishery (20-22% observer coverage) (McCracken 2013, Bradford & Forney 2013).

STATUS OF STOCK

The Hawaii stock of killer whales is not considered strategic under the 1994 amendments to the MMPA. The status of killer whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this stock. Killer whales are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor designated as "depleted" under the MMPA. Given the absence of recent recorded fishery-related mortality or serious injuries the total fishery mortality and serious injury can be considered to be insignificant and approaching zero.

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SHORT-FINNED PILOT WHALE (*Globicephala macrorhynchus*): Hawaii Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

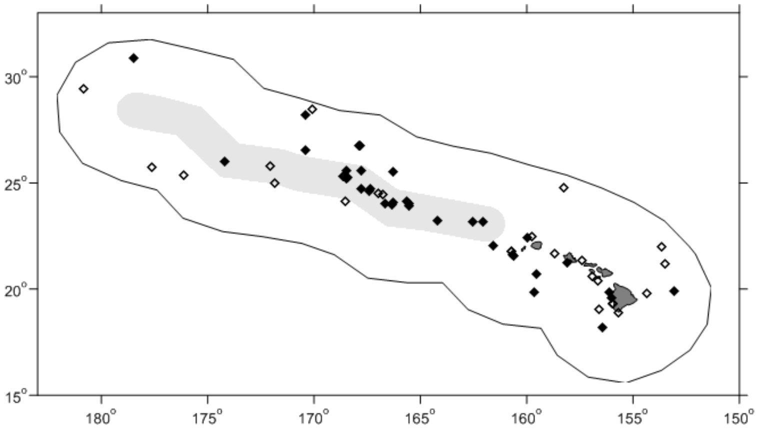

Figure 1. Short-finned pilot whale sighting locations during the 2002 (open diamonds) and 2010 (black diamonds) shipboard surveys of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006, Bradford et al. 2013); see Appendix 2 for details on timing and location of survey effort). Outer solid line represents approximate boundary of survey area and U.S. EEZ. Gray shading indicates area of Papahanaumokuakea Marine National Monument.

Short-finned pilot whales are found in all oceans, primarily in tropical and warm-temperate waters. They are commonly observed around the main Hawaiian Islands and are also present around the Northwestern Hawaiian Islands (Shallenberger 1981, Baird et al. 2013, Bradford et al. 2013). Summer/fall shipboard surveys of the waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands resulted in 25 sightings in 2002 and 36 in 2010, including more encounters near shore within the Northwestern Hawaiian Islands (Figure 1; Barlow 2006, Bradford et al. 2013). Twenty-three strandings of short-finned pilot whales have been documented from the Hawaiian Islands since 1957, including five mass strandings in May and October of 1958 and 1959 (Tomich 1986; Nitta 1991; Maldini et al. 2005, NMFS-PIR Marine Mammal Response Network database). There have been four strandings since 2007. Two forms of short-finned pilot whales have been identified in Japanese waters based on pigmentation patterns and differences in the shape of the heads of adult males (Kasuya et al. 1988). The pilot whales in Hawaiian waters are similar morphologically to the Japanese "southern form." Phylogeographic analysis of short-finned pilot whale samples off Hawaii versus those in the eastern tropical Pacific and western Pacific suggest long-term isolation of those animals found in Hawaiian waters (Chivers et al. 2003).

Photo-identification and telemetry studies suggest there may be inshore and pelagic populations of short-finned pilot whales in Hawaiian waters. Resighting and social network analyses of individuals photographed off Hawaii Island suggest the occurrence of one large and several smaller social clusters that use those waters, with some individuals within the smaller social clusters commonly resighted off Hawaii Island (Mahaffy 2012). Further, two groups of 14 individuals have been seen at Hawaii and elsewhere in the main Hawaiian Islands, one off Oahu and the other off Kauai. Satellite telemetry data from over 60 individuals tagged throughout the main Hawaiian Islands also support the occurrence of at least two populations (Oleson et al. 2013). Genetic analyses are underway to evaluate differentiation between island-associated versus pelagic short-finned pilot whales. Oleson et al. (2013) suggested formal stock division would be more robust following conclusion of genetics analyses and updating of the social network with more recent sightings data.

Fishery interactions with short-finned pilot whales demonstrate that this species also occurs in U.S. EEZ waters of Palmyra Atoll and Johnston Atoll, but it is not known whether these animals are part of the Hawaii stock or whether they represent separate stocks of short-finned pilot whales. For the Marine Mammal Protection Act (MMPA) stock assessment reports, short-finned pilot whales within the Pacific U.S. EEZ are divided into two discrete areas: 1) Hawaiian waters (this report), and 2) waters off California, Oregon and Washington. The Hawaii stock includes animals found both within the Hawaiian Islands EEZ and in adjacent high seas waters. The status of the Hawaii stock is evaluated based on abundance, distribution, and human-caused impacts within the Hawaiian Islands EEZ, as such datasets are largely lacking for high seas waters (NMFS 2005).

POPULATION SIZE

A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 8,846 (CV=0.49) short-finned pilot whales (Barlow 2006). The recent 2010 shipboard line-transect survey of the Hawaiian Islands EEZ resulted in an abundance estimate of 12,422 (CV = 0.43) short-finned pilot whales (Bradford et al. 2013). This is currently the best available abundance estimate for short-finned pilot whales within the Hawaiian Islands EEZ.

Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow et al. 1995) of the 2010 abundance estimate for the Hawaiian Islands EEZ or 8,782 short-finned pilot whales.

Current Population Trend

The broad and overlapping confidence intervals around the 2002 and 2010 estimates preclude assessment of trend with the available data.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Hawaii short-finned pilot whale stock is calculated as the minimum population estimate (8,782) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.40 (for a stock of unknown status with a Hawaiian Islands EEZ fishery mortality and serious injury rate CV> 0.80; Wade and Angliss 1997), resulting in a PBR of 70 short-finned pilot whales.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen *et al*. 2008, NMFS 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*". Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fishery Information

Information on fishery-related mortality of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Entanglement in gillnets and hooking or entanglement in various hook and line fisheries have been reported for small cetaceans in Hawaii (Nitta & Henderson, 1993). No estimates of human-caused mortality or serious injury are currently available for nearshore hook and line or gillnet fisheries because these

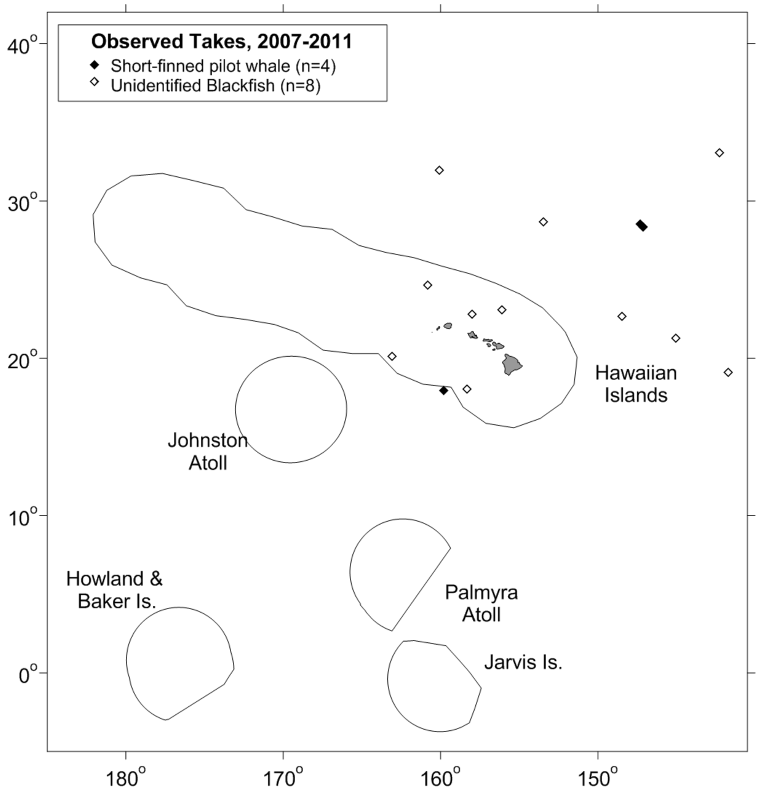

Figure 2. Locations of short-finned pilot whale takes (filled diamonds) and possible takes of this species (open diamonds) in Hawaii-based longline fisheries, 2007-2011. Some take locations overlap. Solid lines represent the U. S. EEZ. Fishery descriptions are provided in Appendix 1.

fisheries are not observed or monitored for protected species bycatch.

There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas, but are prohibited from operating within the Papahanaumokuakea Marine National Monument, a region that extends 50 nmi from shore around the Northwestern Hawaiian Islands, and within the Longline Exclusion Area, a region extending 25-75 nmi from shore around the main Hawaiian Islands. Between 2007 and 2011, no short-finned pilot whales were observed hooked or entangled in the SSLL fishery (100% observer coverage), and four short-finned pilot whales were observed taken in the DSLL fishery (20-22% observer coverage) (Bradford & Forney 2013, McCracken 2013), all in high-seas waters. Based on an evaluation of the observer's description of the interaction and following the most recently developed criteria for assessing serious injury in marine mammals (NMFS 2012), two short-finned pilot whales were considered not seriously injured, and the other two were considered seriously injured (Bradford & Forney 2013). Seven additional unidentified "blackfish" (unidentified cetaceans known to be either false killer whales or short-finned pilot whales) that may have been pilot whales were also seriously injured during 2007-2011 (Bradford & Forney 2013). Additionally, one

Table 1. Summary of available information on incidental mortality and serious injury of short-finned pilot whales (Hawaii stock) and including those presumed to be short-finned pilot whales based on assignment of unidentified blackfish to this species in commercial longline fisheries, within and outside of the U.S. EEZs (McCracken 2013). Mean annual takes are based on 2007-2011 data unless otherwise indicated. Information on all observed takes (T) and combined mortality events & serious injuries (MSI) is included. Total takes were prorated to deaths, serious injuries, and non-serious injuries based on the observed proportions of each outcome. Unidentified blackfish are pro-rated as either false killer whales or short-finned pilot whales according to their distance from shore (McCracken 2010). CVs are estimated based on the combination of annual short-finned pilot whale and blackfish variances and do not yet incorporate additional uncertainty introduced by prorating the unidentified blackfish.

Fishery Name	Year	Data Type	Percent Observer Coverage	Observed total interactions (T) and mortality events, and serious injuries (MSI), and total estimated mortality and serious injury (M&SI) of short-finned pilot whales (GM)			
				Outside U.S. EEZs		Hawaiian EEZ	
				Obs. GM T/MSI Obs. UB T/MSI	Estimated M&SI (CV)	Obs. GM T/MSI Obs. UB T/MSI	Estimated M&SI (CV)
Hawaii-based deep-set longline fishery	2007	Observer data	20%	1/1 0	2 (2.4)	0 0	0 (-)
	2008		22%	3/1 0	2 (1.6)	0 3/3	0 (0.5)
	2009		21%	0 0	0 (-)	0 0	0 (-)
	2010		21%	0 0	0 (-)	0 1/1	0 (1.2)
	2011		20%	0 1/0	0 (1.1)	0 1/1	0 (0.9)
Mean Estimated Annual Take (CV)					**1.0 (2.1)**		**0.1 (7.2)**
Hawaii-based shallow-set longline fishery	2007	Observer data	100%	0 0	0	0 0	0
	2008		100%	0 1/1	0	0 0	0
	2009		100%	0 0	0	0 0	0
	2010		100%	0 0	0	0 0	0
	2011		100%	0 1/1	0	0 0	0
Mean Annual Takes (100% coverage)					**0.1**		**0**
Minimum total annual takes within U.S. EEZ							**0.1 (7.2)**

unidentified blackfish was taken on the high seas in the deep set longline fishery in 2011, but was not seriously injured (Table 1). Five of the seven serious injuries were taken in the DSLL fishery within U.S. EEZ waters and the remaining two serious injuries were taken the SSLL fishery on the high seas (Table 1 and Figure 3).Unidentified blackfish are prorated to each stock based on distance from shore (McCracken 2010). The distance-from-shore model was chosen following consultation with the Pacific Scientific Review Group, based on the model's performance and simplicity relative to a number of other more complicated models with similar output (McCracken 2010). Proration of unidentified blackfish takes introduces unquantified uncertainty into the bycatch estimates, but until all animals taken can be identified to species (e.g., photos, tissue samples), this approach ensures that potential impacts to all stocks are assessed. Average 5-yr estimates of annual mortality and serious injury for 2007-2011 are 0.7 (CV = 2.1) short-finned pilot whales outside of U.S. EEZs and 0.1 (CV = 7.2) within the Hawaiian Islands EEZ. Although M&SI estimates are shown as whole numbers of animals, the 5-yr average M&SI is calculated based on the unrounded annual estimates. Eight unidentified cetaceans were taken in the DSLL fishery, and two unidentified cetaceans were taken in the SSLL fishery, some of which may have been short-finned pilot whales.

STATUS OF STOCK

The Hawaii stock of short-finned pilot whales is not considered strategic under the 1994 amendments to the MMPA. The status of short-finned pilot whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this stock. Short-finned pilot whales are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor designated as "depleted" under the MMPA. The estimated rate of mortality and serious injury within the Hawaiian Islands EEZ (0.1 animals per year) is less than the PBR (70). Based on the available data, which indicate total fishery-related takes are less than 10% of PBR, the total fishery mortality and serious injury for short-finned pilot whales can be considered to be insignificant and approaching zero.

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BLAINVILLE'S BEAKED WHALE (*Mesoplodon densirostris*): Hawaii Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Blainville's beaked whale has a cosmopolitan distribution in tropical and temperate waters, apparently the most extensive known distribution of any *Mesoplodon* species (Mead 1989). Forty-five sightings over 13 years were reported from the main islands by Baird et al (2013), who indicated that Blainville's beaked whale represent a small proportion (2-3%) of all odontocete sightings in the main Hawaiian Islands. Shallenberger (1981) suggested that Blainville's beaked whales were present off the Waianae Coast of Oahu for prolonged periods annually. Summer/fall shipboard surveys of the waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands, resulted in three sightings in 2002 and one in 2010; however, several sightings of unidentified *Mesoplodon* whales may have also been Blainville's beaked whale (Figure 1; Barlow 2006, Bradford et. al. 2013).

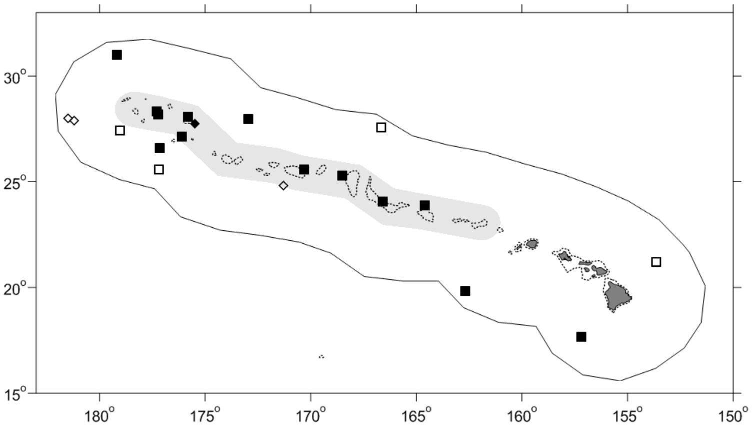

Figure 1. Sighting locations of *Mesoplodon densirostris* (diamonds) and unidentified *Mesoplodon* beaked whales (squares) during the 2002 (open symbols) and 2010 (black symbols) shipboard cetacean surveys of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006; see Appendix 2 for details on timing and location of survey effort). Outer line indicates approximate boundary of survey area and U.S. EEZ. Gray shading indicates area of Papahanaumokuakea Marine National Monument. Dotted line represents the 1,000m isobath.

Recent analysis of Blainville's beaked whale resightings and movements near the main Hawaiian Islands (MHI) suggest the existence of insular and offshore (pelagic) populations of this species in Hawaiian waters (McSweeney et al. 2007, Schorr et al., 2009, Baird et al. 2013). Photo-identification of individual Blainville's beaked whales from Hawaii Island since 1986 reveal repeated use of this area by individuals for over 17 years (Baird et al. 2011) and 75% of individuals seen off Hawaii Island link by association into a single social network (Baird et al. 2013). Those individuals seen farthest from shore and in deep water (>2100m) have not been resighted, suggesting they may be part of an offshore, pelagic population (Baird et al. 2011). Eleven Blainville's beaked whales linked to the social network have been satellite tagged off Hawaii Island. All 11 individuals had movements restricted to the MHI, extending to nearshore waters of Oahu, with average distance from shore of 21.6 km (Baird et al. 2013). One individual tagged 32km from Hawaii Island did not link to the social network and had movements extending far from shore, moving over 900km from the tagging location in 20 days, approaching the edge of the Hawaiian EEZ west of Nihoa (Baird et al. 2011). Division of this population into a separate island-associated stock may be warranted in the future.

For the Marine Mammal Protection Act (MMPA) stock assessment reports, three *Mesoplodon* stocks are defined within the Pacific U.S. EEZ: 1) *M. densirostris* in Hawaiian waters (this report), 2) *M. stejnegeri* in Alaskan waters, and 3) all *Mesoplodon* species off California, Oregon and Washington. The Hawaii stock of Blainville's beaked whales includes animals found both within the Hawaiian Islands EEZ and in adjacent high seas waters. Because data on abundance, distribution, and human-caused impacts are largely lacking for high seas waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

POPULATION SIZE

A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 2,872 (CV=1.17) Blainville's beaked whales (Barlow 2006). The recent 2010 shipboard line-transect survey of the Hawaiian Islands EEZ resulted in an abundance estimate of 2,338 (CV = 1.13) Blainville's beaked whales (Bradford et al. 2013) in the Hawaii stock. This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow et al. 1995) of the 2010 abundance estimate or 1,088 Blainville's beaked whales within the Hawaiian Islands EEZ.

Current Population Trend

The broad and overlapping confidence intervals around the 2002 and 2010 estimates preclude assessment of population trend for the Hawaii stock with the available data.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population estimate for the U.S. EEZ of the Hawaiian Islands (1,088) <u>times</u> one half the default maximum net growth rate for cetaceans (½ of 4%) <u>times</u> a recovery factor of 0.50 (for a species of unknown status with no recent fishery mortality or serious injury within the Hawaiian Islands EEZ; Wade and Angliss 1997), resulting in a PBR of 11 Hawaii Blainville's beaked whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*". Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

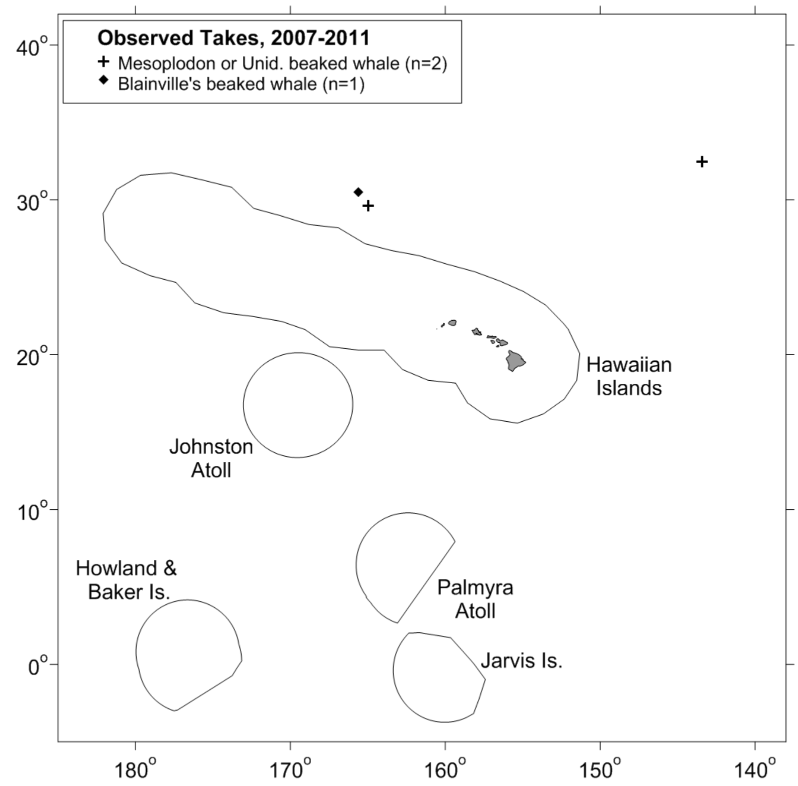

Figure 2. Location of the Blainville's beaked whale take (filled diamond) and the possible takes of this species (cross) in Hawaii-based longline fisheries, 2007-2011. Solid lines represent the U.S. EEZ. Fishery descriptions are provided in Appendix 1.

Fishery Information

Information on fishery-related mortality of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaii fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. No interactions between nearshore fisheries and Blainville's beaked whales have been reported in Hawaiian waters. No estimates of human-caused mortality or serious injury are currently available for nearshore hook and line fisheries because these fisheries are not observed or monitored for protected species bycatch.

There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2007 and 2011, no Blainville's beaked whale was observed killed or seriously injured in the SSLL fishery (100% observer coverage) or the DSLL fishery (20-22% observer coverage) (Bradford & Forney 2013 , McCracken 2013) within the Hawaiian EEZ. One Blainville's beaked whale was observed taken, but not seriously injured, on the high seas in the SSLL fishery (Bradford & Forney 2013). One unidentified *Mesoplodon* whale and one unidentified beaked whale were taken in the SSLL fishery and both were considered to be seriously injured based on an evaluation of the observer's description of the interaction and following the most recently developed criteria for assessing serious injury in marine mammals (NMFS 2012). Average 5-yr estimates of annual mortality and serious injury for 2007-2011 are zero Blainville's beaked whales within or outside of the U.S. EEZs, and 0.4 (CV = 0) *Mesoplodon* or unidentified beaked whales outside the U.S. EEZs (Table 1). Eight unidentified cetaceans were taken in the DSLL fishery, and two unidentified cetaceans were taken in the SSLL fishery, some of which may have been Blainville's beaked whales.

Table 1. Summary of available information on incidental mortality and serious injury of Blainville's beaked whales (Hawaii stock) in commercial longline fisheries, within and outside of the Hawaiian Islands EEZ (McCracken 2013). Mean annual takes are based on 2007-2011 data unless otherwise indicated. Information on all observed takes (T) and combined mortality events & serious injuries (MSI) is included. Total takes were prorated to deaths, serious injuries, and non-serious injuries based on the observed proportions of each outcome.

				Observed total interactions (T) and mortality events, and serious injuries (MSI), and total estimated mortality and serious injury (M&SI) of Blainville's beaked whales (MD), unidentified Mesoplont whales (UM) and unidentified beaked whales (ZU)			
				Outside U.S. EEZs		**Hawaiian EEZ**	
Fishery Name	**Year**	**Data Type**	**Percent Observer Coverage**	**Obs. MD T/MSI Obs. UM+ZU T/MSI**	**Estimated MD M&SI (CV) Estimated UM+ZU MSI (CV)**	**Obs. MD T/MSI Obs. UM+ZU T/MSI**	**Estimated MD M&SI (CV) Estimated UM+ZU MSI (CV)**
Hawaii-based deep-set longline fishery	2007	Observer data	20%	0	0 (-)	0	0 (-)
	2008		22%	0	0 (-)	0	0 (-)
	2009		21%	0	0 (-)	0	0 (-)
	2010		21%	0	0 (-)	0	0 (-)
	2011		20%	0	0 (-)	0	0 (-)
Mean Estimated Annual MD Take (CV)					**0 (-)**		**0 (-)**
Mean Estimated Annual UM+ZU Take (CV)					**0 (-)**		**0 (-)**
Hawaii-based shallow-set longline fishery	2007	Observer data	100%	0	0	0	0
	2008		100%	0	0	0	0
	2009		100%	0	0	0	0
	2010		100%	0	0	0	0
	2011		100%	1/0 2/2	0 0.4	0	0
Mean Annual MD Takes (100% coverage)					**0**		**0**
Mean Annual UM + ZU Takes (100% coverage)					**0.4**		**0**
Minimum total annual MD takes within U.S. EEZ							**0 (-)**

Other Mortality

Anthropogenic sound sources, such as military sonar and seismic testing have been implicated in the mass strandings of beaked whales, including atypical events involving multiple beaked whale species (Simmonds and Lopez-Jurado 1991, Frantiz 1998, Anon. 2001, Jepson et al. 2003, Cox et al. 2006). While D'Amico et al. (2009) note that most mass strandings of beaked whales are unassociated with documented sonar activities, lethal or sub-lethal effects of such activities would rarely be documented, due to the remote nature of such activities and the low probability that an injured or dead beaked whale would strand. Filadelpho et al. (2009) reported statistically significant correlations between military sonar use and mass strandings of beaked whales in the Mediterranean and Caribbean Seas, but not in Japanese and Southern California waters, and hypothesized that regions with steep bathymetry adjacent to coastlines are more conducive to stranding events in the presence of sonar use. In Hawaiian waters, Faerber & Baird (2010) suggest that the probability of stranding is lower than in some other regions due to nearshore currents carrying animals away from beaches, and that stranded animals are less likely to be detected due to low human population density near many of Hawaii's beaches. Actual and simulated sonar are known to interrupt the foraging dives and echolocation activities of tagged beaked whales (Tyack et al. 2011, DeRuiter et al. 2013). Cuvier's beaked whales tagged and tracked during simulated mid-frequency sonar exposure showed avoidance reactions, including prolonged diving, cessation of echolocation click production associated with foraging, and directional travel away from the simulated sonar source (DeRuiter et al. 2013). Blainville's beaked whale presence was monitored on hydrophone arrays before, during, and after sonar activities on a Caribbean military range, with evidence of avoidance behavior: whales were detected throughout the range prior to sonar exposure, not detected in the center of the range coincident with highest sonar use, and gradually returned to the range center after the cessation of sonar activity (Tyack et al. 2011). Fernández et al. (2013) report that there have been no mass strandings of beaked whales in the Canary Islands following a 2004 ban on sonar activities in that region. The absence of beaked whale bycatch in California drift gillnets following the introduction of acoustic pingers into the fishery implies additional sensitivity of beaked whales to anthropogenic sound (Carretta et al. 2008, Carretta and Barlow 2011). The impact of sonar exercises on resident versus offshore beaked whales may be significantly different with offshore animals less frequently exposed, and possibly subject to more extreme reactions (Baird *et al.* 2009). No estimates of potential mortality or serious injury are available for U.S. waters.

STATUS OF STOCK

The Hawaii stock of Blainville's beaked whales is not considered strategic under the 1994 amendments to the MMPA The status of Blainville's beaked whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Blainville's beaked whales are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor designated as "depleted" under the MMPA. Given the absence of recorded recent fishery-related mortality or serious injuries within U.S. EEZs, the total fishery mortality and serious injury can be considered to be insignificant and approaching zero. The impacts of anthropogenic sound on beaked whales remain a concern (Barlow and Gisiner 2006, Cox et al. 2006, Hildebrand et al. 2005, Weilgart 2007). One Blainville's beaked whale found stranded on the main Hawaiian Islands has tested positive for *Morbillivirus* (Jacob 2012). Although *morbillivus* is known to trigger lethal disease in cetaceans (Van Bressem et al. 2009), its impact on the health of the stranded animal is not known as it was found in only a few tested tissues (Jacob 2012). The presence of *morbillivirus* in 10 species of cetacean in Hawaiian waters, including all 3 known species of beaked whales (Jacob 2012), raises concerns about the history and prevalence of this disease in Hawaii and the potential population impacts on Hawaiian cetaceans.

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Revised 6/4/2014

CUVIER'S BEAKED WHALE (*Ziphius cavirostris*):
Hawaii Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

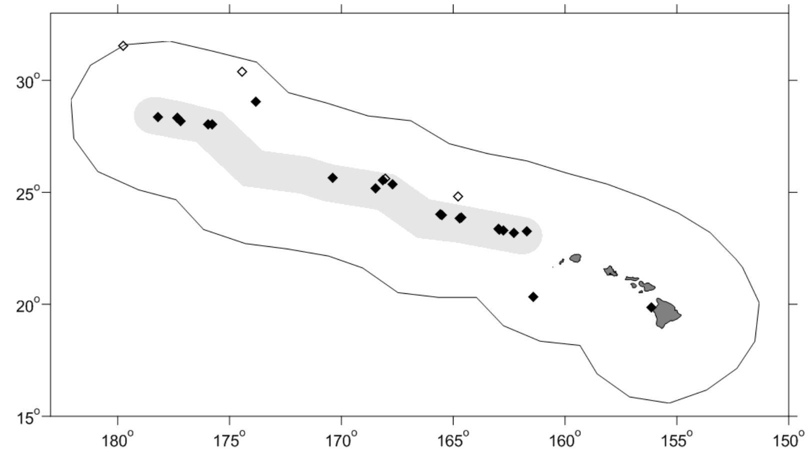

Figure 1. Cuvier's beaked whale sighting locations during the 2002 (open diamonds) and 2010 (black diamonds) shipboard surveys of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ. Gray shading indicates area of Papahanaumokuakea Marine National Monument.

Cuvier's beaked whales occur in all oceans and major seas (Heyning 1989). Summer/fall shipboard surveys of the waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands, resulted in four sightings in 2002 and 22 in 2010, including markedly higher sighting rates during nearshore surveys in the Northwestern Hawaiian Islands. (Figure 1; Barlow 2006, Bradford et al. 2013).

Resighting and movement data of individual Cuvier's beaked whales suggest the existence of insular and offshore populations of this species in Hawaiian waters. A 21-yr study off Hawaii Island suggests long-term site fidelity and year-round occurrence (McSweeney *et al* 2007). Eight Cuvier's beaked whales have been tagged off Hawaii Island since 2006, with all remaining close to the island of Hawaii for the duration of tag data received (Baird et al 2013). Approximately 95% of all locations were within 45 km of shore and the farthest offshore an individual was documented was 67 km (Baird et al. 2013). The satellite data suggest that a resident population may occur near Hawaii Island, distinct from offshore, pelagic Cuvier's beaked whales. This conclusion is further supported by the long-term site fidelity evident from photo-identification data (McSweeney et al. 2007). Division of this population into a separate island-associated stock may be warranted in the future.

For the Marine Mammal Protection Act (MMPA) stock assessment reports, Cuvier's beaked whales within the Pacific U.S. EEZ are divided into three discrete, non-contiguous areas: 1) Hawaiian waters (this report), 2) Alaskan waters, and 3) waters off California, Oregon and Washington. The Hawaii stock includes animals found both within the Hawaiian Islands EEZ and in adjacent high seas waters. Because data on abundance, distribution, and human-caused impacts are largely lacking for high seas waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

POPULATION SIZE

Wade and Gerrodette (1993) estimated population size for Cuvier's beaked whales in the eastern tropical Pacific, but it is not known whether any of these animals are part of the same population that occurs around the Hawaiian Islands. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 15,242 (CV=1.43) Cuvier's beaked whales (Barlow 2006). The recent 2010 shipboard line-transect survey of the Hawaiian Islands EEZ resulted in an abundance estimate of 1,941 (CV = 0.70) Cuvier's beaked whales (Bradford et al 2013), including a correction factor for missed diving animals. This is currently the best available abundance estimate for the Hawaii stock.

Minimum Population Estimate

Minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow et al. 1995) of the 2010 abundance estimate, or 1,142 Cuvier's beaked whales.

Current Population Trend

The significant decrease in abundance estimates between the 2002 and 2010 surveys is attributed to the use of higher sea states (beaufort 0–5) in estimating the trackline detection probability for the 2010 survey, compared to the 2002 survey, which utilized only beaufort sea state data 0 through 2 (Bradford et al. 2013). This change in analysis methodology resulted in far less extrapolation over the survey area, resulting in a more representative estimate of abundance. The 2002 survey data have not been reanalyzed using this method. This change precludes evaluation of population trends at this time.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the pelagic stock of Cuvier's beaked whales is calculated as the minimum population estimate for the U.S. EEZ of the Hawaiian Islands (1,142) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no known fishery mortality within the Hawaiian Islands EEZ; Wade and Angliss 1997), resulting in a PBR of 11.4 Cuvier's beaked whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*". Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fishery Information

Information on fishery-related mortality of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. In 1998, a Cuvier's beaked whale stranded possibly entangled, with scars and cuts from fishing gear along its body (Bradford & Lyman 2013). The gear was not described. No other interactions between nearshore fisheries and Cuvier's beaked whales have been reported in Hawaiian waters. No estimates of human-caused mortality or serious injury are currently available for nearshore hook and line fisheries because these fisheries are not observed or monitored for protected species bycatch.

There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2007 and 2011, no Cuvier's beaked whales were observed hooked or entangled in the SSLL fishery (100% observer coverage) or the DSLL fishery (20-22% observer coverage) (Bradford and Forney 2013, McCracken 2013).

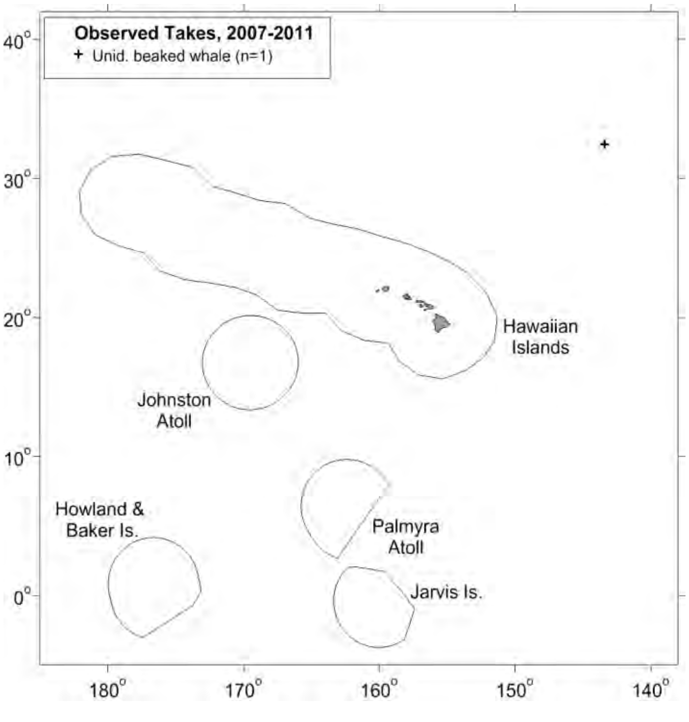

Figure 2. Location of the possible take of Cuvier's beaked whale (cross) in Hawaii-based longline fisheries, 2007-2011. Solid lines represent the U.S. EEZ. Fishery descriptions are provided in Appendix 1.

One unidentified beaked whale was taken in the SSLL fishery and considered seriously injured based on an evaluation of the observer's description of the interaction and following the most recently developed criteria for assessing serious injury in marine mammals (NMFS 2012). Average 5-yr estimates of annual mortality and serious injury for 2007-2011 are zero Cuvier's beaked whales within or outside of the U.S. EEZs, and 0.2 unidentified beaked whales outside the U.S. EEZs (Table 1). Eight unidentified cetaceans were taken in the DSLL fishery, and two unidentified cetaceans were taken in the SSLL fishery, some of which could have been Cuvier's beaked whales.

Table 1. Summary of available information on incidental mortality and serious injury of Cuvier's beaked whales (Hawaii pelagic stock) and unidentified beaked whales (ZU) in commercial longline fisheries, within and outside of the Hawaiian Islands EEZ (McCracken 2013). Mean annual takes are based on 2007-2011 data unless otherwise indicated. Information on all observed takes (T) and combined mortality events & serious injuries (MSI) is included. Total takes were prorated to deaths, serious injuries, and non-serious injuries based on the observed proportions of each outcome.

Fishery Name	Year	Data Type	Percent Observer Coverage	Observed total interactions (T) and mortality events, and serious injuries (MSI), and total estimated mortality and serious injury (M&SI) unidentified beaked whales			
				Outside U.S. EEZs		Hawaiian EEZ	
				Obs. T/MSI	Estimated ZU MSI (CV)	Obs. T/MSI	Estimated ZU MSI (CV)
Hawaii-based deep-set longline fishery	2007	Observer data	20%	0	0 (-)	0	0 (-)
	2008		22%	0	0 (-)	0	0 (-)
	2009		21%	0	0 (-)	0	0 (-)
	2010		21%	0	0 (-)	0	0 (-)
	2011		20%	0	0 (-)	0	0 (-)
Mean Estimated Annual Unidentified Beaked Whale Take (CV)					**0 (-)**		**0 (-)**
Hawaii-based shallow-set longline fishery	2007	Observer data	100%	0	0	0	0
	2008		100%	0	0	0	0
	2009		100%	0	0	0	0
	2010		100%	0	0	0	0
	2011		100%	1/1	0.2	0	0
Mean Annual Unidentified Beaked Whale Takes (100% coverage)					**0.2**		**0**
Minimum total annual ZI takes within U.S. EEZ							**0 (-)**

Other Mortality

Anthropogenic sound sources, such as military sonar and seismic testing have been implicated in the mass strandings of beaked whales, including atypical events involving multiple beaked whale species (Simmonds and Lopez-Jurado 1991, Frantiz 1998, Anon. 2001, Jepson et al. 2003, Cox et al. 2006). While D'Amico et al. (2009) note that most mass strandings of beaked whales are unassociated with documented sonar activities, lethal or sub-lethal effects of such activities would rarely be documented, due to the remote nature of such activities and the low probability that an injured or dead beaked whale would strand. Filadelpho et al. (2009) reported statistically significant correlations between military sonar use and mass strandings of beaked whales in the Mediterranean and Caribbean Seas, but not in Japanese and Southern California waters, and hypothesized that regions with steep bathymetry adjacent to coastlines are more conducive to stranding events in the presence of sonar use. In Hawaiian waters, Faerber & Baird (2010) suggest that the probability of stranding is lower than in some other regions due to nearshore currents carrying animals away from beaches, and that stranded animals are less likely to be detected due to low human population density near many of Hawaii's beaches. Actual and simulated sonar are known to interrupt the foraging dives and echolocation activities of tagged beaked whales (Tyack et al. 2011, DeRuiter et al. 2013). Cuvier's beaked whales tagged and tracked during simulated mid-frequency sonar exposure showed avoidance reactions, including prolonged diving, cessation of echolocation click production associated with foraging, and directional travel away from the simulated sonar source (DeRuiter et al. 2013). Blainville's beaked whale presence was monitored on hydrophone arrays before, during, and after sonar activities on a Caribbean military range, with evidence of avoidance behavior: whales were detected throughout the range prior to sonar exposure, not detected in the center of the range coincident with highest sonar use, and gradually returned to the range center after the cessation of sonar activity (Tyack et al. 2011). Fernández et al. (2013) report that there have been no mass strandings of beaked whales in the Canary Islands following a 2004 ban on sonar activities in that region. The absence of beaked whale bycatch in California drift gillnets following the introduction of acoustic pingers into the fishery implies additional sensitivity of beaked whales to anthropogenic sound (Carretta et al. 2008, Carretta and Barlow 2011). The impact of sonar exercises on resident versus offshore beaked whales may be significantly different with offshore animals less frequently exposed, and possibly subject to more extreme reactions (Baird *et al.* 2009). No estimates of potential mortality or serious injury are available for U.S. waters.

STATUS OF STOCK

The Hawaii stock of Cuvier's beaked whales is not considered strategic under the 1994 amendments to the MMPA. The status of Cuvier's beaked whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Cuvier's beaked whales are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor designated as "depleted" under the MMPA. There have been no reported fishery related mortality or injuries within the Hawaiian Islands EEZ, such that the total mortality and serious injury can be considered to be insignificant and approaching zero. The impacts of anthropogenic sound on beaked whales remain a concern (Barlow and Gisiner 2006, Cox et al. 2006, Hildebrand et al. 2005, Weilgart 2007). One Cuvier's beaked whale found stranded on the main Hawaiian Islands tested positive for *Morbillivirus* (Jacob 2012). Although *morbillivus* is known to trigger lethal disease in cetaceans (Van Bressem et al. 2009), its impact on the health of the stranded animal is not known as it was found in only a few tested tissues (Jacob 2012). The presence of *morbillivirus* in 10 species of cetacean in Hawaiian waters, including all 3 known species of beaked whales (Jacob 2012), raises concerns about the history and prevalence of this disease in Hawaii and the potential population impacts on Hawaiian cetaceans.

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Revised 6/4/2014

LONGMAN’S BEAKED WHALE (*Indopacetus pacificus*): Hawaii Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

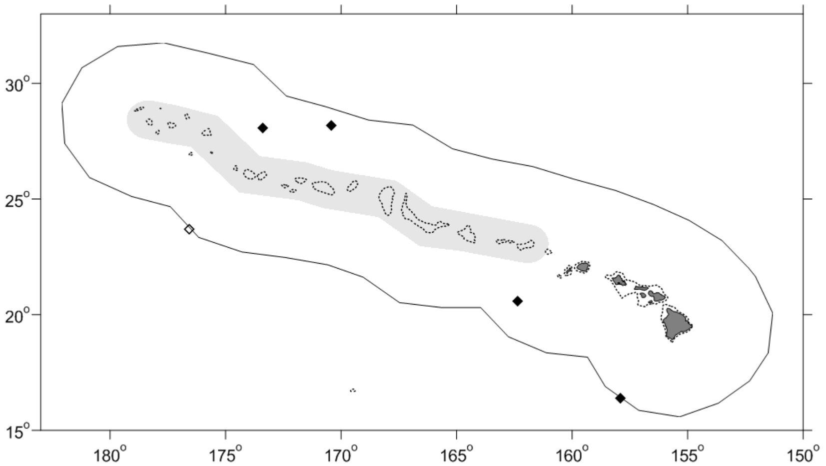

Figure 1. Sighting locations of Longman’s beaked whale during the 2002 (open diamond) and 2010 (black diamonds) shipboard cetacean surveys of U.S. waters surrounding the Hawaiian Islands (Barlow 2006, Bradford et al. 2013; see Appendix 2 for details on timing and location of survey effort). Outer line indicates approximate boundary of survey area and U.S. EEZ. Gray shading indicates area of Papahanaumokuakea Marine National Monument. Dotted line represents the 1000m isobath.

Longman’s beaked whale is considered one of the least known cetacean species (Jefferson et al. 1993; Rice 1998; Dalebout et al. 2003). Until recently, it was known only from two skulls found in Australia and Somalia (Longman 1926; Azzaroli 1968). Recent genetic studies (Dalebout et al. 2003) have revealed that sightings of ‘tropical bottlenose whales’ (*Hyperoodon* sp.; Pitman et al. 1999) in the Indo-Pacific region were in fact Longman’s beaked whales, providing the first description of the external appearance of this species. Although originally described as *Mesoplodon pacificus* (Longman 1926), it has been proposed that this species is sufficiently unique to be placed within its own genus, *Indopacetus* (Moore 1968; Dalebout et al. 2003). The distribution of Longman’s beaked whale, as determined from stranded specimens and sighting records of ‘tropical bottlenose whales’, includes tropical waters from the eastern Pacific westward through the Indian Ocean to the eastern coast of Africa. A single stranding of Longman’s beaked whale has been reported in Hawaii, in 2010 near Hana, Maui (West et al. 2012), and there was a single sighting off Kona over 13 years of nearshore surveys off the leeward waters of the main Hawaiian Islands (Baird et al. 2013). Summer/fall shipboard surveys of the waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands, resulted in one sighting in 2002 and three in 2010 (Barlow 2006, Bradford et al. 2013; Figure 1).

For the Marine Mammal Protection Act (MMPA) stock assessment reports, there is one Pacific stock of Longman’s beaked whales, found within waters of the Hawaiian Islands EEZ. This stock includes animals found both within the Hawaiian Islands EEZ and in adjacent high seas waters; however, because data on abundance, distribution, and human-caused impacts are largely lacking for high seas waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

POPULATION SIZE

A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 1,007 (CV=1.25) Longman’s beaked whales (Barlow 2006). The recent 2010 shipboard line-transect survey of the Hawaiian Islands EEZ resulted in an abundance estimate of 4,571 (CV = 0.65) Longman’s beaked whales (Bradford et al 2013). This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow et al 1995) around the 2010 abundance estimate, or 2,773 Longman’s beaked whales within the Hawaiian Islands EEZ.

Current Population Trend

The increase in the abundance estimate for the 2010 survey versus the 2002 survey is attributed primarily to use of beaufort sea states 0-5 in 2010 versus 0-2 in the 2002 when estimating the trackline detection probability, resulting in significantly less extrapolation to unsurveyed areas in 2010 (Bradford et al. 2013). This change in analysis methodology precludes evaluation of population trend at this time.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate for Longman's beaked whales.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size within the U.S. EEZ of the Hawaiian Islands (2,773) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a stock of unknown status with no known fishery mortality or serious injury within the Hawaiian Islands EEZ; Wade and Angliss 1997), resulting in a PBR of 28 Longman's beaked whales per year.

HUMAN CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*". Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fishery Information

Information on fishery-related mortality and serious injury of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. No interactions between nearshore fisheries and Longman's beaked whales have been reported in Hawaiian waters. No estimates of human-caused mortality or serious injury are currently available for nearshore hook and line fisheries because these fisheries are not observed or monitored for protected species bycatch. There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2007 and 2011, no Longman's beaked whales were observed hooked or entangled in the SSLL fishery (100% observer coverage) or the DSLL fishery (20-22% observer coverage) (McCracken 2013, Bradford & Forney 2013). However, eight unidentified cetaceans, which may have included Longman's beaked whales, were taken in the DSLL fishery, and two unidentified cetaceans, one unidentified Mesoplodon, and one unidentified beaked whale, which may have included Longman's beaked whales, were taken in the SSLL fishery.

Other Mortality

Anthropogenic sound sources, such as military sonar and seismic testing have been implicated in the mass strandings of beaked whales, including atypical events involving multiple beaked whale species (Simmonds and Lopez-Jurado 1991, Frantiz 1998, Anon. 2001, Jepson et al. 2003, Cox et al. 2006). While D'Amico et al. (2009) note that most mass strandings of beaked whales are unassociated with documented sonar activities, lethal or sub-lethal effects of such activities would rarely be documented, due to the remote nature of such activities and the low probability that an injured or dead beaked whale would strand. Filadelpho et al. (2009) reported statistically significant correlations between military sonar use and mass strandings of beaked whales in the Mediterranean and Caribbean Seas, but not in Japanese and Southern California waters, and hypothesized that regions with steep bathymetry adjacent to coastlines are more conducive to stranding events in the presence of sonar use. In Hawaiian waters, Faerber & Baird (2010) suggest that the probability of stranding is lower than in some other regions due to nearshore currents carrying animals away from beaches, and that stranded animals are less likely to be detected due to low human population density near many of Hawaii's beaches. Actual and simulated sonar are known to interrupt the foraging dives and echolocation activities of tagged beaked whales (Tyack et al. 2011, DeRuiter et al. 2013). Cuvier's beaked whales tagged and tracked during simulated mid-frequency sonar exposure showed avoidance reactions, including prolonged diving, cessation of echolocation click production associated with foraging, and directional travel away from the simulated sonar source (DeRuiter et al. 2013). Blainville's beaked whale presence was monitored on hydrophone arrays before, during, and after sonar activities on a Caribbean military range, with evidence of avoidance behavior: whales were detected throughout the range prior to sonar exposure, not detected in the center of the range coincident with highest sonar use, and gradually returned to the range center after the cessation of sonar activity (Tyack et al. 2011). Fernández et al. (2013) report that there have been no mass strandings of beaked whales in the Canary Islands following a 2004 ban on sonar activities in that region. The absence of beaked whale bycatch in California drift gillnets following the introduction of acoustic pingers into the fishery implies additional sensitivity of beaked whales to anthropogenic sound (Carretta et al. 2008, Carretta and Barlow 2011). No estimates of potential mortality or serious injury are available for U.S. waters.

STATUS OF STOCK

The Hawaii stock of Longman's beaked whales is not considered strategic under the 1994 amendments to the MMPA. The status of Longman's beaked whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Longmans' beaked whales are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor designated as "depleted" under the MMPA. Given the absence of recent recorded fishery-related mortality or serious injuries, the total fishery mortality and serious injury can be considered to be insignificant and approaching zero. The impacts of anthropogenic sound on beaked whales remain a concern (Barlow and Gisiner 2006, Cox et al. 2006, Hildebrand et al. 2005, Weilgart 2007). The first confirmed case of *morbillivirus* in a Hawaiian cetacean was found in a subadult Longman's beaked whale stranded on Maui in 2010 (West et al. 2012). The presence of *morbillivirus* in 10 species of cetacean in Hawaiian waters, including all 3 known species of beaked whales (Jacob 2012), raises concerns about the history and prevalence of this disease in Hawaii and the potential population impacts on Hawaii cetaceans.

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Revised 6/4/2014

PYGMY SPERM WHALE (*Kogia breviceps*): Hawaii Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Pygmy sperm whales are found throughout the world in tropical and warm-temperate waters (Caldwell and Caldwell 1989). Pygmy sperm whales have been observed in nearshore waters off Oahu, Maui, Niihau, and Hawaii Island (Shallenberger 1981, Mobley et al. 2000, Baird 2005, Baird et al. 2013). Two sightings were made during a 2002 shipboard survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands (Figure 1; Barlow 2006). A freshly dead pygmy sperm whale was picked up approximately 100 nmi north of French Frigate Shoals on a similar 2010 survey (NMFS, unpublished data). Nothing is known about stock structure for this species.

For the Marine Mammal Protection Act (MMPA) stock assessment reports, pygmy sperm whales within the Pacific U.S. EEZ are divided into two discreate areas: 1) Hawaiian waters (this report), and 2) waters off California, Oregon and Washington. The Hawaii stock includes animals found both within the Hawaiian Islands EEZ and in adjacent high seas waters; however, because data on abundance, distribution, and human-caused impacts are largely lacking for high seas waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

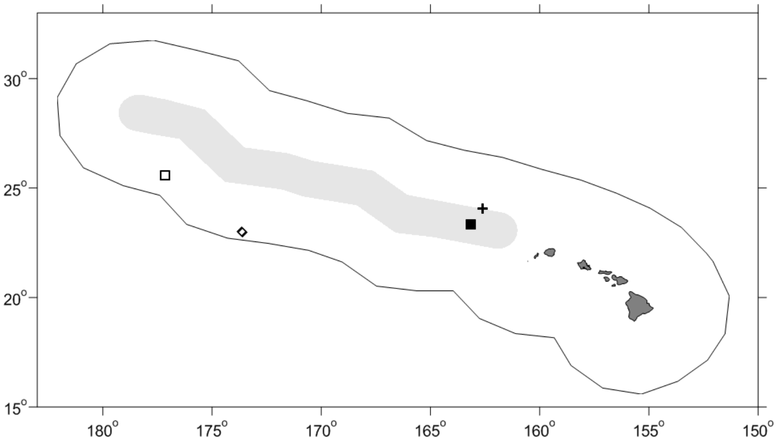

Figure 1. Pygmy sperm whale (open diamond) and unidentified *Kogia* (open square) sighting locations during the 2002 shipboard survey and unidentified *Kogia* (filled square) during the 2010 shipboard cetacean surveys of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006, Bradford et al. 2013; see Appendix 2 for details on timing and location of survey effort). A freshly dead pygmy sperm whale was also retrieved during the 2010 survey (cross). Outer line indicates approximate boundary of survey area and U.S. EEZ. Gray shading indicates area of Papahanaumokuakea Marine National Monument.

POPULATION SIZE

A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 7,138 (CV=1.12) pygmy sperm whales (Barlow 2006), including a correction factor for missed diving animals. This estimate for the Hawaiian EEZ is more than 8 years old and therefore will no longer be used based on NMFS Guidelines for Assessing Marine Mammal Stocks (NMFS 2005). A 2010 shipboard line-transect survey within the Hawaiian EEZ did not result in any sightings of pygmy sperm whales (Bradford et al. 2013).

Minimum Population Estimate

No minimum estimate of abundance is available for pygmy sperm whales, as there were no on-effort sightings during a 2010 shipboard line-transect survey of the Hawaiian EEZ.

Current Population Trend

No data are available on current population abundance or trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size within the U.S EEZ of the Hawaiian Islands times one half the default maximum net growth rate for cetaceans (½ of

4%) times a recovery factor of 0.50 (for a stock of unknown status with no known fishery mortality or serious injury within the Hawaiian Islands EEZ; Wade and Angliss 1997). Because there is no minimum population size estimate for pygmy sperm whales in Hawaii, the PBR is undetermined.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*". Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fishery Information

Information on fishery-related mortality of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. One pygmy sperm whale was found entangled in fishing gear off Oahu in 1994 (Bradford & Lyman 2013), but the gear was not described and the fishery not identified. No estimates of human-caused mortality or serious injury are currently available for nearshore hook and line fisheries because these fisheries are not observed or monitored for protected species bycatch.

There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2007 and 2011, one pygmy or dwarf sperm whale was observed hooked in the SSLL fishery (100% observer coverage) (Figure 2, Bradford & Forney 2013, McCracken 2013). Based on an evaluation of the observer's description of the interaction and following the most recently developed criteria for assessing serious injury in marine mammals (NMFS 2012), this animal was considered not seriously injured (Bradford & Forney 2013). No pygmy sperm whales were observed hooked or entangled in the DSLL fishery (20-22% observer coverage). Eight unidentified cetaceans were taken in the DSLL fishery, and two unidentified cetaceans were taken in the SSLL fishery, some of which may have been pygmy sperm whales.

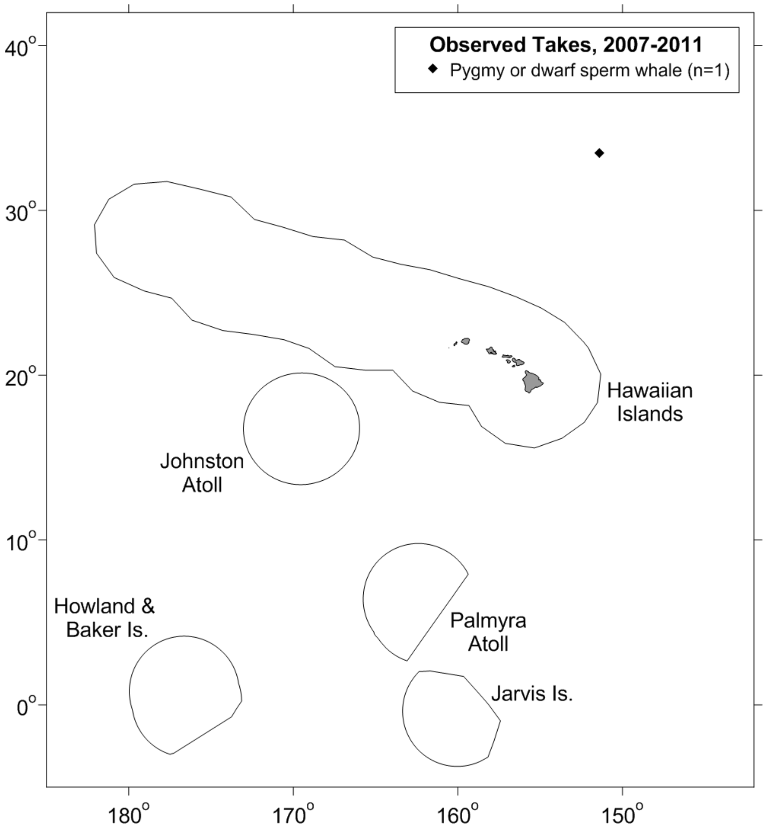

Figure 2. Location of pygmy or dwarf sperm whale takes (filled diamond) in Hawaii-based longline fisheries, 2007-2011. Solid lines represent the U.S. EEZs. Fishery descriptions are provided in Appendix 1.

STATUS OF STOCK

The Hawaii stock of pygmy sperm whales is not considered strategic under the 1994 amendments to the MMPA. The status of pygmy sperm whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Pygmy sperm whales are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor designated as "depleted" under the MMPA. Given the absence of recent recorded fishery-related mortality or serious injuries within the Hawaiian Islands EEZ, the total fishery mortality and serious injury can be considered to be insignificant and approaching zero. The increasing level of anthropogenic noise in the world's oceans has been suggested to be a habitat concern for whales (Richardson et al. 1995), particularly for deep-diving whales like pygmy sperm whales that feed in the oceans' "sound channel". One pygmy sperm whale found stranded in the main Hawaiian Islands tested positive for *Morbillivirus* (Jacob 2012). Although *morbillivus* is known to trigger lethal disease in cetaceans (Van Bressem et al. 2009), its impact on the health of the stranded animal is unknown (Jacob 2012). The presence of *morbillivirus* in 10 species of cetacean in Hawaiian waters (Jacob 2012) raises concerns about the history and prevalence of this disease in Hawaii and the potential population impacts on Hawaiian cetaceans.

Table 1. Summary of available information on incidental mortality and serious injury of pygmy sperm whales (Hawaiian stock) in commercial longline fisheries within and outside of the Hawaiian Islands EEZ (McCracken 2013). Mean annual takes are based on 2007-2011 data unless otherwise indicated. Information on all observed takes (T) and combined mortality events & serious injuries (MSI) is included. Total takes were prorated to deaths, serious injuries, and non-serious injuries based on the observed proportions of each outcome.

Fishery Name	**Year**	**Data Type**	**Percent Observer Coverage**	**Observed total interactions (T) and mortality events, and serious injuries (MSI), and total estimated mortality and serious injury (M&SI) of pygmy sperm whales**			
				Outside U.S. EEZs		**Inside Hawaiian EEZ**	
				Obs. T/MSI	**Estimated M&SI (CV)**	**Obs. T/MSI**	**Estimated M&SI (CV)**
Hawaii-based deep-set longline fishery	2007	Observer data	20%	0	0 (-)	0	0 (-)
	2008		22%	0	0 (-)	0	0 (-)
	2009		21%	0	0 (-)	0	0 (-)
	2010		21%	0	0 (-)	0	0 (-)
	2011		20%	0	0 (-)	0	0 (-)
Mean Estimated Annual Take (CV)					**0 (-)**		**0 (-)**
Hawaii-based shallow-set longline fishery	2007	Observer data	100%	0	0	0	0
	2008		100%	1*/0	0	0	0
	2009		100%	0	0	0	0
	2010		100%	0	0	0	0
	2011		100%	0	0	0	0
Mean Annual Takes (100% coverage)					**0**		**0**
Minimum total annual takes within U.S. EEZ							**0 (-)**

*One animal was identified as either a pygmy sperm whale or a dwarf sperm whale.

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Revised 6/4/2014

DWARF SPERM WHALE (*Kogia sima*): Hawaii Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Dwarf sperm whales are found throughout the world in tropical to warm-temperate waters (Nagorsen 1985). At least eight strandings of dwarf sperm whales have been documented in Hawaii since 1985 (Tomich 1986; Nitta 1991; Maldini et al. 2005, NMFS PIR Marine Mammal Response Network database), including two since 2007. From 2002 and 2012, dwarf sperm whales have been seen near Niihau, Kauai, Oahu, Lanai, and Hawaii during small boat surveys (Baird et al 2005, Baird et al 2013). Summer/fall shipboard surveys of the waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands resulted in five sightings of dwarf sperm whales during 2002 and one during 2010 (Figure 1; Barlow 2006, Bradford et al. 2013).

Small boat surveys within the main Hawaiian Islands (MHI) since 2002 have documented dwarf sperm whales on 73 occasions, most commonly in water depths between 500m and 1,000m (Baird et al. 2013). Long-term site-fidelity is evident off Hawaii Island, with one third of the distinctive individuals seen there encountered in more than one year. Resighting data from 25 individuals documented at Hawaii Island suggest an island-resident population with restricted range, with all encounters in less than 1,600m water depth and less than 20 km from shore (Baird et al 2013). Division of this population into a separate island-associated stock may be warranted in the future. For the Marine Mammal Protection Act (MMPA) stock assessment reports, dwarf sperm whales within the Pacific U.S. EEZ are divided into two discrete, non-contiguous areas: 1) Hawaiian waters (this report), and 2) waters off California, Oregon and Washington. The Hawaii stock includes animals found within the Hawaiian Islands EEZ and in adjacent high seas waters; however, because data on abundance, distribution, and human-caused impacts are largely lacking for high seas waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

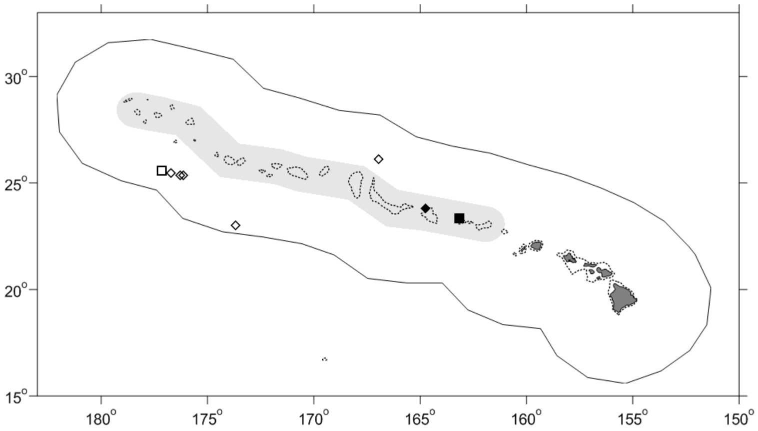

Figure 1. Dwarf sperm whale (diamonds) and unidentified *Kogia* (squares) sighting locations during the 2002 (open symbols) and 2010 (black symbols) shipboard cetacean surveys of U.S. waters surrounding the Hawaiian Islands (Barlow 2006, Bradford et al. 2013; see Appendix 2 for details on timing and location of survey effort). Outer line indicates approximate boundary of survey area and U.S. EEZ. Gray shading indicates area of Papahanaumokuakea Marine National Monument. Dotted line represents the 1000m isobath.

POPULATION SIZE

Wade and Gerrodette (1993) provided an estimate for the eastern tropical Pacific, but it is not known whether these animals are part of the same population that occurs in the central North Pacific. This species' small size, tendency to avoid vessels, and deep-diving habits, combined with the high proportion of *Kogia* sightings that are not identified to species, may result in negatively biased estimates of relative abundance in this region. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 17,519 (CV=0.74) dwarf sperm whales (Barlow 2006), including a correction factor for missed diving animals. There were no on-effort sightings of dwarf sperm whales during the 2010 shipboard survey of the Hawaiian EEZ (Bradford et al 2013), such that there is no current abundance estimate for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate (Barlow 2006) is 10,043 dwarf sperm whales within the Hawaiian Islands EEZ; however, the minimum abundance estimate for the entire Hawaiian EEZ is ≥ 8 years old and will no longer be used (NMFS 2005). No minimum estimate of abundance is available for this stock, as there were no sightings of dwarf sperm whales during a 2010 shipboard line-transect survey of the Hawaiian EEZ.

Current Population Trend

No data are available on current population abundance or trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size within the U.S. EEZ of the Hawaiian Islands times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a stock of unknown status with no known fishery mortality or serious injury within the Hawaiian Islands EEZ; Wade and Angliss 1997). Because there is no minimum population size estimate for Hawaii pelagic dwarf sperm whales, the PBR is undetermined.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*". Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fishery Information

Information on fishery-related mortality of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. No interactions between nearshore fisheries and dwarf sperm whales have been reported in Hawaiian waters. No estimates of human-caused mortality or serious injury are currently available for nearshore hook and line fisheries because these fisheries are not observed or monitored for protected species bycatch.

There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2007 and 2011, one pygmy or dwarf sperm whale was observed hooked in the SSLL fishery (100% observer coverage) (Figure 2, McCracken 2013, Bradford & Forney 2013). Based on an evaluation of the observer's description of the interaction and following the most recently developed criteria for assessing serious injury in marine mammals (NMFS 2012), this

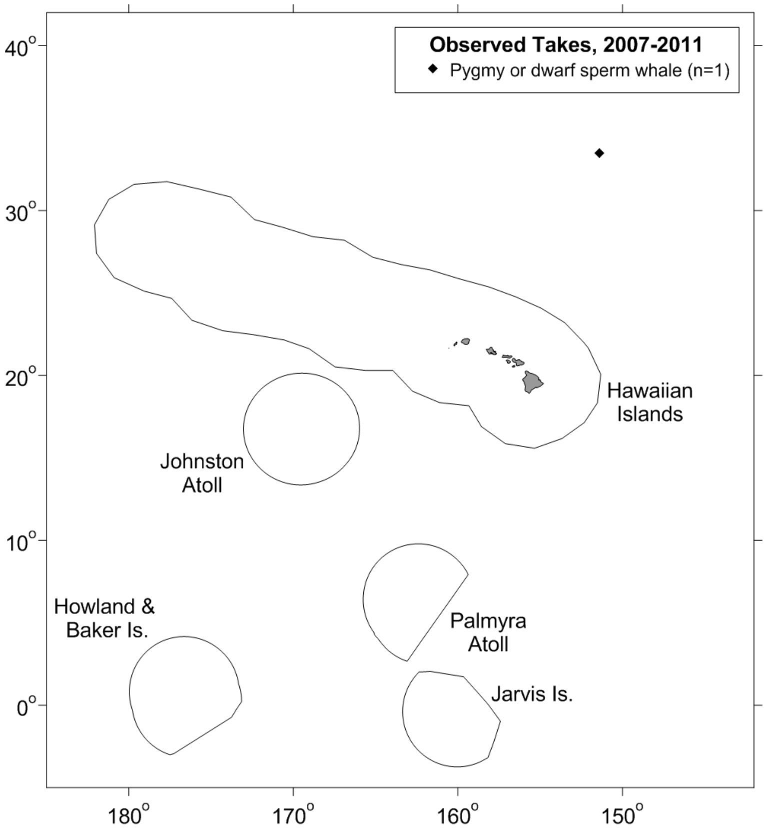

Figure 2. Location of pygmy or dwarf sperm whale take (filled diamond) in Hawaii-based longline fisheries, 2007-2011. Solid lines represent the U.S. EEZs. Fishery descriptions are provided in Appendix 1.

animal was considered not seriously injured (Bradford & Forney 2013). No dwarf sperm whales were observed hooked or entangled in the DSLL fishery (20-22% observer coverage). Eight unidentified cetaceans were taken in the DSLL fishery, and two unidentified cetaceans were taken in the SSLL fishery, some of which may have been dwarf sperm whales.

Table 1. Summary of available information on incidental mortality and serious injury of dwarf sperm whales (Hawaii stock) in commercial longline fisheries, within and outside of the Hawaiian Islands EEZ (McCracken 2013). Mean annual takes are based on 2007-2011 data unless otherwise indicated. Information on all observed takes (T) and combined mortality events & serious injuries (MSI) is included. Total takes were prorated to deaths, serious injuries, and non-serious injuries based on the observed proportions of each outcome.

Fishery Name	Year	Data Type	Percent Observer Coverage	Observed total interactions (T) and mortality events, and serious injuries (MSI), and total estimated mortality and serious injury (M&SI) of dwarf sperm whales			
				Outside U.S. EEZs		Inside Hawaiian EEZ	
				Obs. T/MSI	Estimated M&SI (CV)	Obs. T/MSI	Estimated M&SI (CV)
Hawaii-based deep-set longline fishery	2007	Observer data	20%	0	0 (-)	0	0 (-)
	2008		22%	0	0 (-)	0	0 (-)
	2009		21%	0	0 (-)	0	0 (-)
	2010		21%	0	0 (-)	0	0 (-)
	2011		20%	0	0 (-)	0	0 (-)
Mean Estimated Annual Take (CV)					**0 (-)**		**0 (-)**
Hawaii-based shallow-set longline fishery	2007	Observer data	100%	0	0	0	0
	2008		100%	1*/0	0	0	0
	2009		100%	0	0	0	0
	2010		100%	0	0	0	0
	2011		100%	0	0	0	0
Mean Annual Takes (100% coverage)					**0**		**0**
Minimum total annual takes within U.S. EEZ							**0 (-)**

*One animal was identified as either a pygmy sperm whale or a dwarf sperm whale.

STATUS OF STOCK

The Hawaii stock of dwarf sperm whales is not considered strategic under the 1994 amendments to the MMPA. The status of dwarf sperm whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Dwarf sperm whales are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor designated as "depleted" under the MMPA. There have been no reported fishery related mortality or injuries within the Hawaiian Islands EEZ, such that the total mortality and serious injury can be considered to be insignificant and approaching zero. The increasing levels of anthropogenic noise in the world's oceans has been suggested to be a habitat concern for whales (Richardson et al. 1995), particularly for deep-diving whales like dwarf sperm whales that feed in the oceans' "sound channel".

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Revised 6/4/2014

SPERM WHALE (*Physeter macrocephalus*): Hawaii Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Sperm whales are widely distributed across the entire North Pacific and into the southern Bering Sea in summer but the majority are thought to be south of 40^{o}N in winter (Rice 1974, 1989; Gosho et al. 1984; Miyashita et al. 1995). For management, the International Whaling Commission (IWC) had divided the North Pacific into two management regions (Donovan 1991) defined by a zig-zag line which starts at 150^{o}W at the equator to 160^{o}W between 40-50^{o}N, and ending at 180^{o}W north of 50^{o}N; however, the IWC has not reviewed this stock boundary in many years (Donovan 1991). Summer/fall surveys in the eastern tropical Pacific (Wade and Gerrodette 1993) show that although sperm whales are widely distributed in the tropics, their relative abundance tapers off markedly westward towards the middle of the tropical Pacific (near the IWC stock boundary at 150^{o}W) and tapers off northward towards the tip of Baja California. The Hawaiian Islands marked the center of a major nineteenth century whaling ground for sperm whales (Gilmore 1959; Townsend 1935). Since 1936, at least 28 strandings have been reported from the Hawaiian Islands (Woodward 1972; Nitta 1991; Maldini et al. 2005, NMFS PIR Marine Mammal Response Network databse), including 7 since 2007. Sperm whales have also been sighted throughout the Hawaiian EEZ, including nearshore waters of the main and Northwestern Hawaiian Islands (Rice 1960; Barlow 2006; Lee 1993; Mobley et al. 2000; Shallenberger 1981). In addition, sperm whale sounds have been recorded throughout the year off Oahu (Thompson and Friedl 1982). Summer/fall shipboard surveys of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands resulted in 43 sperm whale sightings in 2002 and 46 in 2010 throughout the study area (Figure 1; Barlow 2006, Bradford et al. 2013).

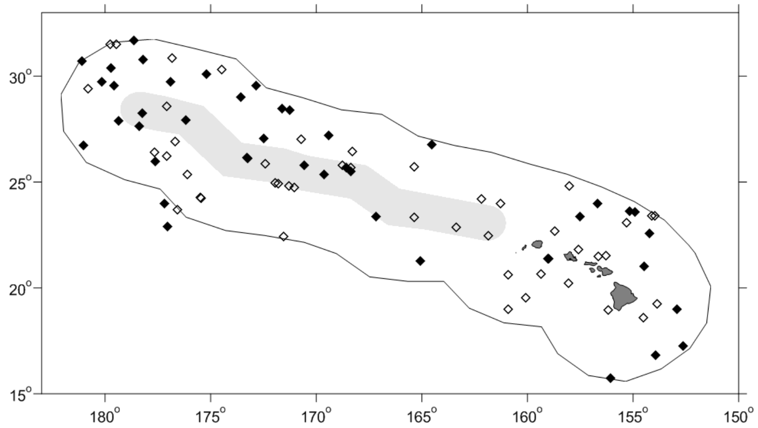

Figure 1. Sperm whale sighting locations during the 2002 (open diamonds) and 2010 (black diamonds) shipboard surveys of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006, Bradford et al. 2013; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ. Gray shading indicates area of Papahanaumokuakea Marine National Monument.

The stock identity of sperm whales in the North Pacific has been inferred from historical catch records (Bannister and Mitchell 1980) and from trends in CPUE and tag-recapture data (Ohsumi and Masaki 1977). A 1997 survey designed specifically to investigate stock structure and abundance of sperm whales in the northeastern temperate Pacific revealed no apparent hiatus in distribution between the U.S. EEZ off California and areas farther west, out to Hawaii (Barlow and Taylor 2005). Recent genetic analyses revealed significant differences in mitochondrial and nuclear DNA and in single-nucleotide polymorphisms between sperm whales sampled off the coast of California, Oregon and Washington and those sampled near Hawaii and in the eastern tropical Pacific (ETP) (Mesnick et al. 2011). These results suggest demographic independence between matrilineal groups found California, Oregon, and Washington, and those found elsewhere in the central and eastern tropical Pacific. Further, assignment tests identified male sperm whales sampled in the sub-Arctic with each of the three regions, suggesting mixing of males from potentially several populations during the summer (Mesnick et al. 2011).

For the Marine Mammal Protection Act (MMPA) stock assessment reports, sperm whales within the Pacific U.S. EEZ are divided into three discrete, non-contiguous stocks: 1) waters around Hawaii (this report), 2) California, Oregon and Washington waters, and 3) Alaskan waters. The Hawaii stock includes animals found both within the Hawaiian Islands EEZ and in adjacent high seas waters; however, because data on abundance, distribution, and human-caused impacts are largely lacking for high seas waters, the status of the Hawaii stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

POPULATION SIZE

A large 1982 abundance estimate for the entire eastern North Pacific (Gosho et al. 1984) was based on a CPUE method which is no longer accepted as valid by the International Whaling Commission. A spring 1997 combined visual and acoustic line-transect survey conducted in the eastern temperate North Pacific resulted in estimates of 26,300 (CV=0.81) sperm whales based on visual sightings, and 32,100 (CV=0.36) based on acoustic detections and visual group size estimates (Barlow and Taylor 2005). Sperm whales appear to be a good candidate for acoustic surveys due to the increased range of detection; however, visual estimates of group size are still required (Barlow and Taylor 2005). In the eastern tropical Pacific, the abundance of sperm whales has been estimated as 22,700 (95% C.I.=14,800-34,600; Wade and Gerrodette 1993). However, it is not known whether any or all of these animals routinely enter the U.S. EEZ of the Hawaiian Islands. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 6,919 (CV=0.81) sperm whales (Barlow 2006). The recent 2010 shipboard line-transect survey of the Hawaiian Islands EEZ resulted in an abundance estimate of 3,354 (CV = 0.34) sperm whales (Bradford et al. 2013), including a correction factor for missed diving animals. This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow et al. 1995) around the 2010 abundance estimate or 2,539 sperm whales within the Hawaiian Islands EEZ.

Current Population Trend

The broad and overlapping confidence intervals around the 2002 and 2010 estimates preclude assessment of trend with the available data.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data on current or maximum net productivity rate are available.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Hawaii stock of sperm whales is calculated as the minimum population size (2,539) within the U.S. EEZ of the Hawaiian Islands times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.2 (for an endangered species with N_{min} > 1,500 and CV_{Nmin} > 0.50, with low vulnerability to extinction; (Taylor et al. 2003), resulting in a PBR of 10.2 sperm whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen *et al*. 2008, NMFS 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*". Injury determinations for stock assessments

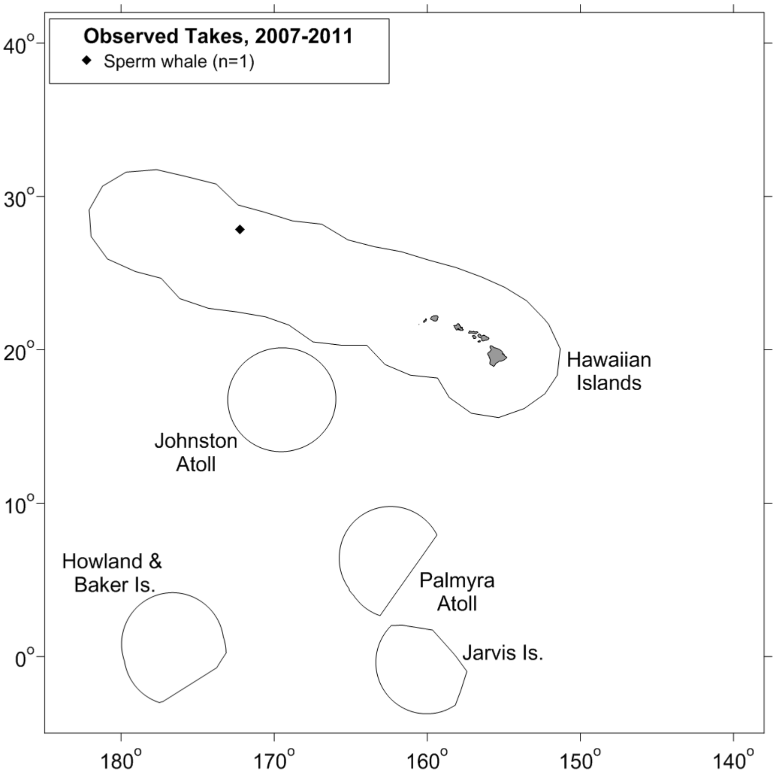

Figure 2. Locations of observed sperm whale take (filled diamonds) in the Hawaii-based longline fishery, 2007-2011. Solid lines represent the U. S. EEZ. Fishery descriptions are provided in Appendix 1.

revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fishery Information

Information on fishery-related mortality of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. One stranded sperm whale was found with fishing line and netting its stomach, though it is unclear whether the gear caused its death, nor what fisheries the gear came from (NMFS PIR MMRN). No estimates of human-caused mortality or serious injury are currently available for nearshore hook and line fisheries because these fisheries are not observed or monitored for protected species bycatch.

There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas Between 2007 and 2011, no sperm whales were observed hooked or entangled in the SSLL fishery (100% observer coverage) and one was observed either hooked or entangled in the DSLL fishery (20-22% observer coverage) (Bradford & Forney 2013). The observer could not determine whether the whale was hooked or entangled; however, the mainline came under tension when the animal surfaced. The whale was cut free with the hook, 0.5m wire leader, 45g weight, 12m of branchline, and 25-30 ft of mainline possibly attached. This interaction was prorated as 75% probability of serious injury because the whale was hooked or entangled but the exact nature of the injury could not be determined (Bradford & Forney 2013). This determination is based on an evaluation of the observer's description of the interaction and following the most recently developed criteria for assessing serious injury in marine mammals (NMFS 2012). The prorating of serious injury is based on the proportion of known outcomes for whales with similar fisheries interactions in other regions. Average 5-yr estimates of annual mortality and serious injury for sperm whales during 2007-2011 are zero sperm whales outside of U.S. EEZs, and 0.7 (CV = 0.6) within the Hawaiian Islands EEZ (Table 1, McCracken 2013).

Table 1. Summary of available information on incidental mortality and serious injury of sperm whales in commercial longline fisheries, within and outside of the U.S. EEZs (McCracken 2013). Mean annual takes are based on 2007-2011 data. Information on all observed takes (T) and combined mortality events & serious injuries (MSI) is included. Total takes were prorated to deaths, serious injuries, and non-serious injuries based on the observed proportions of each outcome.

Fishery Name	Year	Data Type	Percent Observer Coverage	Observed total interactions (T) and mortality events, and serious injuries (MSI), and total estimated mortality and serious injury (M&SI) of sperm whales			
				Outside U.S. EEZs		Hawaiian EEZ	
				Obs. T/MSI	Estimated M&SI (CV)	Obs. T/MSI	Estimated M&SI (CV)
Hawaii-based deep-set longline fishery	2007	Observer data	20%	0	0 (-)	0	0 (-)
	2008		22%	0	0 (-)	0	0 (-)
	2009		21%	0	0 (-)	0	0 (-)
	2010		21%	0	0 (-)	0	0 (-)
	2011		20%	0	0 (-)	1/1*	3 (0.2)
Mean Estimated Annual Take (CV)					**0 (-)**		**0.7 (0.5)**
Hawaii-based shallow-set longline fishery	2007	Observer data	100%	0	0	0	0
	2008		100%	0	0	0	0
	2009		100%	0	0	0	0
	2010		100%	0	0	0	0
	2011		100%	0	0	0	0
Mean Annual Takes (100% coverage)							**0**
Minimum total annual takes within U.S. EEZ							**0.7 (0.5)**

*This injury was prorated 75% probability of being a serious injury based on known outcomes from other whales with this injury type (NOAA 2012).

Historical Mortality

Between 1800 and 1909, about 60,842 sperm whales were estimated taken in the North Pacific (Best 1976). The reported take of North Pacific sperm whales by commercial whalers between 1947 and 1987 totaled 258,000 (C.

Allison, pers. comm.). Factory ships operated as far south as 20°N (Ohsumi 1980). Ohsumi (1980) lists an additional 28,198 sperm whales taken mainly in coastal whaling operations from 1910 to 1946. Based on the massive under-reporting of Soviet catches, Brownell et al. (1998) estimated that about 89,000 whales were additionally taken by the Soviet pelagic whaling fleet between 1949 and 1979. Japanese coastal operations apparently also under-reported catches by an unknown amount (Kasuya 1998). Thus a total of at least 436,000 sperm whales were taken between 1800 and the end of commercial whaling for this species in 1987. Of this grand total, an estimated 33,842 were taken by Soviet and Japanese pelagic whaling operations in the eastern North Pacific from the longitude of Hawaii to the U.S. West coast, between 1961 and 1976 (Allen 1980, IWC statistical Areas II and III), and 965 were reported taken in land-based U.S. West coast whaling operations between 1947 and 1971 (Ohsumi 1980). In addition, 13 sperm whales were taken by shore whaling stations in California between 1919 and 1926 (Clapham et al. 1997). There has been a prohibition on taking sperm whales in the North Pacific since 1988, but large-scale pelagic whaling stopped earlier, in 1980. Some of the whales taken during the whaling era were certainly from a population or populations that occur within Hawaiian waters.

STATUS OF STOCK

The only estimate of the status of North Pacific sperm whales in relation to carrying capacity (Gosho et al. 1984) is based on a CPUE method which is no longer accepted as valid. The status of sperm whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Sperm whales are formally listed as "endangered" under the Endangered Species Act (ESA), and consequently the Hawaiian stock is automatically considered as a "depleted" and "strategic" stock under the MMPA. The estimated rate of fisheries related mortality or serious injury within the Hawaiian Islands EEZ (0.7 animals per year) is less than the PBR (10.2). Insufficient information is available to determine whether the total fishery mortality and serious injury for sperm whales is insignificant and approaching zero mortality and serious injury rate. The increasing level of anthropogenic noise in the world's oceans has been suggested to be a habitat concern for whales (Richardson et al. 1995), particularly for deep-diving whales like sperm whales that feed in the oceans' "sound channel". One sperm whale stranded in the main Hawaiian Islands tested positive for both *Brucella* and *Morbillivirus* (Jacob 2012, West, unpublished data). *Brucella* is a bacterial infection that may limit recruitment by compromising male and female reproductive systems if it is common in the population, and it can also cause neurological disorders that may result in death (Van Bressem et al. 2009). *Morbillivus* is known to trigger lethal disease in cetaceans (Van Bressem et al. 2009); however, investigation of the pathology of the stranded sperm whale suggests that *Brucella* was more likely the cause of death in this sperm whale (West, unpublished data). The presence of *Morbillivirus* in 10 species (Jacob 2012) and *Brucella* in 3 species (Cherbov 2010, West unpublished data) raises concerns about the history and prevalence of these diseases in Hawaii and the potential population impacts on Hawaiian cetaceans. It is not known if *Brucella or Morbillivirus* are common in the Hawaii stock.

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Revised 6/4/2014

BLUE WHALE (*Balaenoptera musculus musculus*): Central North Pacific Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The International Whaling Commission (IWC) has formally considered only one management stock for blue whales in the North Pacific (Donovan 1991), but up to five populations have been proposed (Reeves et al. 1998). Rice (1974) hypothesized that blue whales from Baja California migrated far offshore to feed in the eastern Aleutians or Gulf of Alaska and returned to feed in California waters; though more recently concluded that the California population is separate from the Gulf of Alaska population (Rice 1992). Length frequency analyses (Gilpatrick et al. 1996) and photo-identification studies (Calambokidis et al. 1995) through the 1990s supported separate populations for blue whales feeding off California and those feeding in Alaskan waters. Whaling catch data indicated that whales feeding along the Aleutian Islands were probably part of a central Pacific stock (Reeves et al. 1998), which was thought to migrate to offshore waters north of Hawaii in winter (Berzin and Rovnin 1966). Blue whale feeding aggregations have not been found in Alaska despite several surveys (Leatherwood et al. 1982; Stewart et al. 1987; Forney and Brownell 1996). More recently, analyses of acoustic data obtained throughout the North Pacific (Stafford et al. 2001; Stafford 2003) have revealed two distinct blue whale call types, suggesting two North Pacific stocks: eastern and central (formerly western). The regional occurrence patterns suggest that blue whales from the eastern North Pacific stock winter off Mexico, Central America, and as far south as 8° S (Stafford et al. 1999), and feed during summer off the U. S. West Coast and to a lesser extent in the Gulf of Alaska. This stock has previously been observed to feed in waters off California (and occasionally as far north as British Columbia; Calambokidis et al. 1998) in summer/fall (from June to November) migrating south to productive areas off Mexico (Calambokidis et al. 1990) and as far south as the Costa Rica Dome (10° N) in winter/spring (Mate et al. 1999, Stafford et al. 1999). Blue whales belonging to the central Pacific stock appear to feed in summer southwest of Kamchatka, south of the Aleutians, and in the Gulf of Alaska (Stafford 2003; Watkins et al. 2000), and in winter migrate to lower latitudes in the western and central Pacific, including Hawaii (Stafford et al. 2001).

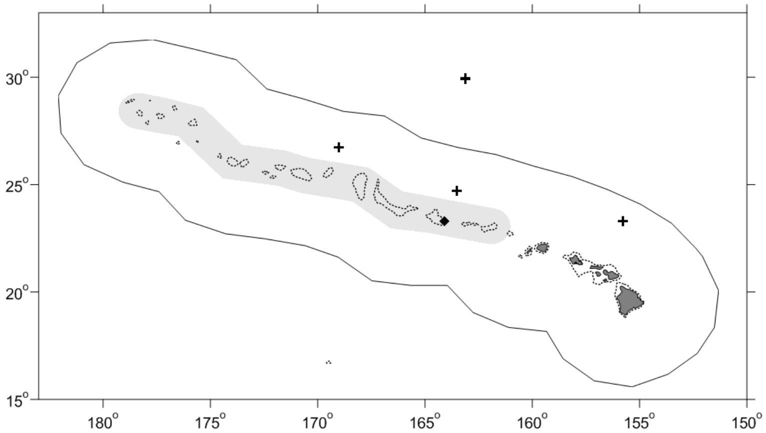

Figure 1. Locations of blue whale sightings made by observers aboard Hawaii-based longline fishing vessels between July 1994 and December 2009 (crosses, NMFS/PIR unpublished data), and location of a single blue whale sighting during a 2010 (black diamond) shipboard cetacean survey of U.S. EEZ waters surrounding the Hawaiian Islands (Bradford et al. 2013; see Appendix 2 for details on timing and location of survey effort). Outer line indicates approximate boundary of survey area and U.S. EEZ. Gray shading indicates area of Papahanaumokuakea Marine National Monument. Dotted line represents the 1000m isobath.

The first published sighting record of blue whales near Hawaii is that of Berzin and Rovnin (1966), though recently, two blue whales were seen with fin whales and an unidentified rorqual in November 2010 during a survey of Hawaiian U.S. EEZ waters (Bradford et al. 2013). Four sightings have been made by observers on Hawaii-based longline vessels (Figure 1; NMFS/PIR, unpublished data). Additional evidence that blue whales occur in this area comes from acoustic recordings made off Oahu and Midway Islands (Northrop et al. 1971; Thompson and Friedl 1982), which likely included at least some whales within the EEZ. The recordings made off Hawaii showed bimodal peaks throughout the year (Stafford et al. 2001), with central Pacific call types heard during winter and eastern Pacific calls heard during summer. For the Marine Mammal Protection Act (MMPA) stock assessment reports, there are two blue whale stocks within the Pacific U.S. EEZ: 1) the central North Pacific stock (this report), which includes whales found around the Hawaiian Islands during winter and 2) the eastern North Pacific stock, which feeds primarily off California.

POPULATION SIZE

From ship line-transect surveys, Wade and Gerrodette (1993) estimated 1,400 blue whales for the eastern tropical Pacific. No blue whale sightings were made during summer/fall 2002 shipboard surveys of the entire Hawaiian Islands EEZ (Barlow 2006). A 2010 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in a summer/fall abundance estimate of 81 (CV = 1.14) blue whales (Bradford et al. 2013). This is currently the best available abundance estimate for this stock within the Hawaii EEZ, but the majority of blue whales would be expected to be at higher latitudes feeding grounds at this time of year.

Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow et al. 1995) of the 2010 abundance estimate, or 38 blue whales within the Hawaiian Islands EEZ.

Current Population Trend

The first sightings of blue whales during systematic surveys occurred in 2010, and there is currently insufficient data to assess population trends.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Central North Pacific stock of blue whales is calculated as the minimum population size within the U.S. EEZ of the Hawaiian Islands (38) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.1 (the default value for an endangered species with N_{min} <1500; Taylor et al. 2003), resulting in a PBR of 0.1 Central Pacific blue whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen *et al*. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*". Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fishery Information

There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2007 and 2011, no blue whales were observed hooked or entangled in the SSLL fishery (100% observer coverage) or the DSLL fishery (20-22% observer coverage) (McCracken 2013, Bradford & Forney 2013).

Historical Mortality

At least 9,500 blue whales were taken by commercial whalers throughout the North Pacific between 1910 and 1965 (Ohsumi and Wada 1972). Some proportion of this total may have been from a population or populations that migrate seasonally into the Hawaiian EEZ. The species has been protected in the North Pacific by the IWC since 1966.

STATUS OF STOCK

The status of blue whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Blue whales are formally listed as "endangered" under the Endangered Species Act (ESA), and consequently the central Pacific stock is automatically considered as a "depleted" and "strategic" stock under the MMPA. Because there have been no reported fishery related mortality or serious injuries of blue whales within the Hawaiian Islands EEZ, the total fishery-related mortality and serious injury of this stock can be considered to be insignificant and approaching zero. Increasing levels of anthropogenic noise in the world's oceans has been suggested to be a habitat concern for blue whales (Reeves et al. 1998). Tagged blue whales exposed to simulated mid-frequency sonar and pseudo-random noise demonstrated a variety of behavioral responses, including no change in behavior, termination of deep dives, directed travel away from sound sources, and cessation of feeding (Goldbogen et al. 2013). Behavioral responses were highly dependent upon the type of sound source and the behavioral state of the animal at the time of exposure. Deep-feeding and non-feeding whales reacted more strongly to experimental sound sources than surface-feeding whales that typically showed no change in behavior. The authors stated that behavioral responses to such sounds are influenced by a complex interaction of behavioral state, environmental context, and prior exposure of individuals to such sound sources. One concern expressed by the authors is if blue whales did not habituate to such sounds near feeding areas that "repeated exposures could negatively impact individual feeding performance, body condition and ultimately fitness and potentially population health." Currently, no evidence indicates that such reduced population health exists, but such evidence would be difficult to differentiate from natural sources of reduced fitness or mortality in the population.

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Revised 6/4/2014

FIN WHALE (*Balaenoptera physalus physalus*): Hawaii Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

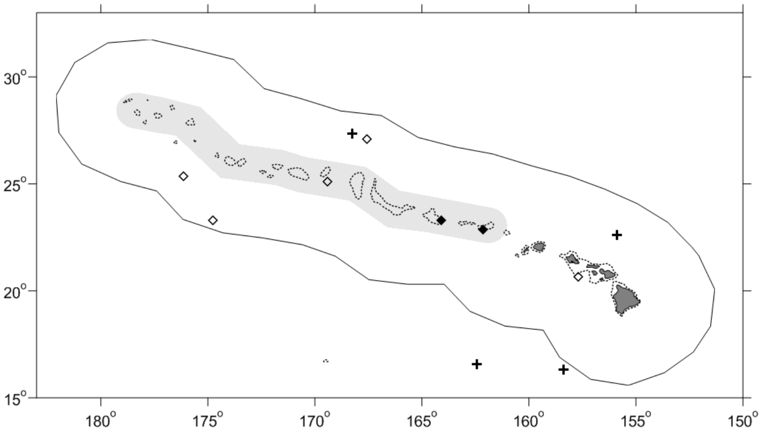

Figure 1. Locations of fin whale sightings from longline observer records (crosses; NMFS/PIR, unpublished data) and sighting locations during the 2002 (open diamonds) and 2010 (black diamonds) shipboard surveys of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2003, Bradford et al 2013; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ. Gray shading indicates area of Papahanaumokuakea Marine National Monument. Dotted line represents the 1000m isobath.

Fin whales are found throughout all oceans from tropical to polar latitudes. They have been considered rare in Hawaiian waters and are absent to rare in eastern tropical Pacific waters (Hamilton et al. 2009). Balcomb (1987) observed 8-12 fin whales in a multispecies feeding assemblage on 20 May 1966 approx. 250 mi. south of Honolulu. Additional sightings were reported north of Oahu in May 1976, in the Kauai Channel in February 1979 (Shallenberger 1981), north of Kauai in February 1994 (Mobley et al. 1996), and off Lanai in 2012 (Baird unpublished data). Summer/fall shipboard surveys of the waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands resulted in five sightings in 2002 and two sightings in 2010 (Barlow 2003, Bradford et al 2013; Figure 1). A single stranding was reported on Maui in 1954 (Shallenberger 1981). Thompson and Friedl (1982; and see Northrop et al. 1968) suggested that fin whales migrate into Hawaiian waters mainly in fall and winter, based on acoustic recordings off Oahu and Midway Islands. Although the exact positions of the whales producing the sounds could not be determined, at least some of them were almost certainly within the U.S. EEZ. More recently, McDonald and Fox (1999) reported an average of 0.027 calling fin whales per 1000^2 km (grouped by 8-hr periods) based on passive acoustic recordings within about 16 km of the north shore of Oahu.

The International Whaling Commission (IWC) recognized two stocks of fin whales in the North Pacific: the East China Sea and the rest of the North Pacific (Donovan 1991). Mizroch et al. (1984) cite evidence for additional fin whale subpopulations in the North Pacific. There is still insufficient information to accurately determine population structure, but from a conservation perspective it may be risky to assume panmixia in the entire North Pacific. In the North Atlantic, fin whales were locally depleted in some feeding areas by commercial whaling (Mizroch et al. 1984), in part because subpopulations were not recognized. The Marine Mammal Protection Act (MMPA) stock assessment reports recognize three stocks of fin whales in the North Pacific: 1) the Hawaii stock (this report), 2) the California/Oregon/Washington stock, and 3) the Alaska stock. The Hawaiian stock includes animals found both within the Hawaiian Islands EEZ and in adjacent high seas waters; however, because data on abundance, distribution, and human-caused impacts are largely lacking for high seas waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

POPULATION SIZE

Using passive acoustic detections from a hydrophone north of Oahu, MacDonald and Fox (1999) estimated an average density of 0.027 calling fin whales per 1000 km^2 within about 16 km from shore. However, the relationship between the number of whales present and the number of calls detected is not known, and therefore this acoustic method does not provide an estimate of absolute abundance for fin whales. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 174 (CV=0.72) fin whales (Barlow 2003). The recent 2010 shipboard line-transect survey of the Hawaiian Islands EEZ resulted in an abundance estimate of 58 (CV = 1.12) fin whales (Bradford et al 2013). This is currently the best available abundance estimate for this stock within the Hawaii EEZ, but the majority of fin whales would be expected to be at higher latitudes feeding grounds at this time of year

Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow et al 1995) around the 2010 abundance estimate or 27 fin whales within the Hawaiian Islands EEZ.

Current Population Trend

No data are available on current population trend. The broad and overlapping confidence intervals around the 2002 and 2010 estimates preclude assessment of trend with the available data.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Hawaii stock of fin whales is calculated as the minimum population size within the U.S EEZ of the Hawaiian Islands (27) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.1 (the default value for an endangered species with Nmin <1500; Taylor et al 2003), resulting in a PBR of 0.1 fin whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*". Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fishery Information

There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2007 and 2011, no fin whales were observed hooked or entangled in the SSLL fishery (100% observer coverage) or the DSLL fishery (20-22% observer coverage) (McCracken 2013, Bradford & Forney 2013.

Historical Mortality

Large numbers of fin whales were taken by commercial whalers throughout the North Pacific from the early 20th century until the 1970s (Tønnessen and Johnsen 1982). Approximately 46,000 fin whales were taken from the North Pacific by commercial whalers between 1947 and 1987 (C. Allison, IWC, pers. comm.). Some of the whales taken may have been from a population or populations that migrate seasonally into the Hawaiian EEZ. The species has been protected in the North Pacific by the IWC since 1976.

STATUS OF STOCK

The status of fin whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Fin whales are formally listed as "endangered" under the Endangered Species Act (ESA), and consequently the Hawaiian stock is automatically considered as a "depleted" and "strategic" stock under the MMPA. Because there have been no reported fishery related mortality or serious injuries within the Hawaiian Islands EEZ, the total fishery-related mortality and serious injury of this stock can be considered to be insignificant and approaching zero. Increasing levels of anthropogenic sound in the world's oceans has been suggested to be a habitat concern for whales, particularly for baleen whales that may communicate using low-frequency sound (Croll et al. 2002). Behavioral changes associated with exposure to simulated mid-frequency sonar, including no change in behavior, cessation of feeding, increased swimming speeds, and movement away from simulated sound sources has been documented in tagged blue whales (Goldbogen et al. 2013), but it is unknown if fin whales respond in the same manner to such sounds.

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Revised 7/15/2014

BRYDE'S WHALE (*Balaenoptera edeni*):
Hawaii Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bryde's whales occur in tropical and warm temperate waters throughout the world. Leatherwood et al. (1982) described the species as relatively abundant in summer and fall on the Mellish and Miluoki banks northeast of Hawaii and around Midway Islands. Ohsumi and Masaki (1975) reported the tagging of "many" Bryde's whales between the Bonin and Hawaiian Islands in the winters of 1971 and 1972 (Ohsumi 1977). Summer/fall shipboard surveys of the waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands resulted in 13 Bryde's whale sightings throughout the study area in 2002 and 30 in 2010 (Figure 1; Barlow 2006; Bradford et al 2013). There is currently no biological basis for defining separate stocks of Bryde's whales in the central North Pacific. Bryde's whales were seen occasionally off southern California (Morejohn and Rice 1973) in the 1960s, but their seasonal occurrence has increased since at least 2000 based on detection of their distinctive calls (Kerosky et al. 2012).

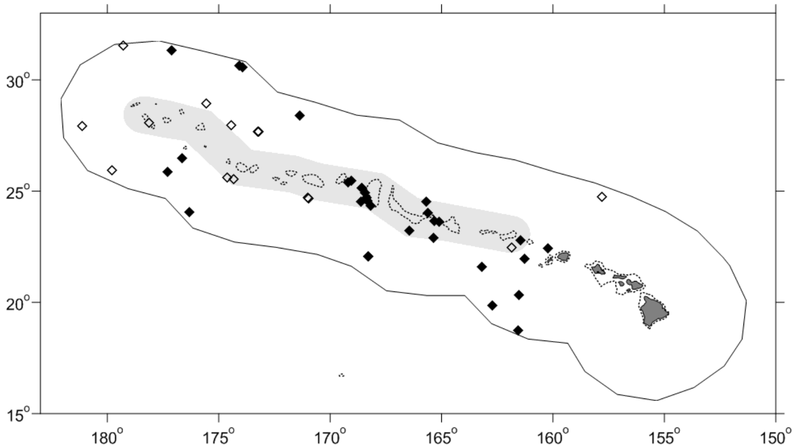

Figure 1. Bryde's whale sighting locations during the 2002 (open diamonds) and 2010 (black diamonds) shipboard surveys of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006, Bradford et al 2013; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ. Gray shading indicates area of Papahanaumokuakea Marine National Monument. Dotted line represents the 1000m isobath.

For the MMPA stock assessment reports, Bryde's whales within the Pacific U.S. EEZ are divided into two areas: 1) Hawaiian waters (this report), and 2) the eastern Pacific (east of 150^{o}W and including the Gulf of California and waters off California). The Hawaiian stock includes animals found both within the Hawaiian Islands EEZ and in adjacent high seas waters; however, because data on abundance, distribution, and human-caused impacts are largely lacking for high seas waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

POPULATION SIZE

Tillman (1978) concluded from Japanese and Soviet CPUE data that the stock size in the North Pacific pelagic whaling grounds, mostly to the west of the Hawaiian Islands, declined from approximately 22,500 in 1971 to 17,800 in 1977. An estimate of 13,000 (CV=0.20) Bryde's whales was made from vessel surveys in the eastern tropical Pacific between 1986 and 1990 (Wade and Gerrodette 1993). The area to which this estimate applies is mainly southeast of the Hawaiian Islands, and it is not known whether these animals are part of the same population that occurs around the Hawaiian Islands. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 469 (CV=0.45) Bryde's whales (Barlow 2006). A more recent estimate from a similar 2010 EEZ-wide survey resulted in an abundance estimate of 798 (CV = 0.28) Bryde's whales (Bradford et al. 2013). This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

Minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow et al. 1995) of the 2010 abundance estimate, or 633 Bryde's whales.

Current Population Trend

No data are available on current population trends. The broad and overlapping confidence intervals around the 2002 and 2010 estimates preclude assessment of trends with the available data.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Hawaii stock of Bryde's whales is calculated as the minimum population size within the U.S EEZ of the Hawaiian Islands (633) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a stock of unknown status with no known fishery mortality or serious injury within the Hawaiian Islands EEZ; Wade and Angliss 1997), resulting in a PBR of 6.3 Bryde's whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*". Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fishery Information

There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2007 and 2011, no Bryde's whales were observed hooked or entangled in the SSLL fishery (100% observer coverage) or the DSLL fishery (20-22% observer coverage) (McCracken 2013, Bradford & Forney 2013). One Bryde's whale was observed entangled in shallow-set longline gear off the Hawaiian Islands in 2005 (Forney 2010).

Historical Mortality

Small numbers of Bryde's whales were taken near the Northwestern Hawaiian Islands by Japanese and Soviet whaling fleets in the early 1970s (Ohsumi 1977). Pelagic whaling for Bryde's whales in the North Pacific ended after the 1979 season (IWC 1981), and coastal whaling for this species ended in the western Pacific in 1987 (IWC 1989).

STATUS OF STOCK

The Hawaii stock of Bryde's whales is not considered strategic under the 1994 amendments to the MMPA. The status of Bryde's whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Bryde's whales are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor designated as "depleted" under the MMPA. Given the absence of recent recorded fishery-related mortality or serious injuries within the Hawaiian Islands EEZ, the total fishery mortality and serious injury can be considered to be insignificant and approaching zero. The increasing level of anthropogenic noise in the world's oceans has been suggested to be a habitat concern for whales (Richardson et al. 1995, Weilgart 2007).

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SEI WHALE (*Balaenoptera borealis borealis*): Hawaii Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

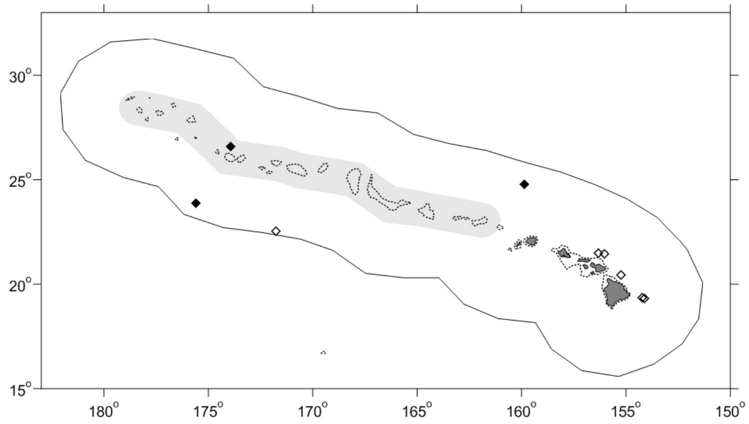

Figure 1. Sei whale sighting locations during the 2002 (open diamonds) and 2010 (black diamonds) shipboard cetacean surveys of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2003, Bradford et al. 2013; see Appendix 2 for details on timing and location of survey effort). Outer line indicates approximate boundary of survey area and U.S. EEZ. Gray shading indicates area of Papahanaumokuakea Marine National Monument. Dotted line represents the 1000m isobath.

The International Whaling Commission (IWC) recognizes one stock of sei whales in the North Pacific (Donovan 1991), but some evidence exists for multiple populations (Masaki 1977; Mizroch et al. 1984; Horwood 1987). Sei whales are distributed far out to sea in temperate regions of the world and do not appear to be associated with coastal features. Whaling effort for this species was distributed continuously across the North Pacific between 45-55°N (Masaki 1977). Two sei whales that were tagged off California were later killed in whaling operations off Washington and British Columbia (Rice 1974) and the movement of tagged animals has been noted in many other regions of the North Pacific. There is still insufficient information to accurately determine population structure, but from a conservation perspective it may be risky to assume panmixia in the entire North Pacific. Summer/fall shipboard surveys of the waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands resulted in four sightings in 2002 and three in 2010 (Figure 1; Barlow 2003; Bradford et al. 2013). There have been no reported strandings of sei whales in the Hawaiian Islands.

For the Marine Mammal Protection Act (MMPA) stock assessment reports, sei whales within the Pacific U.S. EEZ are divided into three discrete areas: 1) waters around Hawaii (this report), 2) California, Oregon and Washington waters, and 3) Alaskan waters. The Hawaiian stock includes animals found both within the Hawaiian Islands EEZ and in adjacent high seas waters; however, because data on abundance, distribution, and human-caused impacts are largely lacking for high seas waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

POPULATION SIZE

Ohsumi and Wada (1974) estimate the pre-whaling abundance of sei whales to be 58,000-62,000 in the North Pacific. Later, Tillman (1977) used a variety of methods to estimate sei whale abundance in the North Pacific and revised the pre-whaling estimate to 42,000. His estimates for the year 1974, following 27 years of whaling, ranged from 7,260 to 12,620. All methods depend on using the history of catches and trends in CPUE or sighting rates; there have been no direct estimates of sei whale abundance in the entire North Pacific based on sighting surveys. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in a summer/fall abundance estimate of 77 (CV=1.06) sei whales (Barlow 2003). More recently, the 2010 shipboard line-transect survey of the Hawaiian Islands EEZ resulted in a summer/fall abundance estimate of 178 (CV = 0.9) sei whales (Bradford et al. 2013). This is currently the best available abundance estimate for this stock, but the majority of sei whales would be expected to be in higher-latitude feeding grounds at this time of year.

Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow et al 1995) of the 2010 abundance estimate or 93 sei whales within the Hawaiian Islands EEZ.

Current Population Trend

No data are available on current population trend. Although the population in the North Pacific is expected to have grown since being given protected status in 1976, the possible effects of continued unauthorized takes (Yablokov 1994) make this uncertain. The broad and overlapping confidence intervals around the 2002 and 2010 estimates preclude assessment of trend with the available data.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate for sei whales.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size within the U.S. EEZ of the Hawaiian Islands (93) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.1 (the default value for an endangered species with N_{min} <1500; Taylor et al. 2003), resulting in a PBR of 0.2 sei whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*". Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fishery Information

Information on fishery-related mortality of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. In March 2011 a subadult sei whale was found near Lahaina, Maui entangled with one or two wraps of heavy-gauge polypropylene line around the tailstock and trailing about 30 feet of line including a large bundle (Bradford & Lyman 2013). Closer examination also revealed line scars on the body near the dorsal fin. Although disentanglement was attempted, the gear could not be removed. Although the source of the line entangling the whale could not be determined, this injury is considered serious based on extent of trailing gear and condition of the whale (Bradford & Lyman 2013, NMFS 2012). This serious injury record results in an average annual serious injury and mortality rate of 0.2 sei whales for the period 2007 to 2011.

There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2007 and 2011, no sei whales were observed hooked or entangled in the SSLL fishery (100% observer coverage) or the DSLL fishery (20-22% observer coverage) (McCracken 2013, Bradford & Forney 2013).

Historical Whaling

The reported take of North Pacific sei whales by commercial whalers totaled 61,500 between 1947 and 1987 (C. Allison, IWC, pers. comm.). There has been an IWC prohibition on taking sei whales since 1976, and commercial whaling in the U.S. has been prohibited since 1972.

STATUS OF STOCK

Previously, sei whales were estimated to have been reduced to 20% (8,600 out of 42,000) of their pre-whaling abundance in the North Pacific (Tillman 1977). Sei whales are formally listed as "endangered" under the Endangered Species Act (ESA), and consequently the Hawaiian stock is automatically considered as a "depleted" and "strategic" stock under the MMPA. The observed rate of fisheries-related mortality or serious injury within the Hawaiian Islands EEZ (0.2 animals per year) is equal to the PBR (0.2), though the responsible fishery is unknown. The increasing level of anthropogenic noise in the world's oceans has been suggested to be a habitat concern for whales (Richardson et al. 1995). Behavioral changes associated with exposure to simulated mid-frequency sonar, including no change in behavior, cessation of feeding, increased swimming speeds, and movement away from simulated sound sources has been documented in tagged blue whales (Goldbogen et al. 2013), but it is unknown if sei whales respond in the same manner to such sounds.

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Revised 6/4/2014

MINKE WHALE (*Balaenoptera acutorostrata scammoni*): Hawaii Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The International Whaling Commission (IWC) recognizes 3 stocks of minke whales in the North Pacific: one in the Sea of Japan/East China Sea, one in the rest of the western Pacific west of 180°N, and one in the "remainder" of the Pacific (Donovan 1991). The "remainder" stock only reflects the lack of exploitation in the eastern Pacific and does not imply that only one population exists in that area (Donovan 1991). In the "remainder" area, minke whales are relatively common in the Bering and Chukchi seas and in the Gulf of Alaska, but are not considered abundant in any other part of the eastern Pacific (Leatherwood et al. 1982; Brueggeman et al. 1990). In the Pacific, minke whales are usually seen over continental shelves (Brueggeman et al. 1990). In the extreme north, minke whales are believed to be migratory, but in inland waters of Washington and in central California they appear to establish home ranges (Dorsey et al. 1990).

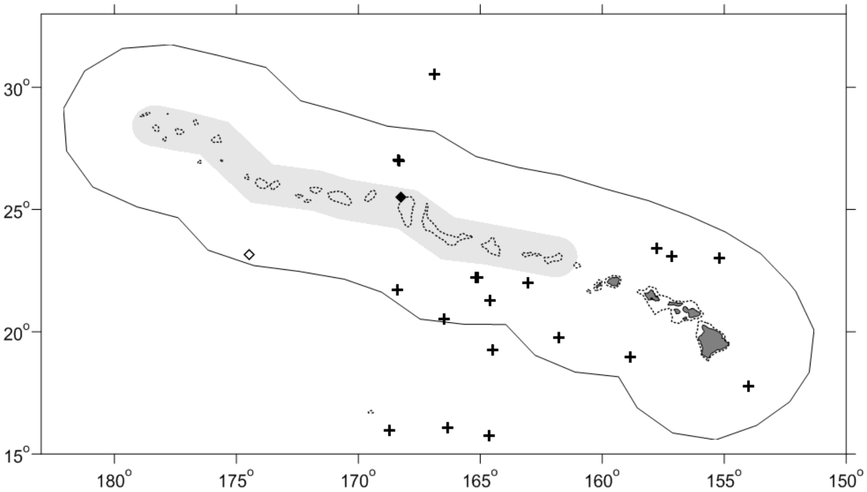

Figure 1. Locations of minke whale sightings from longline observer records (crosses; NMFS/PIR, unpublished data), and sightings made during the 2002 (open diamond) and 2010 (black diamond) shipboard surveys of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006, Bradford et al. 2013; see Appendix 2 for details on timing and location of survey effort). Outer line indicates approximate boundary of survey area and U.S. EEZ. Gray shading indicates area of Papahanaumokuakea Marine National Monument. Dotted line represents the 1000m isobath.

Minke whales occur seasonally around the Hawaiian Islands (Barlow 2003, Rankin and Barlow, 2005), and their migration routes or destinations are unknown. Minke whale “boing” sounds have been detected near the Hawaiian Islands for decades, with detections by the U.S. Navy during February and March (Thompson and Friedl 1982) and at the ALOHA Cabled Observatory 100km north of Oahu from October to May (Oswald et al. 2011). Minke whales were observed within 22km of Kauai in February 2005 (Rankin et al. 2007) and by observers in the Hawaii-based longline fishery since 1994 (Figure 1; NMFS/PIR unpublished data). Two confirmed sightings of minke whale were made, one in November 2002 and the other during October 2010 during surveys of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands (Barlow 2003; Bradford et al. 2013). There are no known stranding records of this species from the main islands (Nitta 1991; Maldini et al. 2005).

For the Marine Mammal Protection Act (MMPA) stock assessment reports, there are three stocks of minke whale within the Pacific U.S. EEZ: 1) a Hawaiian stock (this report), 2) a California/Oregon/ Washington stock, and 3) an Alaskan stock. The Hawaiian stock includes animals found both within the Hawaiian Islands EEZ and in adjacent high seas waters; however, because data on abundance, distribution, and human-caused impacts are largely lacking for high seas waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

POPULATION SIZE

Using passive acoustic detections from an array of seafloor hydrophones north of Kauai, Martin et al. (2012) estimate a preliminary average density of 2.15 ”boing” calling minke whales per 1000 km^2 during the period February through April and within an area of 8,767 km^2 centered on the seafloor array positioned roughly 50km from shore. However, the relationship between the number of whales present and the number of calls detected is not known, and therefore this acoustic method does not provide an estimate of absolute abundance for minke whales.

Summer/fall 2002 and 2010 shipboard line-transect surveys of the entire Hawaiian Islands EEZ each resulted in one ‘off effort’ sighting of a minke whale (Barlow 2003, Bradford et al. 2013). These sightings were not part of regular survey operations and, therefore, could not be used to calculate estimates of abundance (Barlow 2003; Bradford et al. 2013). The majority of this survey took place during summer and early fall, when the Hawaiian stock of minke whale would be expected to be farther north. There currently is no abundance estimate for this stock of minke whales, which appears to occur seasonally (about October - April) around the Hawaiian Islands.

Minimum Population Estimate

There is no minimum population estimate for the Hawaiian stock of minke whales.

Current Population Trend

No data are available on population size or current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate for Hawaiian minke whales.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Hawaii stock of minke whales is calculated as the minimum population estimate times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no estimated fishery mortality or serious injury within the U.S. EEZ of the Hawaiian Islands; Wade and Angliss 1997). Because there is no minimum population estimate for Hawaii minke whales, the PBR is undetermined.

HUMAN CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an “*injury that is more likely than not to result in mortality*”. Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fishery Information

Information on fishery-related mortality and serious injury of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2007 and 2011, no minke whales were observed hooked or entangled in the SSLL fishery (100% observer coverage) or the DSLL fishery (20-22% observer coverage) (McCracken 2013).

STATUS OF STOCK

The Hawaii stock of minke whales is not considered strategic under the 1994 amendments to the MMPA. The status of minke whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Minke whales are not listed as “threatened” or “endangered” under the Endangered Species Act (1973), nor designated as “depleted” under the MMPA. Because there has been no reported fisheries related mortality or serious injury within the Hawaiian Islands EEZ, the total fishery mortality and serious injury for minke whales can be considered insignificant and approaching zero mortality and serious injury rate. The increasing level of anthropogenic sound in the world’s oceans has been suggested to be a habitat concern for whales (Richardson et al. 1995).

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Revised 10/15/2009

HUMPBACK WHALE (*Megaptera novaeangliae*)

IUCN Oceania subpopulation – American Samoa Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The humpback whale has a global distribution. Humpback whales migrate long distances between their feeding grounds at mid- to high latitudes and their calving and mating grounds in tropical waters. The Oceania subpopulation (as defined by the IUCN Red List process, see Childerhouse *et al*. 2008) ranges throughout the South Pacific, except the west coast of South America, and from the equator to the edges of the Antarctic ice. Humpback whales have been recorded across most of the lower latitudes of the South Pacific from approximately 30°S northwards to the equator during the austral autumn and winter. Although there have been no comprehensive surveys of this huge area, humpback whale densities are known to vary extensively from high densities in East Australia to low densities at many island groups. Many regional research projects have documented the presence of these whales around various island groups, but they are also found in open water away from islands (SPWRC 2008). Movements of individual whales between the tropical wintering grounds and the Antarctic summer feeding grounds have been documented by a variety of methods including Discovery tagging, photo-identification, matching genotypes from biopsies or carcasses, and satellite telemetry (Mackintosh 1942; Chittleborough 1965; Dawbin 1966; Mikhalev 2000; Rock *et al*. 2006, Franklin *et al*. 2007, Robbins *et al*. 2008). However, migratory routes and specific destinations remain poorly known. Unlike the other humpback stocks found in U. S. waters, the IUCN Oceania subpopulation is defined by structure on its calving grounds (Garrigue *et al*. 2006b, Olavarria *et al*. 2006, 2007) rather than on its feeding grounds. The Oceania subpopulation consists of breeding stocks E (including E1, E2 and E3) and F recognized by the International Whaling Commission (IWC). It is found in the area defined by the following approximate boundaries: 145°E (eastern Australia) in the west, 120°W (between French Polynesia and South America) in the east, the equator in the north, and 30°S in the south (Childerhouse *et al.* 2008).

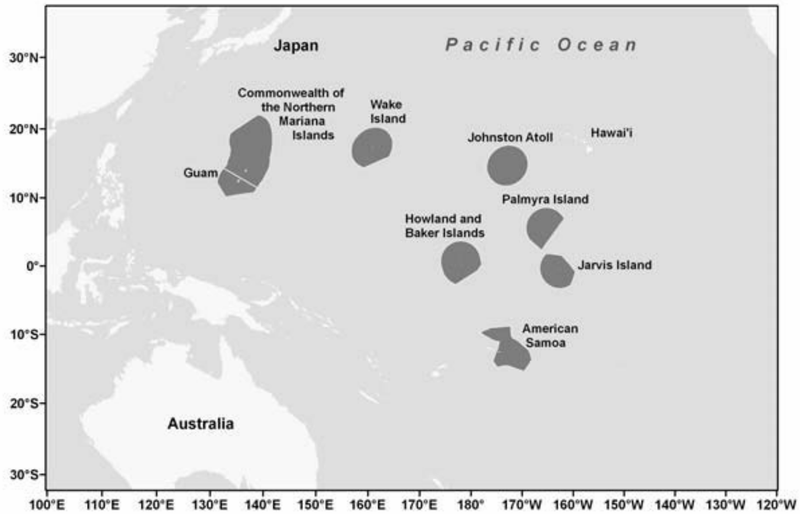

Figure 1. Western Pacific Exclusive Economic Zones for selected U.S. territories, including American Samoa. Information on the American Samoa stock of humpback whales in this report is derived from survey work conducted within the American Samoa EEZ, although animals range well outside this area (see text).

For the Marine Mammal Protection Act (MMPA) stock assessment reports, there is need for only one South Pacific Island region management stock of humpback whales, the American Samoa stock. American Samoa lies at the boundary of breeding stocks E3 and F. Surveys have been undertaken annually at the primary island of Tutuila since 2003. A total of 150 unique individuals were identified by fluke photographs during 58 days at sea, 2003-2008 (D. Mattila and J. Robbins, unpublished data). Individuals have been resighted on multiple days in a single breeding season, but only three inter-annual re-sightings have been made to date (two based on dorsal fin photographs) (D. Mattila and J. Robbins, unpublished data). Breeding behavior and the presence of very young calves has been documented in American Samoa waters. One whale that was sighted initially without a calf was re-sighted later in the season with a calf. Individual exchange has been documented with Western Samoa (SPWRC 2008), as well as Tonga, French Polynesia and the Cook Islands (Garrigue *et al*. 2007). Although the feeding range of American Samoan whales has not yet been defined, there has been one photo-ID match to the Antarctic Peninsula (IWC Antarctic Area I, Robbins *et al.* 2008). Whales at Tonga have exhibited exchange with both Antarctic Area V (Dawbin 1959) and Area I (Brown 1957, Dawbin 1956) and so whales from American Samoa may have a similarly wide feeding range.

On-going photographic studies indicate a higher frequency of certain types of skin lesions on humpback whales at American Samoa as compared to humpback whale populations at Hawaii or the Gulf of Maine (Mattila and Robbins, 2008). However, the cause and implications have yet to be determined. Some similar skin lesions on blue whales in Chilean waters have been observed (Brownell *et al*. 2008).

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Historic whaling

Southern Hemisphere humpback whales were hunted extensively during the last two centuries, and it is thought that populations have been reduced to a small percentage of their former levels (Chapman 1974). After correcting catch records for illegal Soviet whaling, (Clapham & Baker 2002) estimated that over 200,000 Southern Hemisphere humpback whales were killed from 1904 to 1980. Humpback whales were protected from commercial whaling in 1966 by the IWC but they continued to be killed illegally by the Soviet Union until 1972. Illegal Soviet catches of 25,000 humpback whales in two seasons (1959/60 and 1960/61) precipitated a population crash and the closure of land stations in Australia and New Zealand, including Norfolk Island (Mikhalev 2000; Clapham *et al*. 2005).

POPULATION SIZE

There is currently no estimate of abundance for humpback whales in American Samoan waters. The South Pacific Whale Research Consortium produced a number of preliminary mark-recapture estimates of abundance for Oceania and its subregions (SPWRC, 2006). A closed population estimate of 3,827 (CV 0.15) was calculated for eastern Oceania (breeding stocks E3 and F) for 1999-2004 and this may be the most relevant of those currently available, given observed exchange between American Samoa, Tonga, the Cook Islands, and French Polynesia (Garrigue *et al.* 2006a). However, the extent and biological significance of the documented interchange is still poorly understood.

Minimum Population Estimate

The minimum population estimate for this stock is 150 whales, which is the number of individual humpbacks identified in the waters around American Samoa between 2003-2008 by fluke photo identification (J. Robbins, personal communication). This is clearly an underestimation of the true minimum population size as photo ID studies have been conducted over a few weeks per year and there is also evidence of exchange with other areas in Oceania. There are also insufficient data to estimate the proportion of time Oceania humpback whales spend in waters of American Samoa.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No estimates of current or maximum net productivity rates are available for this species in Samoan waters. However, the maximum plausible growth rate for Southern Hemisphere humpback whale populations is estimated as 10.6% (Clapham *et al*. 2006).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) for this stock is calculated as the minimum population size (150) times one half the estimated maximum growth rate for humpback whales in the Southern Hemisphere (1/2 of 10.6%) times a recovery factor of 0.1 (for an endangered species with a total population size of less than 1,500), resulting in a PBR of 0.8. This stock of humpback whales is migratory and thus, it is reasonable to expect that animals spend at least half the year outside of the relatively small American Samoa EEZ. Therefore, the PBR allocation for U.S. waters is half of 0.8, or 0.4 whales.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

No human-related mortalities of humpback whales have been recorded in American Samoan waters. Human-related mortality of humpback whales due to entanglements in fishing gear and collisions with ship have been reported elsewhere in the Southern Hemisphere. Entanglement of humpback whales in pot lines has been reported in both New Zealand and Australia but there are no estimated rates available. There is little information from the rest of the South Pacific but a humpback mother (with calf) was reported entangled in a longline in 2007 in the Cook Islands (N. Hauser, reported in SPWRC 2008).

A photographic-based scar study of the humpback whales of American Samoa has been initiated and there is some indication of healed entanglement and ship strike wounds, although perhaps not at the levels found in some Northern Hemisphere populations (D. Mattila and J. Robbins, unpublished data). However, the sample size to date is insufficient for robust comparison and the study is ongoing.

STATUS OF STOCK

The status of humpback whales in American Samoan EEZ waters relative to OSP is unknown and there are insufficient data to estimate trends in abundance. However, humpback whale populations throughout the South Pacific were drastically reduced by historical whaling and IUCN classifies the Oceania subpopulation as "Endangered" (Childerhouse *et al.* 2008). Worldwide humpback whales are listed as "endangered" under the Endangered Species Act (1973) so the Samoan stock is automatically considered a "depleted" and "strategic" stock under the MMPA. There are no habitat concerns for the stock.

Japan has proposed killing 50 humpback whales as part of its program of scientific research under special permit (scientific whaling) called JARPA II in the IWC management areas IV and V in the Antarctic (Gales *et al.* 2005). Areas IV and V have demonstrated links with breeding stock E. Japan postponed their proposed catch in the 2007/08 and 2008/09 seasons but have not removed them from their future whaling program. The JARPA II program has the potential to negatively impact the recovery of humpbacks in Oceania.

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Appendix 1. Description of U.S. Commercial Fisheries

The Marine Mammal Protection Act (MMPA) requires NMFS to publish a list of commercial fisheries (List Of Fisheries or "LOF") and classify each fishery based on whether incidental mortality and serious injury of marine mammals is frequent (Category I), occasional (Category II), or unlikely or unknown (Category III). The LOF is published annually in the Federal Register. The categorization of a fishery in the LOF determines whether participants in that fishery are subject to certain provisions of the MMPA, such as registration, observer coverage, and take reduction plan requirements. The categorization criteria as they appear in the LOF is reprinted below:

The fishery classification criteria consist of a two-tiered, stock-specific approach that first addresses the total impact of all fisheries on each marine mammal stock, and then addresses the impact of individual fisheries on each stock. This approach is based on consideration of the rate, in numbers of animals per year, of incidental mortality and serious injury of marine mammals due to commercial fishing operations relative to the Potential Biological Removal (PBR) level for each marine mammal stock. The MMPA (16 U.S.C. 1362 (20)) defines the PBR level as the maximum number of animals, not including natural mortality, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population. This definition can also be found in the implementing regulations for section 118 at 50 CFR 229.2.

Tier 1: If the total annual mortality and serious injury across all fisheries that interact with a stock is less than or equal to 10 percent of the PBR level of the stock, all fisheries interacting with the stock would be placed in Category III. Otherwise, these fisheries are subject to the next tier (Tier 2) of analysis to determine their classification.

Tier 2, Category I: Annual mortality and serious injury of a stock in a given fishery is greater than or equal to 50 percent of the PBR level.

Tier 2, Category II: Annual mortality and serious injury of a stock in a given fishery is greater than 1 percent and less than 50 percent of the PBR level.

Tier 2, Category III: Annual mortality and serious injury of a stock in a given fishery is less than or equal to 1 percent of the PBR level.

While Tier 1 considers the cumulative fishery mortality and serious injury for a particular stock, Tier 2 considers fishery-specific mortality and serious injury for a particular stock. Additional details regarding how the categories were determined are provided in the preamble to the final rule implementing section 118 of the MMPA (60 FR 45086, August 30, 1995). Since fisheries are categorized on a per-stock basis, a fishery may qualify as one Category for one marine mammal stock and another Category for a different marine mammal stock. A fishery is typically categorized on the LOF at its highest level of classification (e.g., a fishery that qualifies for Category III for one marine mammal stock and for Category II for another marine mammal stock will be listed under Category II).

Other Criteria That May Be Considered

In the absence of reliable information indicating the frequency of incidental mortality and serious injury of marine mammals by a commercial fishery, NMFS will determine whether the incidental serious injury or mortality qualifies for Category II by evaluating other factors such as fishing techniques, gear used, methods used to deter marine mammals, target species, seasons and areas fished, qualitative data from logbooks or fisher reports, stranding data, and the species and distribution of marine mammals in the area, or at the discretion of the Assistant Administrator for Fisheries (50 CFR 229.2).

This appendix describes commercial fisheries that occur in California, Oregon, Washington, and Hawaiian waters and that interact or may interact with marine mammals. The first three sections describe sources of marine mammal mortality data for these fisheries. The fourth section describes the commercial fisheries for these states. A list of all known fisheries for these states was published as a proposed rule in the Federal Register, 71 FR 20941, 24 April 2006.

1. Sources of Mortality/Injury Data

There are three major sources of marine mammal mortality/injury data for the active commercial fisheries in California, Oregon, Washington, and Hawaii. These sources are the NMFS Observer Programs, the Marine Mammal

Authorization Program (MMAP) data, and the NMFS Marine Mammal Stranding Network (MMSN) data. Each of these data sources has a unique objective. Data on mammal mortality and injury are reported to the MMAP by fishers in any commercial fisheries. Marine mammal mortality and injury is also monitored by the NMFS Marine Mammal Stranding Network (MMSN). Data provided by the MMSN is not duplicated by either the NMFS Observer Program or MMAP reporting. Human-related data from the MMSN include occurrences of mortality due to entrainment in power station intakes, ship strikes, shooting, evidence of net and line fishery entanglement (net remaining on animal, net marks, severed flukes), and ingestion of hooks.

2. Marine Mammal Reporting from Fisheries

In 1994, the MMPA was amended to implement a long-term regime for managing mammal interactions with commercial fisheries (the Marine Mammal Authorization Program, or MMAP). Logbooks are no longer required - instead vessel owners/operators in any commercial fishery (Category I, II, or III) are required to submit one-page pre-printed reports for all interactions (including those that occur while an observer is onboard) resulting in an injury to or death of a marine mammal. The report must include owner/operator's name and address, vessel name and ID, where and when the interaction occurred, the fishery, species involved, and type of injury (if the animal was released alive). These postage-paid report forms are mailed to all Category I and II fishery participants that have registered with NMFS, and must be completed and returned to NMFS within 48 hours of returning to port for trips in which a marine mammal injury or mortality occurred. The number of self-reported marine mammal interactions is considerably lower than the number reported by fishery observers, even though observer reports are typically based on 20% observer effort. For example, from 2000-2004, there were 112 fisher self-reports of marine mammal interactions in the California swordfish/thresher shark drift gillnet fishery. This compares with 141 observed interactions over the same period, based on only 20% observer coverage. This suggests that fisher self-reports are negatively-biased. From 2007-2011 there were 12 fisher self-reports of marine mammal interactions in the Hawaii-based deep-set longline fishery, 11 of which corresponded to observer records. This compares with 50 observed interactions over the same period, based on 20-22% observer coverage. This suggests fisher self-reports are significantly negatively biased.

3. NMFS Marine Mammal Stranding Network data

From 2000-2004, there were 1,022 cetacean and 13,215 pinniped strandings recorded in California, Oregon, and Washington states. Approximately 10% of all cetacean and 6% of all pinniped strandings showed evidence of human-caused mortality during this period. From 2007-2011, there were 144 cetacean strandings recorded in Hawaii, with 42% of all cetacean strandings showing evidence of human-caused mortality during this period. Human-related causes of mortality include: entrainment in power station intakes, shooting, net fishery entanglement, and hook/line, set-net and trap fishery interaction.

4. Fishery Descriptions

Category I, CA/OR thresher shark/swordfish drift gillnet fishery (≥14 inch mesh)

Number of permit holders: The numbers of eligible permit holders in California for, 2008 to 2012 ranged between 78 and 84 (data source: California Deparment of Fish and Wildlife website: www.dfg.ca.gov/licensing). Permits are non-transferable and are linked to individual fishermen, not vessels.

Number of active permit holders: The numbers of vessels active in this fishery declined from 40 in 2008 to 16 vessels in 2012.

Total effort: Both estimated and observed effort for the drift-net fishery during the calendar years 1990 through 2012 are shown in Figure 2.

Geographic range: Effort in this fishery ranges from the U.S./Mexico border north to waters off the state of Oregon. For this fishery there are area-season closures (see below). Figures 1 shows locations of observed sets for the period 1990 to 2012.

Seasons: This fishery is subject to season-area restrictions. From February 1 to May 15 effort must be further than 200 nautical miles (nmi) from shore; from May 16 to August 14, effort must be further than 75 nmi from shore, and from

August 15 to January 31 there is only the 3 nmi off-shore restriction for all gillnets in southern California (see halibut and white seabass fishery below). The majority of the effort occurs from October through December. A season-area closure to protect leatherback sea turtles was implemented in this fishery in August 2001. The closure area prohibits drift gillnet fishing from August 15 through November 15, in the area bounded by straight lines from Point Sur, California (N36° 17') to N 34° 27' W 123° 35', west to W129°, north to N 45°, then east to the Oregon coast. An additional season-area closure south of Point Conception and east of W120 degrees longitude is effective during the months of June, July, and August during El Niño years to protect loggerhead turtles (Federal Register, 68 FR 69962, 16 December 2003).

Gear type and fishing method: Typical gear used for this fishery is a 1000-fathom gillnet with a stretched mesh size typically ranging from 18-22 inches (14 inch minimum). The net is set at dusk and allowed to drift during the night after which, it is retrieved. The fishing vessel is typically attached to one end of the net. Soak duration is typically 12-14 hours depending on the length of the night. Net extender lengths of a minimum 36 ft. became mandatory for the 1997-1998 fishing season. The use of acoustic warning devices (pingers) became mandatory 28 October 1997.

Regulations: The fishery is managed under a Fishery Management Plan (FMP) developed by the Pacific Fishery Management Council and NMFS.

Management type: The drift-net fishery is a limited-entry fishery with seasonal closures and gear restrictions (see above). The state of Oregon restricts landing to swordfish only.

Comments: This fishery has had a NMFS observer program in place since 1990. Due to bycatch of strategic stocks including short-finned pilot whales, beaked whales, sperm whales and humpback whales, a Take Reduction Team was formed in 1996. Since then, the implementation of increased extender lengths and the deployment of pingers have substantially decreased cetacean entanglement. The fraction of active vessels in this fishery that are not observed owing to a lack of berthing space for observers has been increasing. The fishery currently operates under an emergency rule designed to reduce to the bycatch of sperm whales (Federal Register 4 September 2013, Volume 78: pages 54548-54552.

Category I, Hawaii deep-set (tuna target) longline/set line fishery

Note: The Hawaii-based longline fisheries of the Pelagic Fishery Ecosystem Plan (FEP) consist of two separately managed longline fisheries. One is the deep-set (tuna targeted) fishery which is classified as a Category I fishery under the MMPA. This fishery is discussed here. The classification of this fishery was elevated to Category I in 2004 based on revised PBR levels of false killer whales and observed false killer whale mortality in this fishery (Federal Register 69 FR 48407 1, 10 August 2004). The other Hawaii-based longline fishery is the Hawaii shallow-set longline (swordfish targeted) fishery which is classified as a Category II fishery under the MMPA and is discussed in the Category II section of this Appendix.

Number of permit holders: The number of Hawaii longline limited access permit holders is 164. Not all such permits are renewed and used every year. Permit holders may use the permits for either deep-set or shallow-set fishing, but must notify NMFS how they will fish before each trip. Most holders of Hawaii longline limited access permits are based in, or operate out of, Hawaii**.**

Number of active deep-set longline vessels targeting tuna: From 2007 to 2011, the number of active longline vessels based and landing in Hawaii was 129, 127, 127, 122, and 129, respectively (http://www.pifsc.noaa.gov/fmsd/reports.php).

Total effort: The number of trips ranged from a low of approximately 500 (in 1992) to 1,427 in 2007. Figure 4 shows the number of fishing trips by longline vessels based and landing in Hawaii, by year and trip type, 1991-2009. The number of sets for the deep-set tuna fishery in 2007-2011was 17,885, 16,810, 16,070, and 17,155 . The number of hooks set in 2007-2011 was 38.8 million, 40.1 million, 37.7 million, 37.1 million, and 40.7 million.

Geographic range: The Hawaii-based pelagic, deep-set longline fishery operates inside and outside the EEZ, primarily around the main Hawaiian Islands and Northwestern Hawaiian Islands, with some trips to the EEZs around the remote U.S. Pacific islands (however there are restricted areas, please refer to “Regulations”). Vessels vary their fishing grounds depending on their target species. Most of the deep-set fishing occurs south of 25° N.

Seasons: This fishery operates year-round, although vessel activity increases during the fall and is greatest during the winter and spring months.

Gear type: Deep-set longline gear typically consists of a continuous main line set on the surface and supported in the water column horizontally by floats with branch lines connected at intervals to the main line. In addition radio buoys are also used to keep track of the mainline as it drifts at sea. A line shooter is used on deep-sets to deploy the mainline faster than the speed of the vessel, thus allowing the longline gear to sink to its target depth (average target depth is 167 m, target depth for bigeye tuna is approximately 400 m). The main line is typically 30 to 100 km (18 to 60 nm) long. A minimum of 15, but typically 20 to 30, weighted branch lines (gangions) are clipped to the mainline at regular intervals between the floats. Each gangion terminates with a single baited hook. The branch lines are typically 11 to 15 meters (35 to 50 feet) long. Sanma (saury) or sardines are used for bait. Lightsticks are not typically attached to the gangions on this type of longline set. Deep-set longline gear is set in the morning and hauled in the evening and at night.

Regulations: This fishery is managed under the Pelagics FEP and subject to Federal regulation. Measures that are currently applicable to the fishery include, but are not limited to, limited access (requirement for a permit), vessel and gear marking requirements, vessel length restrictions, Federal catch and effort logbooks, large longline restricted areas around the Hawaiian Archipelago, vessel monitoring system (VMS), annual protected species workshops, use of circle hooks with wire diameter not greater than 4.5mm and branch line not less than 2.0mm, and the use of sea turtle, seabird, and marine mammal handling and mitigation gear and techniques. The vessel operator must notify NMFS prior to departure whether the vessel is undertaking a deep-set or shallow-set trip. Once the trip type is set, it cannot be changed during the trip. Vessel operators must take a NMFS contracted observer if requested by NMFS – target observer coverage is 20 percent of trips. If any marine mammal interaction (hooking or entanglement) resulting in injury or mortality occurs, the vessel operator must complete and mail a pre-addressed, postage paid form to NOAA Fisheries within 48 hours of the end of the trip. Additional information on all applicable regulations for the deep-set longline fishery is available at http://www.fpir.noaa.gov/SFD/SFD_regs_2.html. This fishery is subject to the False Killer Whale Take-Reduction Team. NMFS is currently implementing the Take-Reduction Plan and associated regulations.

Management type: Federal limited access program. This fishery is managed under a Fishery Ecosystem Plan (FEP) developed by the Western Pacific Fishery Management Council and NMFS.

Comments: Non-target species are caught incidentally. Interactions with common bottlenose dolphins, false killer whales, humpback whales, short-finned pilot whales, pantropical spotted dolphins, Blainville's beaked whale, sperm whales, striped dolphins and Risso's dolphins have been documented. Due to interactions with protected species, especially turtles, this fishery has been observed since February 24, 1994. Initially, observer coverage was less than 5%, increased to 10% in 2000, and equaled or exceeded 20% since 2001. *Observed* marine mammal injures and deaths form 2007-2011 included 24 false killer whales, 4 short-finned pilot whales, 3 Risso's dolphins, 2 common bottlenose dolphins, 1 sperm whale, 1 pantropical spotted dolphin, one striped dolphin, and 14 unidentified cetaceans. Four of the interactions were deaths, 32 were serious injuries, nine were non-serious injuries, one involved prorating a large whale interaction as 0.75 serious (NMFS, 2012), and four were classified as cannot-be-determined.

Category II , CA halibut/white seabass and other species set gillnet fishery (>3.5 inch mesh).

Halibut are typically targeted using 8.5 inch mesh while the remainder of the fishery targets white seabass and yellowtail using 6.5 inch mesh. In recent years, there has been an increasing number of 6.0-6.5 inch mesh sets fished using drifting methods; this component is now identified as a separate fishery (see "**CA yellowtail, barracuda, white seabass, and tuna drift gillnet fishery (>3.5 and <14 in mesh)**" fishery described below).

Number of permit holders: There is no specific permit category for this fishery. Overall, the current number of legal permit holders for gill and trammel nets, excluding swordfish drift gillnets and herring gillnets were between 141 and 154 annually. Information on permit numbers is available from the California Department of Fish and Game website (http://www.dfg.ca.gov/licensing).

Number of active permit holders: Approximately 50 vessels participate in this fishery (NMFS List of Fisheries, Federal Register 29 August 2013).

Total effort: Total fishing effort for the period 2008 to 2012 has been approximately 2,000 sets annually.

Geographic range: Effort in this fishery previously ranged from the U.S./Mexico border north to Monterey Bay and was localized in more productive areas: San Ysidro, San Diego, Oceanside, Newport, San Pedro, Ventura, Santa Barbara, Morro Bay, and Monterey Bay. Fishery effort is now predominantly in the Ventura Flats area off of Ventura, the San Pedro area between Pt. Vicente and Santa Catalina Island and in the Monterey Bay area. The central California portion of the fishery from Point Arguello to Point Reyes has been closed since September 2002 when a ban on gillnets inshore of 60 fathoms took effect.

Seasons: This fishery operates year round. Effort generally increases during the summer months and declines during the last three months of a year.

Gear type and fishing method: Typical gear used for this fishery is a 200 fathom gillnet with a stretched mesh size of 8.5 inches. The component of this fishery that targets white seabass and yellowtail utilizes 6.5 inch mesh. The net is generally set during the day and allowed to soak for up to 2 days. Soak duration is typically 8-10, 19-24, or 44-49 hours. The depth of water ranges from 15-50 fathoms with most sets in water depths of 15-35 fathoms.

Regulations: This fishery is managed by the California Dept. of Fish and Game in accordance with state and federal laws.

Management type: The halibut and white seabass set-net fishery is a limited-entry fishery with gear restrictions and area closures.

Comments: An observer program for the halibut and white seabass portion of this fishery operated from 1990-94 and was discontinued after area closures were implemented in 1994, which prohibited gillnets within 3 nmi of the mainland and within 1 nmi of the Channel Islands in southern California. NMFS re-established an observer program for this fishery in Monterey Bay in 1999-2000 due to a suspected increase in harbor porpoise mortality in Monterey Bay. In 1999 and 2000, fishery mortality exceeded PBR for the Monterey Bay harbor porpoise stock, which at that time, was designated as strategic [the stock is currently non-strategic]. In the autumn of 2000, the California Department of Fish and Game implemented the first in a series of emergency area closures to set gillnets within 60 fathoms along the central California coast in response to mortality of common murres and threats to sea otters. This effectively reduced fishing effort to negligible levels in 2001 and 2002 in Monterey Bay. A ban on gill and trammel nets inside of 60 fathoms from Point Reyes to Point Arguello became effective in September 2002. Bycatch of marine mammals, including California sea lions and harbor seals, continues in this fishery, based on limited observer data.

Category II, Hawaii shallow-set (swordfish target) longline/set line fishery

Note: The Hawaii-based longline fisheries of the Pelagic Fishery Ecosystem Plan (FEP) consist of two separately managed longline fisheries. One is the deep-set (tuna targeted) fishery which is classified as a Category I fishery under the MMPA. The other is the Hawaii shallow-set longline (swordfish targeted) fishery which is classified as a Category II fishery under the MMPA and is discussed here.

Number of permit holders: The number of Hawaii longline limited access permit holders is 164. Not all such permits are renewed and used every year. Permit holders may use the permits for either deep-set or shallow-set fishing, but must notify NMFS how they will fish before each trip. Most holders of Hawaii longline limited access permits are based in, or operate out of, Hawaii**.** Longline general permits are not limited by number. These general permits are open access and usable in Guam, CNMI, and the Pacific Remote Island Areas; they are usually not more than a half dozen a year.

Number of active shallow-set longline vessels targeting swordfish: From 2007 to 2011, the number of active shallow-set longline vessels based in and landing in Hawaii was 28, 27, 28, 28, and 20.

Total effort: The number of trips since 1991 has ranged from zero (2002-2003) to approximately 300 in 1993. Figure 4 shows the number of fishing trips by longline vessels based and landing in Hawaii, by year and trip type, 1991-2011. The number of sets for the shallow-set swordfish fishery in 2007-2011 was 1,570, 1,597, 1,762, 1,833, and 1,468. The number of hooks set in 2007-2011 was 1.4 million, and 1.5 million, 1.7 million, 1.8 million, 1.5 million.

Geographic range:
The most productive swordfishing areas for Hawaii-based longline vessels are north of Hawaii outside the U.S. Exclusive Economic Zone (EEZ) on the high seas, and this fishery operates almost entirely north of Hawaii (north of approximately 20° N). In some years, when influenced by seawater temperature, this fishery may operate mostly north of 30° N.

Seasons: Shallow-set effort is highest in either the first or second quarter of the calendar year and drops off substantially in the latter half of the year.

Gear type: Shallow-set longline gear typically consists of a continuous main line set on the surface and supported in the water column horizontally by floats with branch lines connected at intervals to the main line. In addition radio buoys are also used to keep track of the mainline as it drifts at sea. Longline fishing for swordfish is known as shallow-set longline fishing as the bait is set at depths of 30–90 m. The portion of the mainline with branchlines attached is suspended between floats at about 20–75 m of depth, and the branchlines hang off the mainline another 10–15 m. Only 4-6 branchlines are clipped to the mainline between floats, and a typical set for swordfish uses about 1,000-1,200 hooks. Shallow-set longline gear is set at night, with luminescent light sticks attached to the branchlines. Formerly, J-hooks and squid bait were used, but since 2004, circle hooks and mackerel-type bait have been required. These gear restrictions were implemented to reduce sea turtle bycatch.

Regulations: This fishery is managed under the Pelagics FEP and subject to Federal regulation. Measures that are currently applicable to the fishery include, but are not limited to, limited access (requirement for a permit), vessel and gear marking requirements, vessel length restrictions, Federal catch and effort logbooks, 100-percent observer coverage, large longline restricted areas around the Hawaiian Archipelago, vessel monitoring system (VMS), annual protected species workshops, and the use of sea turtle, seabird, and marine mammal handling and mitigation gear and techniques. The vessel operator must notify NMFS prior to departure whether the vessel is undertaking a shallow-set or a deep-set trip. Once the trip type is set, the type cannot be changed during the trip. All shallow-set trips must have a NMFS contracted observer. If any marine mammal interaction (hooking or entanglement) resulting in injury or mortality occurs, the vessel operator must complete and mail a pre-addressed, postage paid form to NOAA Fisheries within 48 hours of the end of the trip. More information on all applicable regulations is available at http://www.fpir.noaa.gov/SFD/SFD_regs_2.html. This fishery is subject to the False Killer Whale Take-Reduction Team. NMFS is currently implementing the Take-Reduction Plan and associated regulations.

Management type: Federal limited access program. This fishery is managed under a Fishery Ecosystem Plan (FEP) by the Western Pacific Fishery Management Council and NMFS.

Comments: Non-target species are caught incidentally. Interactions with common bottlenose dolphins, false killer whales, humpback whales, short-finned pilot whales, striped dolphins, Bryde's whales, Risso's dolphins, sperm whales, spinner dolphins, pygmy sperm or dwarf sperm whales, Blainville's beaked whales, and common dolphins have been documented. The shallow-set fishery was completely closed in 2001 and reopened in 2004. One hundred percent observer coverage is required in this fishery. *Observed* injuries of marine mammals in this fishery in 2007-2011 included 3 false killer whales, 21 Risso's dolphins, 2 humpback whale, 1 pygmy or dwarf sperm whale, 3 striped dolphins, 8 common bottlenose dolphins, 1 short-beaked common dolphin, 1 Blainville's beaked whale, 2 unidentified beaked whales, and 2 unidentified dolphins. Three of the interactions were deaths, 31 were serious injuries, 10 were non-serious injuries, and 2 involved prorating a large whale interaction as 0.75 serious. .

Category II, Hawaii Shortline Fishery

Note: The Hawaii shortline fishery was added to the 2010 List of Fisheries as a Category II fishery under the MMPA based on analogy with the Category I "HI deep-set (tuna-target) longline/set line" and Category II "HI shallow-set (swordfish-target) longline/set line" fisheries (Federal Register 74 FR 58859, 16 November 2009).

Number of permit holders: There are no specific fishing permits issued for this fishery. However, all persons with a State of Hawaii Commercial Marine License (CML) may participate in any fishery, including the "HI shortline" fishery.

Number of active shortline vessels: Of those persons possessing CMLs, shortline participation has varied between 5 and 14 vessels from 2003 - 2011.

Total effort: From 2003-2008, there was an average of 135,757 pounds (lbs) of fish landed each year. In 2008 alone, 104,152 lbs of fish were landed.

Geographic range: The Category II "HI shortline" fishery is a small-scale system operating off the State of HI, and targeting bigeye tuna (*Thunnus obesus*) or the lustrous pomfret (*Eumigistes illustris*). This fishery was developed to target these fish species when they concentrate over the summit of Cross Seamount, -290 km (180 mi) south of the State of HI.

Seasons: This fishery has no seasonal component and may operate year-round.

Gear type: The gear style is designed specifically to target the aggregating fish species over seamount structures. The primary gear type used is a horizontal main line (monofilament) less than 1 nautical mile long, and includes two baskets of approximately 50 hooks each. The gear is set before dawn and has a short soak time, with the gear retrieved about two hours after it is set.

Regulations: All persons with a State of Hawaii Commercial Marine License (CML) may participate in -the "HI shortline" fishery. The mainline length must be less than 1 nautical mile.

Management type: Hawaii State managed fishery.

Comments: Currently, there is no Federal reporting system in place to document potential marine mammal interactions in this fishery. However, there are anecdotal reports of interactions off the north side of Maui, but the species and extent of interactions are unknown.

Category II, American Samoa Longline Fishery

Note: The American Samoa longline fishery was added to the 2006 List of Fisheries as a Category II fishery under the MMPA based on analogy with Category I "HI deep-set (tuna-target) longline/set line" and Category II "HI shallow-set (swordfish-target) longline/set line" fisheries.

Number of permit holders: 46

Number of active longline vessels: From 2007 to 2011, the number of active vessels was 29, 28, 26, 26, and 24.

Total effort: The number of trips for 2007-2011 was 377, 287, 175, 264, and 274. The number of sets for the American Samoa longline fishery in 2007-2011 was 5,910, 4,730, 4,601, 4,496, and 3,776. The number of hooks set in 2007-2011 was 17,524, 14,372, 14,207, 13,067, and 10,767.

Geographic range: Waters surrounding American Samoa year-round.

Seasons: Shallow-set effort is highest in either the first or second quarter of the calendar year and drops off substantially in the latter half of the year.

Gear type: This fishery uses longline gear. Vessels over 50 ft (15.2 m) may set 1,500-2,500 hooks and have a greater fishing range and capacity for storing fish (8-40 metric tons). The fleet reached a peak of 66 vessels in 2001, and set a peak of almost 7,000 sets in 2002. It is more common for fishermen to set their gear in the day and haul in the afternoon, mainly to improve their catch rates.

Regulations: This fishery is a limited entry fishery for pelagic longline vessels in the U.S. EEZ around American Samoa. In 2000, the fishery began to expand rapidly with the influx of large (more than 50 ft (15.2m m) overall length) conventional mono hull vessels, similar to the type used in the Hawaii-based longline fisheries. Regulations implemented in 2002 prohibit any large U.S. vessels (50 ft (15.2 m) and longer) from fishing within 50 nmi around the islands of American Samoa. In 2005, the rapid expansion of longline fishing effort within the U.S. EEZ waters around American Samoa prompted the implementation of a limited entry system. Under the limited access program, NMFS issued a total of 60 initial longline limited entry permits in 2005 to qualified candidates, spread among 4 vessel size classes: 22 permits issued in Class A (less than or equal to 40 ft (12.2 m) length); 5 in Class B (40-50 ft (12.2-15.2m)); 12 in Class C (50.1–70 ft (15.2–21.3 m)); and 21 in Class D (more than 70 ft (21.3 m)). The number of active vessels has shifted to large vessels (Class C and D), with only a couple of small vessels active in the past two years. Permits may be transferred and renewed. Under the limited entry program, vessel operators must submit federal catch and effort logbooks, vessels over 40 ft (12.2 m) must carry observers if requested by NMFS, and vessels over 50 ft (15.2 m) must have an operational vessel monitoring system (VMS). In addition, vessel owners and operators must attend a protected species workshop annually, carry and use dip nets, clippers, and bolt cutters, and follow handling, resuscitation, and release requirements for incidentally hooked or entangled sea turtles.

Management type: Federal limited access program. This fishery is managed under a Fishery Ecosystem Plan (FEP) by the Western Pacific Fishery Management Council and NMFS.

Comments: Non-target species are caught incidentally. Interactions with false killer whales, Risso's dolphins, and Cuvier's beaked whale have been documented. One hundred percent observer coverage is required in this fishery. *Observed* injuries of marine mammals in this fishery in 2007-2011 included 3 false killer whales, 21 Risso's dolphins, 2 humpback whale, 1 pygmy or dwarf sperm whale, 3 striped dolphins, 8 common bottlenose dolphins, 1 short-beaked common dolphin, 1 Blainville's beaked whale, 2 unidentified beaked whales, and 2 unidentified dolphins. Three of the interactions were deaths, 31 were serious injuries, 10 were non-serious injuries, and 2 involved prorating a large whale interaction as 0.75 serious.

Category II, CA yellowtail, barracuda, white seabass, and tuna drift gillnet fishery (>3.5 and <14 in mesh)

Number of permit holders: There are approximately 24 active permit holders in this fishery.

Total effort: From 2008 to 2012, there were between 207 and 271 small-mesh drift gillnet sets fished annually, as determined from California Department of Fish and Game logbook data.

Geographic range: This drift gillnet component of this fishery operates primarily south of Point Conception. Observed sets have been clustered around Santa Cruz Island, the east Santa Barbara Channel, and Cortez and Tanner Banks. Some effort has also been observed around San Clemente Island and San Nicolas Island.

Seasons: This fishery operates year round. Targeted species is typically determined by market demand on a short-term basis.

Gear type and fishing method: Typical gear used for this fishery is a 150 to 200-fathom gillnet, which is allowed to drift. The mesh size depends on the target species but typical values observed are 6.0 and 6.5 inches.

Regulations: This fishery is managed by the California Dept. of Fish and Game in accordance with State and Federal laws.

Management type: This fishery is a limited-entry fishery with gear restrictions and area closures.

Comments: This fishery primarily targets white seabass and yellowtail but also targets barracuda and albacore tuna. From 2002-2004, there have been 63 sets observed from 17 vessel trips. Marine mammal mortality includes two long-beaked common dolphin and 3 California sea lions. Also, 4 California sea lions were entangled and released alive during this period. In 2003, there was one coastal bottlenose dolphin stranded with 3.5-inch gillnet wrapped around its tailstock, the responsible fishery is unknown. Observer coverage in this fishery was 12% in 2002, 10% in 2003, and 17% in 2004.

Category II, California Anchovy, Mackerel, and Sardine Purse Seine Fishery. [1]

Number of permit holders: There are 63 limited-entry permits (Pacific Fishery Management Council. 2005. Status of the Pacific Coast coastal pelagic species fishery and recommended acceptable biological catches. Stock Assessment and Fishery Evaluation Report 2005).

Number of active permit holders: There are 61 vessels actively fishing.

Total effort: The fishery is managed under a capacity goal, with gross tonnage of vessels used as a proxy for fishing capacity. Capacity for the fleet is approximately 5,400 gross tons. Harvest guidelines for sardine and mackerel are also set annually.

Geographic range: These fisheries occur along the coast of California predominantly from San Pedro, including the Channel Islands, north to San Francisco.

Seasons: This fishery operates year round. Targeted species vary seasonally with availability and market demand.

Gear type and fishing method: Purse seine, drum seine and lampara nets utilizing standard seining techniques.

Regulations: This is a limited-entry fishery.

Management type: The fishery is managed under a Coastal Pelagic Species Fisheries Management Plan developed by the Pacific Fishery Management Council and NMFS.

A NMFS pilot observer program began in July 2004 and continued through January 2006. A total of 93 sets have been observed. Observed marine mammal interactions with the fishery have included one California sea lion killed, 54 sea lions released alive, and one sea otter released alive. Under the MMAP self-reporting program, the following mortality was reported: In 2003, four California sea lions drowned after chewing through a bait barge net used by the anchovy lampara net fishery.

Category II, California tuna purse seine fishery.

Note: This fishery was previously included in the CA anchovy, mackerel, and sardine purse seine fishery (see above). Vessels in the anchovy, mackerel, and sardine fishery target tuna when oceanographic conditions result in an influx of tuna into southern California waters. Data for this fishery were obtained from the 'Status of the U.S. West Coast Fisheries for Highly Migratory Species through 2004', available at the Pacific Fishery Management Council website (http://www.pcouncil.org).

Number of permit holders: There are 63 limited-entry permits (Pacific Fishery Management Council. 2005. Status of the Pacific Coast coastal pelagic species fishery and recommended acceptable biological catches. Stock Assessment and Fishery Evaluation Report 2005).

Number of active permit holders: Between one and 23 vessels actively purse seined for tunas during the period 2000-2004.

Total effort: The number of vessels landing bluefin, yellowfin, skipjack, and albacore in 2000-2004 varied between one and 23. Logbooks are not required for this fishery, and the overall number of sets fished is unknown.

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[1] Information for this fishery came from the following sources: Pacific Fishery Management Council. 2005. Status of the Pacific Coast coastal pelagic species fishery and recommended acceptable biological catches. Stock assessment and fishery evaluation – 2005; California Coastal Pelagic Species Pilot Observer Program Informational Report 12 October 2005 (NMFS SW Region, unpublished); Lyle Enriquez NMFS Southwest Regional Office (personal communication) and the Marine Mammal Authorization Program, Registration and Reporting System. This fishery was formerly known as the "CA anchovy, mackerel, and tuna purse seine fishery" and was renamed in the NMFS MMPA List of Fisheries for 2007 (Federal Register Volume 72, No. 59, 14466). The "tuna" component of this fishery was designated as a separate fishery in the 2007 List of Fisheries and is named the "CA tuna purse seine fishery" (see fishery description below).

Geographic range: Observed sets in this fishery have occurred in the southern California Bight.

Seasons: Observed sets occurred in August and September. The timing of fishing effort varies with the availability of tuna species in this region.

Gear type and fishing method: Small coastal purse seine vessels with a <640 mt carrying capacity target bluefin, yellowfin, albacore and skipjack tuna during warm-water periods in southern California.

Regulations: This is a limited-entry fishery.

Management type: This fishery is managed under a Highly Migratory Species Management Plan developed by the Pacific Fishery Management Council and NMFS.

Comments: A pilot observer program for this fishery began in July 2004 and ended in January 2006. A total of 9 trips and 15 sets were observed with no marine mammal interactions.

Category II, WA Puget Sound Region salmon drift gillnet fishery.

Number of permit holders: This commercial fishery includes all inland waters south of the US-Canada border and east of the Bonilla/Tatoosh line, at the entrance to the Strait of Juan de Fuca. Treaty Indian salmon gillnet fishing is not included in this commercial fishery. The number of permit holders is reported to be 210 in the NMFS 2013 List of Fisheries (Federal Register 29 August 2013).

Number of active permit holders: The number of "active" permits is assumed to be equal to or less than the number of permits that are eligible to fish.

Total effort: Effort in the Puget Sound salmon drift gillnet fishery is regulated by systematic openings and closures that are specific to area and target salmon species.

Geographic Range: The fishery occurs in the inland marine waters south of the U.S./Canada border and east of the Bonilla/Tatoosh line at the entrance to the Strait of Juan de Fuca. The inland waters are divided into smaller statistical catch areas which are regulated independently.

Seasons: This fishery has multiple seasons throughout the year that vary among local areas dependent on local salmon runs. The seasons are managed to access harvestable surplus of robust stocks of salmon while minimizing impacts on weak stocks.

Gear type and fishing methods: Vessels operating in this fishery use a drift gillnet of single web construction, not exceeding 300 fathoms in length. Minimum mesh size for gillnet gear varies by target species. Fishing directed at sockeye and pink salmon are limited to gillnet gear with a 5-inch minimum mesh and a 6 inch maximum, with an additional "bird mesh" requirement that the first 20 meshes below the corkline be constructed of 5-inch opaque white mesh for visibility; the chinook season has a 7-inch minimum mesh; the coho season has a 5-inch minimum mesh; and the chum season has a 6- to 6.25-inch minimum mesh. The depth of gillnets can vary depending upon the fishery and the area fished. Normally they range from 180 to 220 meshes in depth, with 180 meshes as a common depth. It is the intention of the fisher to keep the net off the bottom. The vessel is attached to one end of the net and drifts with the net. The entire net is periodically retrieved onto the vessel and catch is removed. Drift times vary depending on fishing area, tidal condition and catch.

Regulations: The fishery is a limited-entry fishery with seasonal openings, area closures, and gear restrictions.

Management type: The fishery occurs in State waters and is managed by the Washington Department of Fish and Wildlife consistent with the U.S.-Canada Pacific Salmon Commission management regimes and the ocean salmon management objectives of the Pacific Fishery Management Council. U.S. and Canadian Fraser River sockeye and pink salmon fisheries are managed by the bilateral Fraser Panel in Panel Area waters. This includes the entire U.S. drift gillnet fishery for Fraser sockeye and pink salmon. For U.S. fisheries, Fraser Panel Orders are given effect by federal regulations that consist of In-season Orders issued by the NMFS Regional Administrator of the NMFS Northwest Region. These regulations are filed in the Federal Register post-season.

Comments: Salmon drift gillnet fisheries in Washington inland waters were last observed in 1993 and 1994, with observer coverage levels typically less than 10% (Erstad et al. 1996, Pierce et al. 1994, Pierce et al. 1996, NWIFC 1995). Fishing effort in the inland waters drift gillnet fishery has declined considerably since 1994 because far fewer vessels participate today (NMFS NW Region, unpublished data). Past marine mammal entanglements in this fishery included harbor porpoise, Dall's porpoise, and harbor seals.

Category II, CA squid purse seine fishery.[2]

Number of Permit Holders: A permit has been required to participate in the squid fishery since April 1998. Originally, only two types of permits were issued, either a vessel or light boat permit during the moratorium period from 1998 to 2004. Since the adoption of the Market Squid Fishery Management Plan (MSFMP) in 2005, a total of seven different permit types are now allowed under the restricted access program. Permit types include both transferable and non-transferable vessel, brail and light boat permits whose qualifying criteria are based on historical participation in the fishery during the moratorium period. Market squid vessel and brail permits allow a vessel to use lights to attract and capture squid using either purse seines or brail gear. Light boat owner permits only allow the use of attracting lights to attract and aggregate squid. In addition, three experimental non-transferable permits are allowed for vessel fishing outside of historical fishing areas north of San Francisco. In the 2006/2007 season there were 91 vessel permits, 14 brail permits, 64 light boat permits and 3 experimental permits issued. A permit is not required when fishing for live bait or when landing two short tons or less, which is considered incidental.

Number of Active Permit Holders: The number of active permits varies by year depending on market conditions and availability of squid. During the 2006/2007 season (1 April 2006 – 31 March 2007) there were approximately 84 vessels active during some portion of the year. Twenty-nine vessels harvested 86% of the total landings greater than two tons. The 1999/2000 season had the highest squid landings to date (115,437mt), with 132 vessels making squid landings.

Total Effort: Logbooks have been mandatory for the squid fishery since May 2000. Results for the 2006 calendar year indicate that each hour of fishing required 1.4 hours of search time by light boats. Combined searching and fishing effort resulted in 6.9 metric tons (mt) of catch per hour. In the 2006/2007 season, the fishery made 1,611 landings. This is a 47% decrease from the previous season. In addition, the average landing decreased from 23.9 mt to 21.7 mt.

Geographic Range: Since the 1960's there have been two distinct fisheries in operation north and south of Point Conception. Since the mid-1980's the majority of the squid fishing harvest has occurred in the southern fishery, with efforts focused around the Channel Islands and along the mainland from Port Hueneme to La Jolla. In the 2006/2007 season, the southern fishery landed 98% of the catch with the majority of landings occurring around the northern Channel Islands. In contrast, during the 2005/2006 season, landings in the southern fishery were primarily around Catalina Island. The northern fishery, centered primarily in Monterey Bay, has been in operation since the mid-1860's and has historical significance to California. During the 2002/2003 season, a moderate El Niño condition resulted in nearly 60% of the catch being landed in northern California.

Seasons: The fishery can occur year-round; however, fishing efforts differ north and south of Point Conception. Typically, the northern fishery operates from April through September while the southern fishery is most active from October through March. El Niño conditions generally hamper the fishery in the southern fishery and squid landings are minimal during these events. In contrast, landings in the northern fishery often increase during El Niño events and then are depressed for several years after.

Gear Type: There are several gears employed in this fishery. From 1996 to 2006, the vast majority (95%) of vessels use either purse (69%) or drum (26%) seine nets. Other types of nets used include brail (5%) and lampara nets (<1%). Another

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[2] This fishery description was provided by Dianna Porzio and Dale Sweetnam, California Department of Fish and Game. Details of marine mammal interactions with this fishery were obtained from NOAA Fisheries, Southwest Regional Office.

gear type associated with the fishery is attracting lights (30,000 watts maximum) that are used to attract and aggregate spawning squid in shallow waters.

Regulations: Since March 2005, the fishery operates under a restricted access program that requires all vessels to be permitted. A mandatory logbook program for fishing and lighting vessels has been in place since May 2000. A /monitoring program has been in place since 2000 that samples the landings is designed to evaluate the impact of the fishery on the resource. Attracting lights were regulated with each vessel restricted to no more than 30,000 watts of light during fishing activities. These lights must also be shielded and oriented directly downward to reduce light scatter. The lighting restrictions were enacted to avoid risks to nesting brown pelicans and interactions with other seabird species of concern. A seabird closure area restricting the use of attracting lights for commercial purposes in any waters of the Gulf of the Farallones National Marine Sanctuary was enacted. A seasonal catch limitation of 107,047 mt (118,000 short tons) was established to limit further expansion of the fishery. Commercial squid fishing is prohibited between noon on Friday and noon on Sunday of each week to allow an uninterrupted consecutive two-day period of spawning. Additional closure areas to the fishery to protect squid spawning habitat include the Channel Islands Marine Protected Areas (MPAs) and the newly established MPAs along the central California coast as well as areas closed to the use of purse seine gear including the leeward side of Catalina Island, Carmel and Santa Monica Bays.

Management Type: The market squid fishery is under California State management. The fishery was largely unregulated until 1998 when it came under regulatory control of the California Fish and Game Commission and the Department of Fish and Game. The MSFMP was enacted on March 28, 2005. The MSFMP was developed to ensure sustainable long-term conservation and to be responsive to environmental and socioeconomic changes. Market squid is also considered a monitored species under the Pacific Fishery Management Council’s (PFMC) Coastal Pelagic Species Fishery Management Plan.

Comments: During the 1980’s, California’s squid fishery grew rapidly in fleet size and landings when international demand for squid increased due to declining fisheries in other parts of the world. In 1997 industry-sponsored legislation halted the growth of fleet size with a moratorium on new permits. Landing records were set several times during the 1990’s, but landings seem to fluctuate with changing environmental and atmospheric conditions of the California Current. Encounters with marine mammals and sea birds are documented in logbooks. Seal bombs are used regularly, but fishermen report that they no longer have an effect. A pilot observer program began in July 2004 and has documented one unidentified common dolphin death in 135 sets through January 2006. In addition, there have been 96 California sea lions and three harbor seals released alive (NMFS, Southwest Region, unpublished data). In addition to the observed death, there were three strandings of Risso’s dolphin from 2002-2003 where evidence of gunshot wounds was confirmed, suggesting interaction with this fishery (NMFS Southwest Regional Office, unpublished data). The squid fishery operates primarily at night and targets spawning aggregations of adult squid. In recent years the amount of daylight fishing has increased, especially in Monterey, in part due to better sonar gear, but also to reduce interactions with California sea lions. The PFMC adopted the egg escapement method to monitor the impact of market squid fishery since no reliable biomass estimate has been developed. It is a proxy for Maximum Sustainable Yield (MSY), setting an egg escapement threshold level at which to evaluate the magnitude of fishing mortality on the spawning potential of the squid stock. The egg escapement method was developed on conventional spawning biomass “per-recruit” theory. In general, the MSY Control Rule for market squid is based on evaluating levels of egg escapement associated with the exploited population. The egg escapement threshold, initially set at 30%, represents a biological reference point from which to evaluate fishery related impacts.

Category III, CA Dungeness crab pot

Notes: NMFS is reviewing several pot and trap fisheries along the U.S. west coast, in response to entanglements of humpback whales in pot and trap gear. An update on these fisheries will appear in the MMPA Proposed List of Fisheries for 2009. For all commercial pot and trap fisheries in California, a general trap permit is required, in addition to any specific permits required for an individual fishery. All traps are required to be tended and serviced at least every 96 hours, weather permitting. Descriptions of those pot and/or trap fisheries for which interactions with marine mammals have been documented or suspected are included in this Appendix.

Number of permit holders: The Dungeness crab fishery is a limited access fishery requiring a vessel-based permit that is transferable. This program was initiated in 1994 based on landing histories. The number of vessels participating on an annual basis does vary, but approximately 400 vessels have been landing crab in recent years.

Number of active permit holders: Approximately 400 vessels have been landing crabs in recent years.

Total effort: There is no restriction on the number of traps that may be fished at one time by a single vessel. Some vessels use as many as 1000 or more traps at the peak of the season (December/January).

Geographic range: This fishery operates in central and northern California.

Seasons: The fishery is divided into two management areas. The central region (south of the Mendocino-Sonoma county line) fishery opens November 15 and continues through June 30. The northern region (north of the Mendocino-Sonoma county line) is annually scheduled to open on December 1, but may be delayed by CDF&G based on the condition of market size crabs, and continues until July 15.

Gear type: For each trap fished there is one vertical line in the water, though only in the northern region, is fishing strings illegal. All traps are required to be marked with buoys bearing the commercial fishing license number. The normal operating depth for Dungeness crab is between 35 and 70 m. Traps are typically tended on a daily basis.

Regulations: There is no daily logbook requirement for the commercial Dungeness crab fishery. There is a recreation fishery for Dungeness crab, which allows for 10 crab per day to be harvested except when fishing on a commercial passenger fishing vessel (CPFV) in central California, the limit is 6 crab per person. There is no reliable estimate for the effort or landings in the sport fishery except that CPFVs are required to track catch and effort by species.

Management type: The Dungeness crab pot fishery is managed by the California legislature, CDF&G and also by the tri-state committee for Dungeness, which includes the states of Oregon and Washington.

Comments: Humpback whale entanglements with Dungeness crab gear have not been confirmed, but are suspected as the responsible fishery based on the location and timing of fishing effort and observed humpback entanglements.

Category III, OR Dungeness crab pot

Notes: Dungeness crab is the most significant pot/trap fishery in the state of Oregon. Over the long term, the fishery has averaged around 10 million lb of landings per year; although since 2003, annual landings have been approximately 25 to 30 million lb. This fishery requires an Oregon issued limited-entry permit, which is transferable.

Number of permit holders: There were 433 permit holders in 2006.

Number of active permit holders: A total of 364 vessels landed crabs in 2006.

Total effort: In 2006, the fishery made a transition to a three-tiered pot limitation program which allows a maximum of 200, 300, or 500 pots to be fished at any one time depending on previous landing history. The pot limitation is implemented through a buoy tag requirement. All Dungeness crab pots require buoy tags with the identifying associated permit attached. The expected result of the buoy tags and tier limits is to reduce the number of pots in Oregon waters down from 200,000 to approximately 150,000.

Geographic range: Oregon waters.

Seasons: The Dungeness crab season runs from December 1 to August 14. The highest landings are always recorded in December through February, at the beginning of the season.

Gear type: Pots.

Regulations: All Oregon pot/trap gear must be marked on its terminal ends with pole and flag, light, radar reflector, and buoy with the owner/operator number clearly marked. By law, gear may not be left unattended for more than seven days. All vessel operators and deck hands must have a commercial fishing license or crewmembers license.

Management type: State management, Oregon Department of Fish and Wildlife.

Comments: Humpback whale entanglements with Dungeness crab gear have not been confirmed, but are suspected as the responsible fishery based on the location and timing of fishing effort and observed humpback entanglements.

Category III, CA spot prawn fishery

Number of permit holders: A three-tiered limited access permit system is used in this fishery to accommodate changes in the fishery that occurred when trawling methods were banned and replaced with trap fishing in 2003. Permits are linked to the vessel owner and only Tier 1 permits are transferable. Tier 1 permits allow a maximum of 500 traps in use at a time. Eighteen vessels had Tier 1 permits in 2007. Tier 2 permits allow 150 traps in use at a time. There were three vessels utilizing Tier 2 permits in 2007. Tier 3 permits were issued to allow vessels that previously used trawl gear to switch to trap gear to target spot prawn. There were nine Tier 3 permits issued in 2007. Information on 2007 license statistics was obtained from the CA Department of Fish and Game website, http://www.dfg.ca.gov/licensing/statistics/statistics.html.

Number of active permit holders: A total of 30 vessels participated in this fishery in 2007.

Total effort: Landings have increased every year since 2003. The total number of traps set is unknown, although the theoretical maximum number of traps that may be fished annually is approximately 13,000.

Geographic range: The fishery operates from Monterey south. Over half of the landings are made in Los Angeles and San Diego. Traps are typically set in waters of 182 m (100 fathoms) or more. South of Point Arguello, traps must be fished in waters 91 m (50 fathoms) or deeper.

Seasons: North of Point Arguello, the fishery is open from February 1 to October 30. North of Point Arguello, the open season is August 1 to April 30.

Gear type: Strings of 25 to 50 traps are fished in deep waters (>182 m).

Regulations: For all commercial pot and trap fisheries in California, a general trap permit is required, in addition to any specific permits required for an individual fishery. All traps are required to be tended and serviced at least every 96 hours, weather permitting. There is a daily logbook requirement in this fishery. There is no buoy marking requirement and no recreational fishery for this species.

Management type: This fishery is managed under state authority by the California Department of Fish and Game.

Comments: One humpback whale was seriously injured in 2006 as a result of entanglement in spot prawn trap gear.

Category III, WA/OR/CA sablefish pot

Notes: Sablefish is likely the most commonly targeted groundfish caught in pot gear in off the U.S. west coast.

Number of permit holders: There are 32 limited-entry permits (LEPs) to catch sablefish with pot gear. Open access privileges are also available to fishermen.

Number of active permit holders: Including all vessels which made landings with an LEP or under open access rules, a total of about 150 vessels participated in this fishery in 2007. This total fluctuates on an annual basis.

Total effort: Estimated annual landings indicate usually over 1 million lbs of sablefish are landed per year in this fishery.

Geographic range: The fishery is well distributed from central California north to the U.S./Canadian border. Most of the effort occurs out in deeper waters (200-400 m).

Seasons: Most fishing effort occurs January through September.

Gear type: Traps <6 ft. in any dimension.

Regulations: A general trap permit is all that is required for open access to this fishery by the states along the U.S. west coast. LEPs are divided into a three-tiered system which allocates annual landing limits to individual permits based on the status of the stock. Daily logbook reporting is required.

Management type: Sablefish is managed under the federal Groundfish Fishery Management Plan. This is the only trap fishery regulated by the federal government; all others are managed by the states.

Comments: One humpback whale was seriously injured in 2006 as a result of entanglement in sablefish trap gear.

Category III, CA rock crab

Number of permit holders: There were 134 permits issued in 2007.

Number of active permit holders: Unknown, but it is likely that most issued permits are active.

Total effort: Annual landings averaged approximately 1 million pounds from 2000 to 2005.

Geographic range: The fishery operates throughout California waters. Most landings are made south of Morro Bay, California, with approximately 65% of all landings coming from the Santa Barbara area.

Seasons: There are no seasonal restrictions, though some area closures exist.

Gear type: There is no restriction on the number of traps that may be fished at one time by the vessel but the typical number of traps operated at any given time is less than 200. Traps are usually buoyed singularly or in pairs, but fishing strings (multiple traps attached together between two buoys) is allowed. Buoys are required to be marked with the license number of the operator. The normal working depth of traps in this fishery is 10 to 35 fathoms.

Regulations: There is no daily logbook requirement for the commercial rock crab fishery.

Management type: The fishery is managed by the California Department of Fish and Game.

Comments: The recreational bag limit is 35 crabs per day, but there is no reliable estimate of the effort or landings in the sport fishery.

Category III, CA halibut bottom trawl.

Notes: This is a newly-listed fishery in the 2007 MMPA NMFS List of Fisheries (Federal Register Volume 72, No. 59, 14466). Information on fishing effort was provided by Stephen Wertz, California Department of Fish and Game.

Number of permit holders: There were 60 permits issued in 2006.

Number of active permit holders: There were 31 active permit holders in 2006.

Total effort: Thirty one vessels made 3,711 tows statewide in 2006, totaling 3,897 tow hours, in 332 days of fishing effort.

Geographic range: The fishery operates from Bodega Bay in northern California to San Diego in southern California, from 3 to 200 nautical miles offshore. Trawling is prohibited in state waters (0 to 3 nmi offshore) and within the entire Monterey

Bay, except in the designated "California halibut trawl grounds", between Point Arguello and Point Mugu beyond 1 nautical mile from shore. Trawls used in this region must have a minimum mesh size of 7.5 in and trawling is prohibited here between 15 March and 15 June to protect spawning adults.

Seasons: Fishing is permitted year-round, except in state waters. State waters are closed between 15 March and 15 June.

Gear type: Otter trawls, with a minimum mesh size of 4.5 inches are required in federal waters, while fishing in state waters has a 7.5 inch mesh size requirement.

Regulations: Fishing in state waters is limited to the period 14 March – 16 June in the 'California halibut trawl grounds' in southern California between Point Arguello and Point Mugu. All other fishing must occur in federal waters beyond 3 nautical miles from shore.

Management type: The fishery is managed by the California Department of Fish and Game.

Comments: No marine mammal interactions have been documented for this fishery, but the gear type and fishing methods are similar to the WA/OR/CA groundfish trawl fishery (also category III), which is known to interact with marine mammals.

Category III, CA herring gillnet fishery.[3]

The herring fishery is concentrated in four spawning areas which are managed separately by the California Department of Fish and Game (CDFG); catch quotas are based on population estimates derived from acoustic and spawning-ground surveys. The largest spawning aggregations occur in San Francisco Bay and produces more than 90% of the herring catch. Smaller spawning aggregations are fished in Tomales Bay, Humboldt Bay, and Crescent City Harbor. During the early 1990's, there were 26 round haul permits (either purse seine or lampara nets). Between 1993 and 1998, all purse seine fishers converted their gear to gillnets with stretched mesh size less than 2.5 inches (which are not known to take mammals) as part of CDFG efforts to protect herring resources. The fishery is managed through a limited-entry program. The California Department of Fish and Game website lists a total of 447 herring gillnet permits for 2005 (http://www.dfg.ca.gov/mrd/herring/index.html). Of these, 406 permits exist for San Francisco Bay, 34 in Tomales Bay, 4 in Humboldt Bay, and 3 in Crescent City Harbor. This fishery begins in December (San Francisco Bay) or January (northern California) and ends when the quotas have been reached, but no later than mid-March.

Category III, WA Willapa Bay salmon drift gillnet fishery.

Number of permit holders: The total number of permit holders for this fishery in 1995 and 1996 was 300, but this number has declined in subsequent years. In 1997 there were 264 total permits and 243 in 1998. The NMFS 2001 List of Fisheries lists an estimate of 82 vessels/persons in this fishery.

Number of active permit holders: The number of active permit holders is assumed to be equal to or less than the number of permits eligible to fish in a given year. The number of permits renewed and eligible to fish in 1996 was 300 but declined to 224 in 1997 and 196 permits were renewed for 1998. The 1996-98 counts do not include permits held on waivers for those years, but do include permits that were eligible to fish at some point during the year and subsequently entered into a buyback program. The number of permits issued for this fishery has been reduced through a combination of State and federal permit buyback programs. Vessels permitted to fish in the Willapa Bay are also permitted to fish in the lower Columbia River drift gillnet fishery.

Total effort: Effort in this fishery is regulated through area and species openings. The fishery was observed in 1992 and 1993 when fishery opening were greater than in recent years. In 1992 and 1993 there were 42 and 19 days of open fishing time during the summer "dip-in" fishery. The "dip-in" fishery was closed in 1994 through 1999. Available openings have also declined in the fall chinook/coho fisheries. In 1992/93 respectively there were 44 and 78 days of available fishing time. There were 43, 45, 22 and 16.5 available open fishing days during 1995 through 1998.

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[3] Pers. Comm. Becky Ota, State Herring Manager, Senior Biologist.

Geographic range: This fishery includes all inland marine waters of Willapa Bay. The waters of the Bay are further divided into smaller statistical catch areas.

Seasons: Seasonal openings coincide with local salmon run timing and fish abundance.

Gear type: Fishing gear used in this fishery is a drift gillnet of single web construction, not exceeding 250 fathoms in length, with a minimum stretched mesh size ranging upward from 5 inches depending on target salmon species. The gear is commonly set during periods of low and high slack tides. It is the intention of the fisher to keep the net off the bottom. The vessel is attached to one end of the net and drifts with the net. The entire net is periodically retrieved onto the vessel and catch is removed. Drift times vary depending on fishing area, tidal condition, and catch.

Regulations: This fishery is a limited-entry fishery with seasonal openings and gear restrictions.

Management type: The salmon drift gillnet fishery is managed by the Washington Department of Fish and Wildlife.

Comments: Observers were placed onboard vessels in this fishery to monitor marine mammal interactions in the early 1980s and in 1990-93. Five incidentally taken harbor seals were recovered by observers in the fishery from 1991through 1993 (3 in ‘92 and 2 in ‘93). Two incidentally taken northern elephant seals were recovered by observers from the fishery in 1991 but no takes of this species were observed. The summer fishery (July- August) in Willapa Bay has been closed since it was last observed in 1993 and available fishing time declined from 1996 through 1998.

Category III, WA Grays Harbor salmon drift gillnet fishery.

Number of permit holders: This commercial drift gillnet fishery does not include Treaty Indian salmon gillnet fishing. The total number of permit holders for this commercial fishery in 1995 and 1996 was 117 but this number has declined in subsequent years. In 1997 there were 101 total permits and 87 in 1998.

Number of active permit holders: The NMFS 2001 List of Fisheries lists a total of 24 vessels/persons operating in this fishery. The number of active permit holders is assumed to be equal to or less than the number of permits eligible to fish in a given year. The number of permits renewed and eligible to fish in 1996 was 117 but declined to 79 in 1997 and 59 permits were renewed for 1998. The 1996-98 counts do not include permits held on waivers for those years but do include permits that were eligible to fish at some point during the year and subsequently entered a buyback program. The number of permits issued for this fishery has been reduced through a combination of State and federal permit buyback programs. Vessels permitted to fish in Grays Harbor are also permitted to fish in the lower Columbia River salmon drift gillnet fishery.

Total effort: Effort in this fishery is regulated through area and species openings. The fishery was observed in 1992 and 1993 when fishery openings were greater than in recent years. In 1992 and 1993 there were 42 and 19 days of open fishing time during the summer "dip-in" fishery. The "dip-in" fishery was closed in 1994 through 1999. Available openings have also declined in the fall chinook/coho fisheries. There were 11, 17.5, 9 and 5 available open fishing days during the 1995 through 1998 fall season.

Geographic range: Effort in this fishery includes all marine waters of Grays Harbor. The waters are further divided into smaller statistical catch areas.

Seasons: This fishery is subject to seasonal openings which coincide with local salmon run timing and fish abundance.

Gear type: Fishing gear used in this fishery is a drift gillnet of single web construction, not exceeding 250 fathoms in length, with a minimum stretched mesh size ranging of 5 inches depending on target salmon species. The gear is commonly set during periods of low and high slack tides and retrieved periodically by the tending vessel. It is the intention of the fisher to keep the net off the bottom. The vessel is attached to one end of the net and drifts with the net. The entire net is periodically retrieved onto the vessel and catch is removed. Drift times vary depending on fishing area, tidal condition, and catch.

Regulations: The fishery is a limited-entry fishery with seasonal openings and gear restrictions.

Management type: The salmon drift gillnet fishery is managed by the Washington Department of Fish and Wildlife.

Comments: Observers were placed onboard vessels in this fishery to monitor marine mammal interactions in the early 1980s and in 1990-93. Incidental take of harbor seals was observed during the fishery in 1992 and 1993. In 1992, one harbor seal was observed entangled dead during the summer fishery and one additional seal was observed entangled during the fall fishery but it escaped uninjured. In 1993, one harbor seal was observed entangled dead and one additional seal was recovered by observers during the summer fishery. The summer fishery (July-August) in Grays Harbor has been closed since it was last observed in 1993. Available fishing time in the fall chinook fisheries declined from 1996 through 1998.

Category III, WA, OR lower Columbia River salmon drift gillnet fishery.

Number of permit holders: The total number of permit holders was 856 (344 from Oregon and 512 from Washington) when the fishery was last observed in 1993. In 1995 through 1998 the number of permits was 747, 693, 675 and 620 respectively. The number of permits issued for this fishery by Washington has been reduced through a combination of State and federal buy-back programs. This reduction is reflected in the overall decline in the total number of permits.

Number of active permit holders: The number of active permits is a subset of the total permits issued for the fishery. For example, in 1995, 110 vessels (of the 747 vessels holding permits) landed fish in the mainstem fishery.

Total effort: Effort in this fishery is regulated through species related seasonal openings and gear restrictions. The fishery was observed in 1991, 1992 and 1993 during several seasons of the year. The winter seasons (openings) for 1991 through 1993 totaled 13, 9.5, and 6 days respectively. The winter season has subsequently been reduced to remnant levels to protect upriver ESA listed salmon stocks. In 1995 there was no winter salmon season, in 1996 the fishery was open for 1 day. In 1997 and 1998 the season was shifted to earlier in the year and gear restrictions were imposed to target primarily sturgeon. The fall fishery in the mainstem was also observed 1992 and 1993 as was the Young's Bay terminal fishery in 1993, however, no marine mammal mortality was observed in these fisheries. The fall mainstem fishery openings varied from 1 day in 1995 to just under 19.5 days in 1997 and 6 days in 1998. The fall Youngs Bay terminal fishery fluctuated between 60 and 70 days for the 1995 through 1998 period which was similar to the fishery during the period observed.

Geographic range: This fishery occurs in the main stem of the Columbia river from the mouth at the Pacific Ocean upstream to river mile 140 near the Bonneville Dam. The lower Columbia is further subdivided into smaller statistical catch areas which can be regulated independently.

Seasons: This fishery is subject to season and statistical area openings which are designed to coincide with run timing of harvestable salmon runs while protecting weak salmon stocks and those listed under the Endangered Species Act. In recent years, early spring (winter) fisheries have been sharply curtailed for the protection of listed salmon species. In 1994, for example, the spring fishery was open for only three days with approximately 1900 fish landed. In 1995 the spring fishery was closed and in 1996 the fishery was open for one day but fishing effort was minimal owing to severe flooding. Only 100 fish were landed during the one day in 1996.

Gear type: Typical gear used in this fishery is a gillnet of single web construction, not exceeding 250 fathoms in length, with a minimum stretched mesh size ranging upwards from 5 inches depending on target salmon species. The gear is commonly set during periods of low and high slack tides. It is the intention of the fisher to keep the net off the bottom. The vessel is attached to one end of the net and drifts with the net. The entire net is periodically retrieved onto the vessel and catch is removed. Drift times vary depending on fishing area, tidal condition, and catch.

Regulations: The fishery is a limited-entry fishery with seasonal openings, area closures, and gear restrictions.

Management type: The lower Columbia River salmon drift gillnet fishery is managed jointly by the Washington Department of Fish and Wildlife and the Oregon Department of Fish and Wildlife.

Comments: Observers were placed onboard vessels in this fishery to monitor marine mammal interactions in the early 1980s and in 1990-93. Incidental takes of harbor seals and California sea lions were documented, but only during the winter seasons (which have been reduced dramatically in recent years to protect ESA-listed salmon). No mortality was observed during the fall fisheries.

Category III, WA, OR salmon net pens.

Number of permit holders: There were 12 commercial salmon net pen ("grow out") facilities licensed in Washington in 1998. There are no commercial salmon net pen or aquaculture facilities currently licensed in Oregon. Non-commercial salmon enhancement pens are not included in the list of commercial fisheries.

Number of active permit holders: Twelve salmon net pen facilities in Washington.

Total effort: The 12 licensed facilities on Washington operate year-round.

Geographic range: In Washington, net pens are found in protected waters in the Straits (Port Angeles), northern Puget Sound (in the San Juan Island area) as well as in Puget Sound south of Admirality Inlet. There are currently no commercial salmon pens in Oregon.

Seasons: Salmon net pens operate year-round.

Gear type: Net pens are large net impoundments suspended below a floating dock-like structure. The floating docks are anchored to the bottom and may also support guard (predator) net systems. Multiple pens are commonly rafted together and the entire facility is positioned in an area with adequate tidal flow to maintain water quality.

Regulations: Specific regulations unknown.

Management type: In Washington, the salmon net pen fishery is managed by the Washington Department of Natural Resources through Aquatic Lands Permits as well as the Washington Department of Fish and Wildlife.

Comments: Salmon net pen operations have not been monitored by NMFS for marine mammal interactions, however, incidental takes of California sea lions and harbor seals have been reported.

Category III, WA, OR, CA groundfish trawl.

Approximate number of vessels/persons: In 1998, approximately 332 vessels used bottom and mid-water trawl gear to harvest Pacific coast groundfish. This is down from 383 vessels in 1995. The NMFS List of Fisheries for 2001 lists 585 vessels as participating in this fishery. Groundfish trawl vessels harvest a variety of species including Pacific hake, flatfish, sablefish, lingcod, and rockfish. This commercial fishery does not include Treaty Indian fishing for groundfish.

All observed incidental marine mammal takes have occurred in the mid-water trawl fishery for Pacific hake. The annual hake allocation is divided between vessels that harvest and process catch at sea and those that harvest and deliver catch to shore-based processing facilities. At least one NMFS-trained observer is placed on board each at-sea processing vessel to provide comprehensive data on total catch, including marine mammal takes. In the California, Oregon, and Washington range of the fishery, the number of vessels fishing ranged between 12 and 16 (all with observers) during 1997-2001. Hake vessels that deliver to shore-based processors are issued Exempted Fishing Permits that requires the entire catch to be delivered unsorted to processing facilities where State technicians have the opportunity to sample. In 1998, 13% of the hake deliveries landed at shore-based processors were monitored. The following is a description of the commercial hake fishery.

Number of permit holders/active permit holders: A license limitation ("limited-entry") program has been in effect in the Pacific coast groundfish fishery since 1994. The number of limited-entry permits is limited to 404. Non-tribal trawl vessels that harvest groundfish are required to possess a limited-entry permit to operate in the fishery. Any vessel with a federal limited-entry trawl permit may fish for hake, but the number of vessels that do is smaller than the number of permits. In 1998, approximately 61 limited-entry vessels, 7 catcher/processors and 50 catcher vessels delivering to shoreside and mothership processors, made commercial landings of hake during the regular season. In addition, 6 unpermitted mothership processors received unsorted hake catch.

Total effort: The hake allocation continues to be fully utilized. From 1997 to 1999 the annual allocation was 232,000 mt/year, this is an increase over the 1996 allocation of 212,000 mt and the 1995 allocation of 178,400 mt. In 1998, motherships vessels received 50,087 mt of hake in 17 days, catcher/processors took 70,365 mt of hake in 54 days and shore-based processors received 87,862 mt of hake over a 196 day period.

Geographic range: The fishery extends from northern California (about 40^{o} 30' N. latitude) to the U.S.-Canada border. Pacific hake migrate from south to north during the fishing season, so effort in the south usually occurs earlier than in the north.

Seasons: From 1997 to 1999, season start dates have remained unchanged. The shore-based season in most of the Eureka area (between 42^{O}- 40^{O}30' N latitude) began on April 1, the fishery south of 40^{O}30' N latitude opened April 15, and the fishery north of 42^{O} N latitude started on June 15. In 1998, the primary season for the shore-based fleet closed on October 13, 1998. The primary seasons for the mothership and catcher/processor sectors began May 15, north of 42^{0} N. lat. In 1998, the mothership fishery closed on May 31, the catcher/processor fishery closed on August 7.

Gear type: The Pacific hake trawl fishery is conducted with mid-water trawl gear with a minimum mesh size of 3 inches throughout the net.

Regulations/Management type: This fishery is managed through Federal regulations by the Pacific Fishery Management Council under the Groundfish Fishery Management Plan.

Comments: Since 1991, incidental takes of Steller sea lions, Pacific white-sided dolphins, Dall's porpoise, California sea lions, harbor seals, northern fur seals, and northern elephant seals have been documented in the hake fishery. From 1997-2001, 4 California sea lions, 2 harbor seals, 2 northern elephant seals, 1 Pacific white-sided dolphin, and 6 Dall’s porpoise were reported taken in California/Oregon/Washington regions by this fishery.

Category III fisheries in Hawaii are managed primarily by the State of Hawaii[4]. Some fisheries have undergone many changes in geographic and temporal extent in recent years and complete analyses of fishing effort for recent years are not yet available. For many, fishing season and specific gear types are not well defined. These fishery descriptions will be updated as new information and analyses become available.

Category III, Hawaii gillnet fishery.[5]

Number of active permit holders: In 2011 there were 36 active commercial fishers. In 1995 there were approximately 115.

Total effort: In 2011 there were 495 trips.. This fishery operates in nearshore and coastal pelagic regions.

Seasons: This fishery operates year-round with the exception of juvenile big-eyed scad less than 8.5 inches which cannot be taken from July through October.

Gear type: Gillnets are of stretched mesh greater than 2 inches and stretched mesh size greater than 2.75 inches for stationary gillnets. The net dimensions may not exceed 7 feet high and 125 feet long.

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[4] Descriptions of Hawaii State managed fisheries provided by Reggie Kokubun and Sarah Courbis , State of Hawaii, Department of Land and Natural Resources, Division of Aquatic Resources and Hawaii Humpback Whale National Marine Sanctuary, Honolulu Hawaii.

Regulations: Stationary nets must be inspected every 2 hours and total soak time cannot exceed four hours in the same location. New restrictions implemented in 2007 include that nets may not: 1) be used more than once in a 24-hour period; 2) exceed a 7 ft stretched height limit; 3) exceed a single-panel; 4) be used at night; 5) be set within 250 ft. of another lay net; 6) be set in more than 80 ft depths; 7) be left unattended for more than ½ hour; 8) break coral during retrieval, 9) be set in freshwater streams or stream mouths, and nets must be 1) registered with the Division of Aquatic Resources; 2) inspected within two hours after being set; 2) tagged with two marker buoys while fished. Gillnets are prohibited around all of Maui and portions of Oahu and Hawaii Island.
Management type: A commercial marine license issued by the Hawaii Department of Land and Natural Resources, Division of Aquatic Resources (DAR) is required for all commercial fishing activities in Hawaii State waters. The Federal Fishery Ecosystem Plan for the Hawaii Archipelago contains no management measures applicable to this gear.

Comments: The principle catches include reef fishes and big-eyed scad (akule) and mackerel scad (opelu). Interactions have been documented with bottlenose dolphins and spinner dolphins.

Category III, Hawaii lift (opelu) net fishery

Number of active permit holders: In 2011 there were 22 active commercial fishers.

Total effort: In 2011 there were 843 trips.

Seasons: unknown.

Gear type: Fishing with a net that captures fish by raising the net from beneath a school of fish. Normally fish are encouraged over and into the new with chum.

Regulations: unknown.

Management type: A commercial marine license issued by the Hawaii Department of Land and Natural Resources, Division of Aquatic Resources (DAR) is required for all commercial fishing activities in Hawaii State waters. The Federal Fishery Ecosystem Plan for the Hawaii Archipelago contains no management measures applicable to this gear.

Category III, Hawaii inshore purse seine fishery

Number of active permit holders: In 2011 there were less than 3 active commercial fishers.

Total effort: Cannot be reported to protect confidentiality.

Seasons: Year round.

Gear type: Fishing with a net that is used to surround a school of fish and is closed by drawing the bottom of the net together to form a bag.

Regulations: It is unlawful for any person without a valid commercial marine license to take akule with any net that has less than 2-3/4" stretched mesh. It is unlawful to take akule less than 8.5 inches with net from July – October or possess or sell more than 200 lbs of akule less than 8.5 inches per day during July – October. Federal regulations governing this gear can be found in the Code of Federal Regulations, Title 50, Part 665, Subpart C.

Management type: A commercial marine license issued by the Hawaii Department of Land and Natural Resources, Division of Aquatic Resources (DAR) is required for all commercial fishing activities in Hawaii State waters. This fishery is also managed under the Federal Hawaiian Archipelago Fishery Ecosystem Plan in waters outside of 3 nmi from shore.

Category III, Hawaii throw net/ cast net fishery

Number of active permit holders: In 2011 there were 29 active commercial fishers.

Total effort: In 2011 there were 445 fishing trips.

Seasons: unknown.

Gear type: Fishing with a round or conical shaped net with a weighted outer perimeter that is thrown over fish.

Regulations: Minimum size 2 inch stretched mesh. Possession of thrownets with mesh size less than 2 inches in or near the water where fish may be taken is unlawful. Nets with smaller mesh may be used to take shrimp (`opae), `opelu, and makiawa.

Management type: A commercial marine license issued by the Hawaii Department of Land and Natural Resources, Division of Aquatic Resources (DAR) is required for all commercial fishing activities in Hawaii State waters. The Federal Fishery Ecosystem Plan for the Hawaii Archipelago contains no management measures applicable to this gear.

Comments: Targets inshore and reef fish.

Category III, Hawaii seine net fishery

Number of active permit holders: In 2011 there were 26 active commercial fishers.

Total effort: In 2011 there were 227 fishing trips.

Seasons: unknown.

Gear type: Includes hukilau, beach seine, dragnet, pen, surround, etc. Fishing with a net by moving it through the water to surround fish by corralling and trapping them within the walls of the net.

Regulations:.Outside of 3nmi from shore, the Federal Fishery Ecosystem Plan for the Hawaii Archipelago requires seine nets be attended to at all times. Federal regulations governing this gear can be found in the Code of Federal Regulations, Title 50, Part 665, Subpart C.

Management type: A commercial marine license issued by the Hawaii Department of Land and Natural Resources, Division of Aquatic Resources (DAR) is required for all commercial fishing activities in Hawaii State waters. This fishery is also managed under the Federal Hawaiian Archipelago Fishery Ecosystem Plan outside of 3 nmi from shore.

Comments: Typical species: usually inshore and reef fish.

Category III, Hawaii trolling, rod, and reel fishery.

Number of active permit holders: In 2011 there were 2,126 active commercial fishers.

Total effort: In 2011 there were 30,020 fishing trips.

Seasons: Year round.

Gear type: Fishing by towing or dragging line(s) with artificial lure(s), dead or live bait, or green stick and dnaglers using a sail, surf or motor-powered vessel underway. Up to six lines rigged with artificial lures may be trolled when outrigger poles are used to keep gear from tangling. When using live bait, trollers move at slower speeds to permit the bait to swim naturally. Pelagic trollers generally fish at an average distance of 5 to 8 miles from shore, with a maximum distance of about 30 miles from shore. Trollers fish where water masses converge and where submarine cliffs, seamounts, and other underwater features dramatically change the bathymetry. Trolls often fish drifting logs, other flotsam, underneath bird aggregations, and near FADs. Typical target species include mahimahi, ono, billfishes (marlin, sailfishes, etc.), kaku, uluas, kamanu, tunas, etc.

Regulations: The Fishery Ecosystem Plan for Pelagic Fisheries of the Western Pacific contains no management regulation applicable to pelagic trolling in Federal waters around Hawaii.

Management type: A commercial marine license issued by the Hawaii Department of Land and Natural Resources, Division of Aquatic Resources (DAR) is required for all commercial fishing activities in Hawaii State waters. This fishery is also managed under the Federal Pacific Pelagics Fishery Ecosystem Plan outside of 3 nmi from shore.

Category III, Hawaii kaka line fishery.

Number of active permit holders: In 2011 there were 17 active commercial fishers.

Total effort: In 2011 there were 46 fishing trips.

Seasons: unknown.

Gear type: Fishing with a gear consisting of a mainline less than one nautical mile in length to which are attached multiple branchlines with baited hooks. Mainline is set horizontally, and fixed on or near the bottom, or in shallow midwater. Typical target species varies spending on set location, e.g., nearshore or pelagics.

Regulations: Managed under State of Hawaii regulations.

Management type: A commercial marine license issued by the Hawaii Department of Land and Natural Resources, Division of Aquatic Resources (DAR) is required for all commercial fishing activities in Hawaii State waters. The Fishery Ecosystem Plan for the Hawaii Archipelago contains no management measures applicable to this gear.

Category III, Hawaii vertical longline fishery.

Number of active permit holders: In 2011 there were 9 active commercial fishers.

Total effort: In 2011 there were 92 fishing trips.

Seasons: unknown.

Gear type: Fishing using a vertical mainline, less than one nautical mile in length and suspended from the surface with float, from which leaders with baited hooks are attached and ending with a terminal weight.

Regulations: unknown.

Management type: A commercial marine license issued by the Hawaii Department of Land and Natural Resources, Division of Aquatic Resources (DAR) is required for all commercial fishing activities in Hawaii State waters. The Fishery Ecosystem Plan for the Hawaii Archipelago contains no management measures applicable to this gear.

Category III, Hawaii crab trap fishery.

Number of active permit holders: In 2011 there were 9 license holders fishing crab traps.

Total effort: In 2011 there were 168 crab traps trips.

Seasons: unknown.

Gear type: Fishing with any of various fishing devices made into the shape of a box, container, or enclosure, with one or more openings that allow marine life to get inside but keep them from leaving.

Regulations: Minimum mesh size: Netting - stretched mesh 2 inches; Rigid material - 2 inches by 1 inch. Entrance cones for traps have no minimum mesh size. Traps must be portable and not exceed 10 feet in length or 6 feet in height or width.

Management type: A commercial marine license issued by the Hawaii Department of Land and Natural Resources, Division of Aquatic Resources (DAR) is required for all commercial fishing activities in Hawaii State waters. The Fishery Ecosystem Plan for the Hawaii Archipelago contains no management measures applicable to this gear.

Comments: From 2007-2011, five humpback whales were reported as entangled in Hawaii trap gear (Lyman 2013, NMFS unpublished data). The gear involved in two entanglements was identified as crab trap gear, one was identified as possibly crab trap gear, and the remaining two could not be identified to a specific trap fishery (NMFS unpublished data). Pre-mitigation injury determinations for the crab trap and possible crab trap entanglements were two serious injuries and one prorated as 0.75 serious injury (Bradford and Lyman 2013, NMFS unpublished data). Humpback serious injury and mortality in the crab trap fishery from 2007-2011 is 2.75, with a 5-year annual average of 0.55 per year.

Category III, Hawaii fish trap fishery.

Number of active permit holders: In 2011 there were 9 active commercial fishers.

Total effort: In 2011, there were 125 fish trap trips.

Seasons: unknown.

Gear type: Fishing with any of various fishing devices made into the shape of a box, container, or enclosure, with one or more openings that allow marine life to get inside but keep them from leaving.

Regulations: Minimum mesh size: Netting - stretched mesh 2 inches; Rigid material - 2 inches by 1 inch. Entrance cones for traps have no minimum mesh size. Traps must be portable and not exceed 10 feet in length or 6 feet in height or width.

Management type: A commercial marine license issued by the Hawaii Department of Land and Natural Resources, Division of Aquatic Resources (DAR) is required for all commercial fishing activities in Hawaii State waters. The Fishery Ecosystem Plan for the Hawaii Archipelago contains no management measures applicable to this gear.

Category III, Main Hawaiian Islands lobster trap fishery.

Number of active permit holders: In 2011 there were less than 3 active commercial fishers.

Geographic range: Lobster fishing is prohibited within the NWHI.

Seasons: In the MHI, open season is from September through April.

Gear type: One string consists of approximately 100-fathom-plus plastic lobster traps. About 10 such strings are pulled and set each day. Since 1987 escape vents that allow small lobsters to escape from the trap have been mandatory. In 1996, the fishery became “retain all”, i.e. there are no size limits or prohibitions on the retention of berried female lobsters. The entry-way of the lobster trap must be less than 6.5 inches to prevent monk seals from getting their heads stuck in the trap. In the MHI, rigid trap materials must have a dimension greater than 1 inch by 2 inches, with the trap not exceeding 10 feet by six feet.

Regulations: The MHI fishery is managed by the State of Hawaii, Division of Aquatic Resources with season and gear restrictions (see above).

Management type: A commercial marine license issued by the Hawaii Department of Land and Natural Resources, Division of Aquatic Resources (DAR) is required for all commercial fishing activities in Hawaii State waters. The Fishery Ecosystem Plan for the Hawaii Archipelago contains no management measures applicable to this gear.

Category III, Hawaii shrimp trap fishery.

Number of active permit holders: In 2011 there were 4 active commercial fishers

Total effort: In 2011 there were 69 shrimp trap trips.

Seasons: unknown.

Gear type: Fishing with any of various fishing devices made into the shape of a box, container, or enclosure, with one or more openings that allow marine life to enter but not exit.

Regulations: State regulations specify a minimum mesh size for traps: netting must be a minimum of 2 inches stretched mesh, and rigid material must be a minimum of 2 inches by 1 inch. Entrance cones for traps have no minimum mesh size. Traps must be portable and not exceed 10 feet in length or 6 feet in height or width.

Management type: A commercial marine license issued by the Hawaii Department of Land and Natural Resources, Division of Aquatic Resources (DAR) is required for all commercial fishing activities in Hawaii State waters. The Fishery Ecosystem Plan for the Hawaii Archipelago contains no management measures applicable to this gear. *Heterocarpus* shrimp are a federally managed complex caught by traps and are subject to annually set Annual Catch Limits.

Category III, Hawaii crab net fishery.

Number of active permit holders: In 2011 there were 6 active commercial fishers

Total effort: In 2011 there were 61 crab net trips.

Seasons: unknown.

Gear type: Fishing normally with a small circular lift net that is used to catch crabs. Ring nets set manually from the shoreline, mainly in estuarine areas. The nets are used singly, and are not connected with a ground line. Gear is typically tended.

Regulations: Managed under State of Hawaii regulations.

Management type: A commercial marine license issued by the Hawaii Department of Land and Natural Resources, Division of Aquatic Resources (DAR) is required for all commercial fishing activities in Hawaii State waters. The Fishery Ecosystem Plan for the Hawaii Archipelago contains no management measures applicable to this gear.

Category III, Hawaii Kona crab net fishery.

Number of active permit holders: In 2011 there were 48 active commercial fishers

Total effort: In 2011 there were 179 Kona crab trips.

Seasons: Closed during breeding season May-August

Regulations: Only male crabs of at least 4 inches carapace length may be retained.

Management type: A commercial marine license issued by the Hawaii Department of Land and Natural Resources, Division of Aquatic Resources (DAR) is required for all commercial fishing activities in Hawaii State waters. The Fishery Ecosystem Plan for the Hawaii Archipelago contains no management measures applicable to this gear.

Category III, aku boat- pole and line fishery.

Number of active permit holders: In 2011 there were 3 active commercial fishers

Total effort: In 2011 there were 86 aku boat trips.

Seasons: unknown.

Gear type: Fishing for aku (skipjack tuna) using live bait (such as nehu or iao) and or artificial lures. Generally live bait and/or water is flung or sprayed out from the stern of the (often drifting) vessel to "chum up the school" and get them feeding. Fishers on the stern of the boat often jig and slap the water with their poles to increase surface feeding behavior. Fish are hooked with pole and line, using a barbless hook (feathered, baited or not).

Regulations: Managed under State of Hawaii regulations. Specific licenses administered by DAR for the taking of baitfish and nehu (Hawaiian anchovy) for baiting purposes may be required. No baitfish may be sold or transferred except for bait purposes and licensees must furnish monthly baitfish catch reports to the DAR.

Management type: A commercial marine license issued by the Hawaii Department of Land and Natural Resources, Division of Aquatic Resources (DAR) is required for all commercial fishing activities in Hawaii State waters. This fishery is also managed under the Federal Pacific Pelagics Fishery Ecosystem Plan outside of 3 nmi from shore.

Category III, Hawaii Main Hawaiian Islands deep sea bottomfish handline fishery.

Note: The Hawaii bottomfish complex is a U.S. fishery management unit comprised primarily of several species of snappers and jacks and a grouper inhabiting waters of the Hawaiian Archipelago. The federal fisheries management regime includes three fishing zones: the main Hawaiian Islands (MHI) Zone, and two zones in the Northwestern Hawaiian Islands, the Mau Zone and the Hoomalu Zone. All bottomfish fishing currently takes place in the MHI zone due to the closure of the Northwestern Hawaiian Islands under Presidential Proclamation 8031. The main Hawaiian Islands bottomfish fishery is managed jointly by NMFS and the State of Hawaii.

Number of permit holders: In 2010 there were 569 active commercial fishers.

Total effort: From 2008 to 2010 in the MHI the reported average annual catch was 221,500 lbs., with an additional 44,300 to 553,700 lbs. estimated to have been caught but not reported[6]

Seasons: Fishing occurs year-round, but effort is concentrated in the late fall and winter and peaks during periods of low wind and sea conditions.

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[6] Brodziak, J., D. Courtney, L. Wagatsuma, J. O'Malley, H-H. Lee, W. Walsh, A. Andrews, R. Humphreys, and G. DiNardo. 2011. Stock assessment of the main Hawaiian Islands Deep7 bottomfish complex through 2010. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-PIFSC-29, 176 p. + Appendix

Gear type: This fishery is a hook-and-line fishery that takes place in deep water. In the MHI the vessels are smaller than 30 ft and trips last from 1 to 3 days.

Regulations: In the MHI, the sale of snappers (opakapaka, onaga and uku) and jacks less than one pound is prohibited. In June of 1998, Hawaii Division of Aquatic Resources (HDAR) closed 19 areas to bottomfishing, and regulations pertaining to seven species (onaga, opakapaka, ehu, kalekale, gindai, hapuupuu and lehi) were enacted. Total Allowable Catch (TAC) limits have been established for the "Deep-7" bottomfish species; these are the 7 primary species targeted by the commercial fleet. The TAC applies to both commercial and non-commercial sectors of the fishery. To ensure the TAC is not exceeded, NMFS and the State of Hawaii monitor the catch of Deep-7 bottomfish during the annual fishing season. Annual TAC quota for Hawaii Restricted Bottomfish Species specified in Federal Register by August 31st each year.

Management type: The portion of the fishery in Federal waters is managed under the Fishery Ecosystem Plan for the Hawaiian Archipelago, and operates under an annual catch limit. The fishery is co-managed with the State of Hawaii, which has adopted complementary measures in State waters.

Comments: The deep-slope bottomfish fishery in Hawaii concentrates on species of eteline snappers, carangids, and a single species of grouper concentrated at depths of 30-150 fathoms. These fish have been fished on a subsistence basis since ancient times and commercially for at least 90 years. Effort in this fishery increases significantly around the Christmas season because a target species, a true snapper, is typically sought for cultural festivities.[11]

Category III, Hawaii inshore handline fishery.

Number of active permit holders: In 2011 there were 378 active commercial fishers

Total effort: In 2011 there were 4,577 inshore handline trips.

Seasons: unknown.

Gear type: Fishing from a vessel using a vertical mainline with single/multiple lures or baited hooks and weight, lowered near the bottom to include drifting for octopus (tako) while using a handline. Fishing tackle usually consists of lighter gear than deep-sea handline. Line can be retrieved manually or by any other powered method. This fishery occurs in nearshore and coastal pelagic regions.

Regulations: Managed under State of Hawaii regulations.

Management type: A commercial marine license issued by the Hawaii Department of Land and Natural Resources, Division of Aquatic Resources (DAR) is required for all commercial fishing activities in Hawaii State waters. The Pacific Pelagics Fishery Ecosystem Plan contains no management measures applicable to this gear.

Comments: The principal catches include reef fishes and big-eyed scad (akule) and mackerel scad (opelu). Bottlenose dolphins and rough-toothed dolphins have been reported as depredating bait or catch from handlines (Shallenberger 1981, Nitta and Henderson 1993). Depredation behavior may increase the risk of marine mammals becoming hooked or entangled.

Category III, Hawaii tuna handline ~~and jig~~ fishery.

Number of active permit holders: In 2011 there were 498 active commercial fishers.

Total effort: In 2011 there were 4,619 trips classified as one of the three tuna handline methods, 74 hybrid, 1,626 ika-shibi, and 2,919 palu-ahi.

Seasons: unknown.

Gear type: Palu-ahi tuna handline fishing usually takes place during the daytime. Sometimes instead of using lead weights, the baited hook and cut pieces of bait ("chum") are laid on a stone and the leader is wrapped around the stone and secured with a slipknot. The line wrapped stone is then lowered to the desired depth, where a tug on the line releases the slipknot, dispersing the chum and releasing the baited hook. The stone falls to the bottom, leaving the line free to be worked by the fisherman. This method also includes the use of "danglers" for reporting purposes. Iki-shibi tuna handline fishing occurs mainly at night also using a vertical mainline with high-test monofilament leader, from which is suspended a single baited hook. A weight may be used between the mainline and leader, with four or more lines usually attached to the vessel by breakaway links. A sea anchor is used to control and slow (at times stop) the drift of the vessel. A small light is usually suspended from the boat to attract muhe'e ("true squid") or opelu, typically used as bait. Line may be hauled manually, mechanically or by any powered method. Hybrid tuna handline fishing is a unique mixture of fishing methods used to catch pelagic species primarily on offshore seamounts and near NOAA weather buoys. It is generally a combination of methods which could include handlining, trolling, baiting techniques and other methods which are used simultaneously.

Regulations: Managed under State of Hawaii regulations.

Management type: A commercial marine license issued by the Hawaii Department of Land and Natural Resources, Division of Aquatic Resources (DAR) is required for all commercial fishing activities in Hawaii State waters. The Fishery Ecosystem Plan for the Hawaii Archipelago contains no management measures applicable to this gear.

Comments: This fishery occurs around offshore fish aggregating devices and mid-ocean seamounts and pinnacles. The principal catches are small to medium sized bigeye, yellowfin and albacore tuna. There are several types of handline methods in the Hawaiian fisheries. Baited lines with chum are used in day fishing operations (palu-ahi), another version uses squid as bait during night operations (ika-shibi), and an operation called "danglers" uses multiple lines with artificial lures suspended or dangled over the water. Bottlenose dolphins and rough-toothed dolphins have been reported as depredating bait or catch from handlines (Shallenberger 1981, Nitta and Henderson 1993). Depredation behavior may increase the risk of marine mammals becoming hooked or entangled.

Category III, Hawaii spearfishing fishery.

Number of active permit holders: In 2011 there were 143 active commercial fishers

Total effort: In 2011 there were 2,142 spearfishing trips.

Seasons: unknown.

Gear type: Fishing with a shaft with one or more sharpened points at one end usually associated with diving. Includes bow and torch fishing.

Regulations: Managed under State of Hawaii regulations.

Management type: A commercial marine license issued by the Hawaii Department of Land and Natural Resources, Division of Aquatic Resources (DAR) is required for all commercial fishing activities in Hawaii State waters. The Fishery Ecosystem Plan for the Hawaii Archipelago contains no management measures applicable to this gear.

Comments: Interactions have been documented with Hawaiian monk seals.

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Table 1. Characteristics of Category I and Category II gillnet fisheries in California.

Fishery	Species	Mesh Size	Water Depth	Set Duration	Deployment	Miscellaneous
Category I CA/OR thresher shark and swordfish drift gillnet fishery	swordfish/shark	14 to 22 inches	Ranges from 90 to 4600 meters	Typically 8 to 15 hrs	Drift net only	Nets 500 to 1800 meters in length; other species caught: opah, louver, tuna, thresher, blue shark, mako shark
Category I CA halibut and white seabass set gillnet fishery (>3.5 inch mesh)	Halibut	8.5 inch	< 70 meters	24 hrs	Set net	
	Barracuda	3.5 inch		< 12 hrs	Drift net	April – July
	Leopard Shark	7.0 to 9.0 inch	< 90 meters			Fished similar to halibut.
	Perch/Croaker	3.5 to 4.0 inch	< 40 meters	< 24 hrs	Set net	Few boats target these species
	Rockfish	4.5 to 7.5 inch	> 90 meters	12 to 18 hrs	Set net	Net lengths 450 to 1800 meters. Soupfin shark is major bycatch.
	Soupfin shark/white seabass	6.0 to 8.5 inch	> 50 meters	24 hrs	Set net	Few boats target this species.
	Miscellaneous shark	6.0 to 14 inch	< 70 meters	8 to 24 hrs	Drift, some set net	Species include thresher and swell sharks.
Category II CA Yellowtail, barracuda, white seabass, and tuna drift gillnet fishery	White seabass, yellowtail, barracuda, white seabass, and tuna	Typically 6.5 inch	15 to 90 meters	8 to 24 hrs	Mostly drift net	White seabass predominant target species.

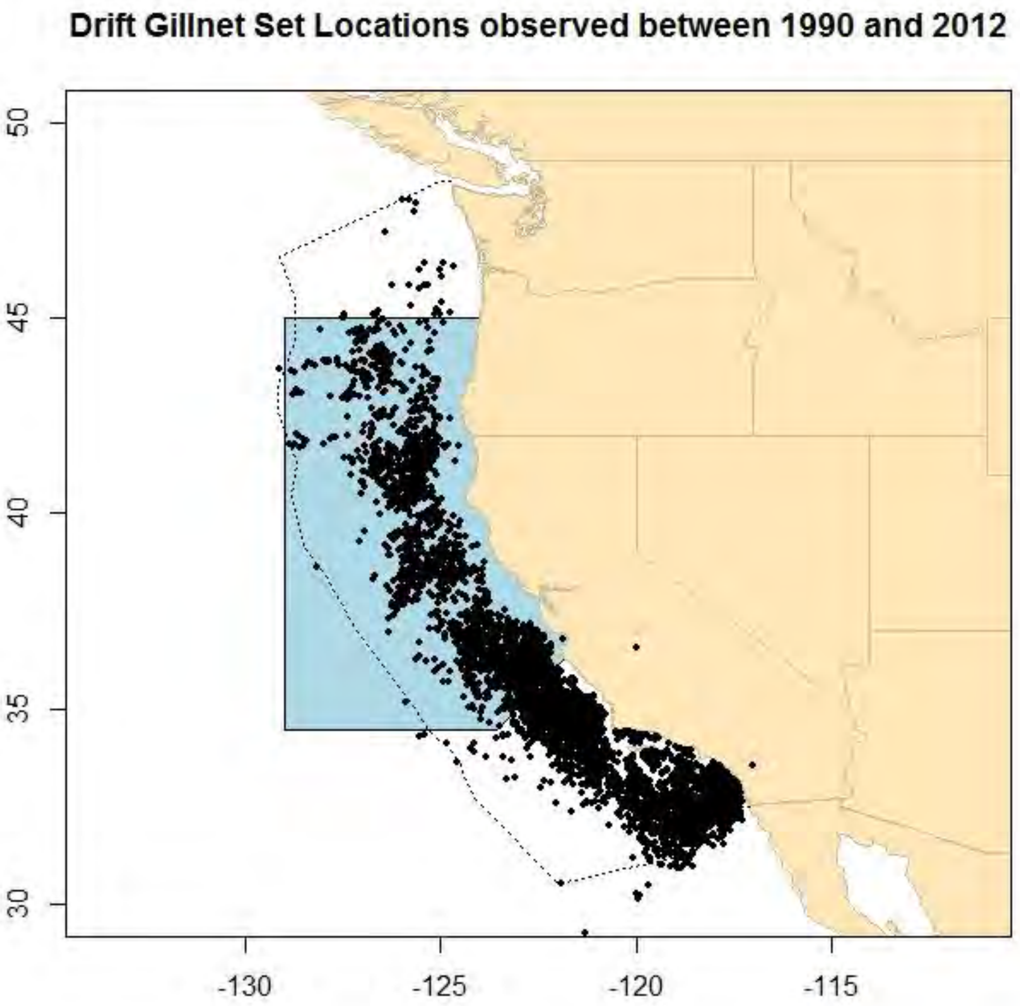

Figure 1. Locations of 8,365 sets observed in the California/Oregon large-mesh drift gillnet fishery for thresher shark and swordfish, 1990- 2012. The area in blue has been closed to gillnetting from 15 August to 15 November each year since 2001 to protect leatherback turtles. The outer dashed line represents the U.S. Exclusive Economic Zone. Observed sets represent approximately 15% of all fishing effort during the period 1990 to 2012, where the total estimate of fishing effort is approximately 53,000 sets.

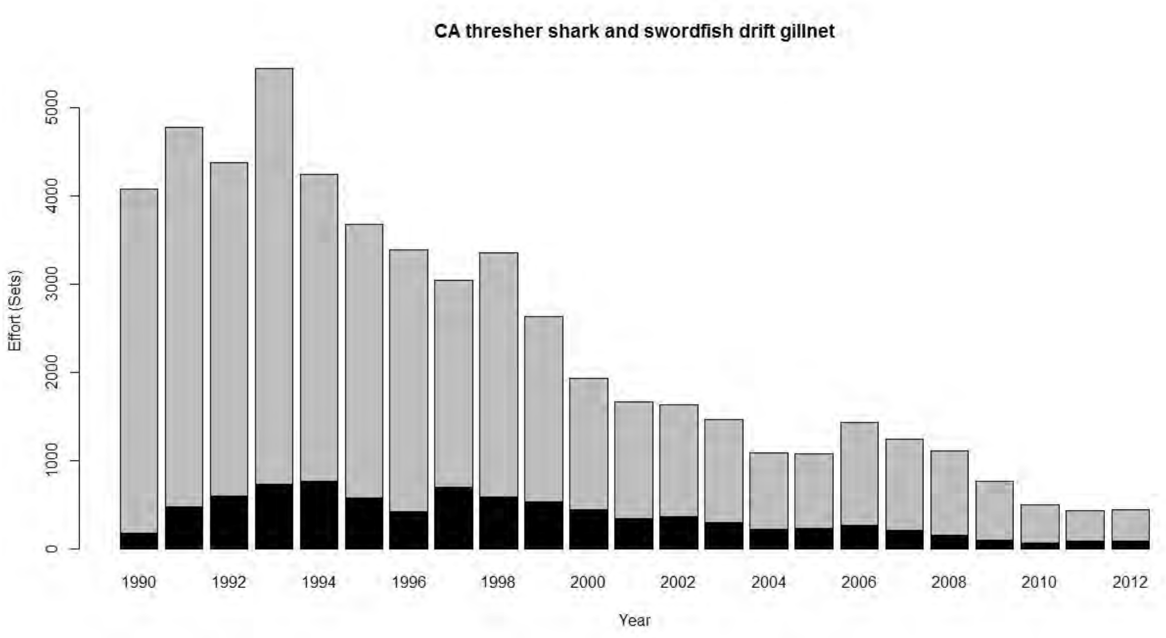

Figure 2. Estimated (gray) and observed (black) days of fishing effort for 1990-2012 in the California/Oregon thresher shark/swordfish drift gillnet fishery (≥ 14 inch mesh). One fishing day is equal to one set in this fishery. The approximate observer coverage during this period has been 15% (Carretta and Barlow 2011).

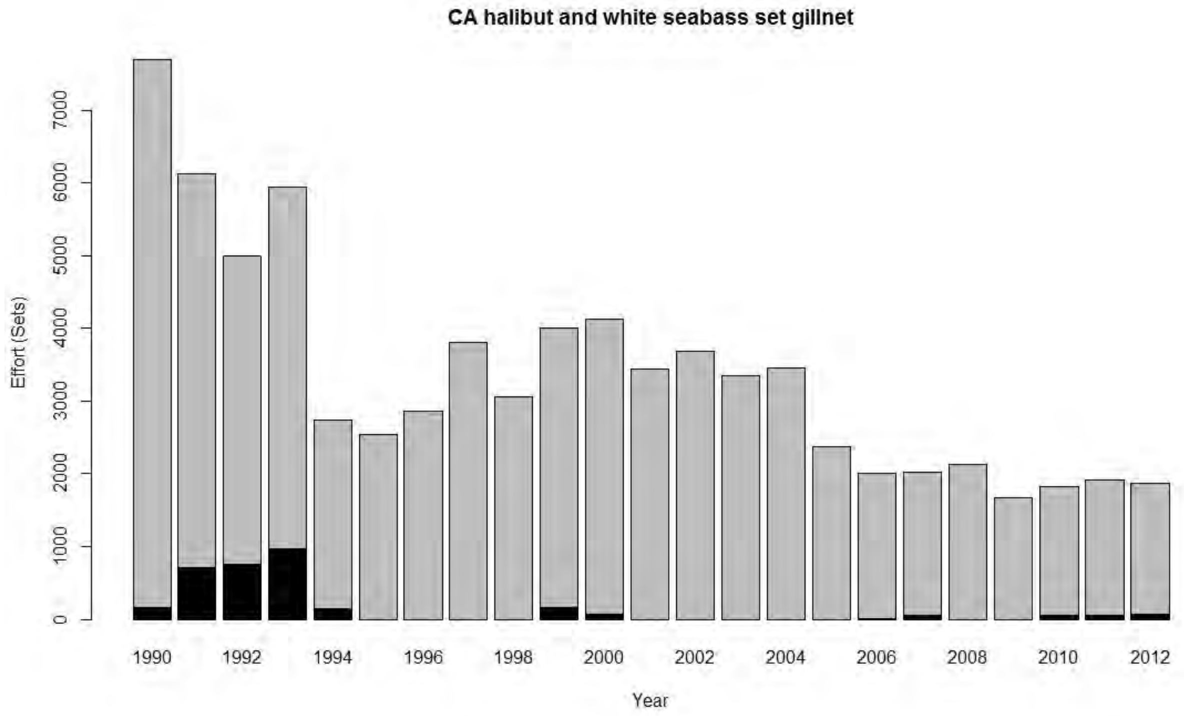

Figure 3. Estimated (gray) and observed (black) days of fishing effort for 1990- 2012 in the California halibut/white seabass set gillnet fishery (> 3.5 inch mesh). The fishery has been observed only sporadically since 1994.

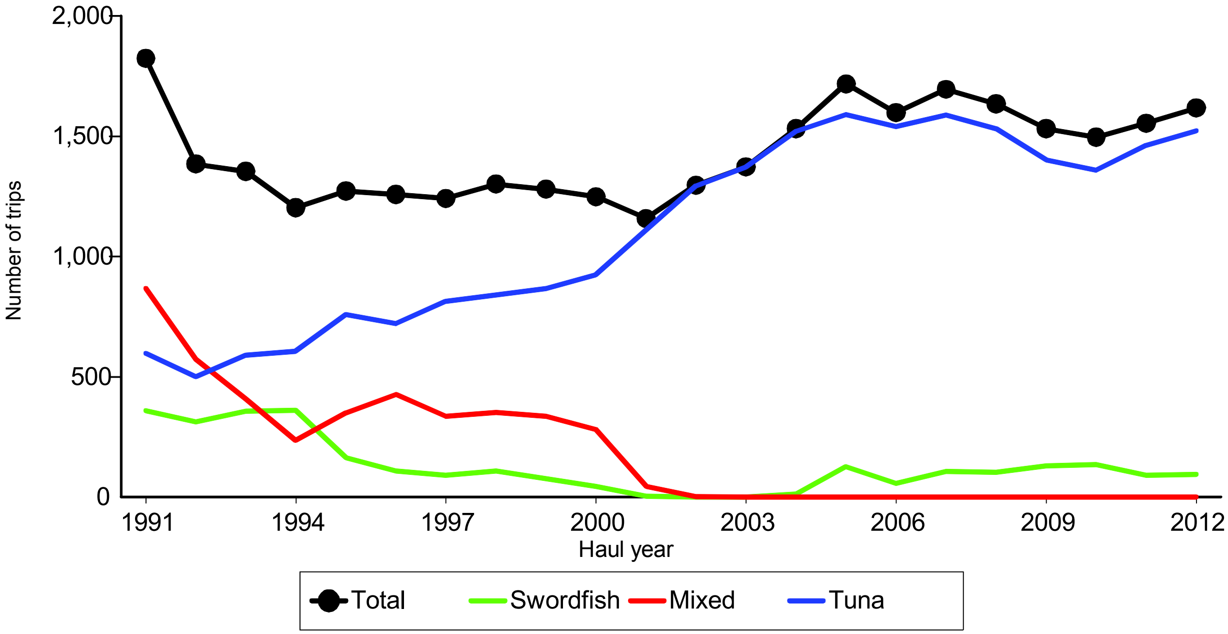

Figure 4. Number of fishing trips by longline vessels based and landing in Hawaii, by year and trip type, 1991-2012. Source: http://www.pifsc.noaa.gov/fmb/reports.php.

Appendix 2. Cetacean Survey Effort

Documentation of cetacean abundance estimates used in the 2008 draft Pacific Marine Mammal Stock Assessments.

Cetacean abundance estimates reported in the Pacific Marine Mammal Stock Assessments originate from several sources: vessel line-transect surveys of U.S. west coast and Pacific Island Exclusive Economic Zone (EEZ) waters (Barlow 2006, Barlow and Rankin 2007, Barlow and Forney 2007, Forney 2007); aerial line-transect surveys of harbor porpoises (Carretta and Forney 2004, Laake et al. 1998); photographic mark-recapture analyses of large whales (Calambokidis et al. 2007); Hawaiian small cetaceans (Baird et al. 2005); and southern resident killer whales (Center For Whale Research, unpublished data). Often, multiple abundance estimates are available for a given cetacean stock and decisions about which estimates to utilize in the stock assessment report must be made, based on what is known about the stock. Considerable interannual variability in abundance estimates can occur because the range of many cetacean stocks extends beyond the U.S. EEZ boundaries where surveys are conducted. For this reason, multi-year averages are utilized in the stock assessments when possible.

Abundance estimates for U.S. west coast coast cetacean stocks are available in two separate publications (Barlow and Forney 2007, Forney 2007). The Barlow and Forney (2007) paper presents a 1991-2005 time series of abundance estimates, based on large-scale vessel line-transect surveys of California, Oregon, and Washington waters out to 300 nmi. The Forney (2007) report presents estimates from a 2005 vessel line transect survey that is included in the Barlow and Forney (2007) paper, however, the Forney (2007) report includes additional analyses from fine-scale strata from coastal waters of the Olympic, Farallones, and Monterey Bay National Marine Sanctuaries. These coastal strata appear to represent seasonally important habitat for some species as Dall's porpoise, northern right whale dolphin, humpback whales, Pacific white-sided dolphin, and blue whales. Inclusion of these coastal strata resulted in improved estimates of abundance for several species and thus, the Forney (2007) report is used for reporting 2005 abundance estimates, while the Barlow and Forney (2007) paper is used for 2001 estimates. For most U.S. west coast cetaceans, average abundances reported in the draft 2008 Pacific Marine Mammal Stock Assessments represent the geometric mean* of 2001 estimates reported by Barlow and Forney (2007) and 2005 estimates reported by Forney (2005). In the case of humpback and blue whales, mark-recapture estimates may sometimes be substituted for line-transect estimates if the precision of the mark-recapture estimate is superior.

* Current stock assessment preparation guidelines currently recommend reporting a weighted arithmetic mean, weighted by the inverse of the variances of the individual abundance estimates. However, the authors of the Pacific stock assessment reports have found that the unweighted geometric mean is a more appropriate measure of mean abundance for cases where estimates are log-normally distributed. The problem with the weighted arithmetic mean is easily understood by example. Consider a case where two equally precise abundance estimates are available; one relatively large, the other small (e.g., $N_1 = 20,000$, $CV_1 = 0.3$; $N_2 = 5,000$, $CV_2 = 0.3$). Calculating a mean abundance using the inverse variance method arbitrarily underweights the larger estimate (due to its larger variance), resulting in a negatively biased mean estimate ($N_{mean} = 5,882$). By comparison, the geometric mean of the two estimates is $N_{geomean} = 10,000$, which is equivalent to calculating the mean of the logarithms of N_1 and N_2.

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Appendix 3. Pacific reports revised in 2016 are highlighted. S=strategic stock, N=non strategic stock. unk=unknown, undet=undetermined, n/a=not applicable.

Species (Stock Area)	N est	CV N est	N min	R max	Fr	PBR	Total Annual Mortality + Serious Injury	Annual Fishery Mortality + Serious Injury	Strategic Status	Recent Abundance Surveys			SAR Last Revised
California sea lion (U.S.)	296,750	n/a	153,337	0.12	1	9,200	389	331	N	2007	2008	2011	2014
Harbor seal (California)	30,968	n/a	27,348	0.12	1	1,641	43	30	N	2004	2009	2012	2014
Harbor seal (Oregon/Washington Coast)	unk	unk	unk	0.12	1	undet	10.6	7.4	N	1999			2013
Harbor seal (Washington Northern Inland Waters)	unk	unk	unk	0.12	1	undet	9.8	2.8	N	1999			2013
Harbor seal (Southern Puget Sound)	unk	unk	unk	0.12	1	undet	3.4	1	N	1999			2013
Harbor seal (Hood Canal)	unk	unk	unk	0.12	1	undet	0.2	0.2	N	1999			2013
Northern Elephant Seal (California Breeding)	179,000	n/a	81,368	0.12	1	4,882	8.8	4	N	2002	2005	2010	2014
Guadalupe Fur Seal (Mexico to California)	20,000	n/a	15,830	0.137	0.5	542	≥3.2	≥3.2	S	2008	2009	2010	2016
Northern Fur Seal (California)	14,050	n/a	7,524	0.12	1	451	1.8	≥0.8	N	2010	2011	2013	2015
Monk Seal (Hawaii)	1,272	n/a	1,205	0.07	0.1	undet	≥2.8	≥1.2	S	2011	2013	2014	2016
Harbor porpoise (Morro Bay)	2,917	0.41	2,102	0.04	0.5	21	≥0.6	≥0.6	N	2002	2007	2012	2013
Harbor porpoise (Monterey Bay)	3,715	0.51	2,480	0.04	0.5	25	0	0	N	2002	2007	2011	2013
Harbor porpoise (San Francisco - Russian River)	9,886	0.51	6,625	0.04	0.5	66	0	0	N	2002	2007	2011	2013
Harbor porpoise (Northern CA/Southern OR)	35,769	0.52	23,749	0.04	1	475	≥0.6	≥0.6	N	2002	2007	2011	2013
Harbor porpoise (Northern OR/Washington Coast)	21,487	0.44	15,123	0.04	0.5	151	≥3.0	≥3.0	N	2002	2010	2011	2013
Harbor porpoise (Washington Inland Waters)	11,233	0.37	8,308	0.04	0.4	66	≥7.2	≥7.2	N	2013	2014	2015	2016
Dall’s porpoise (California/Oregon/Washington)	25,750	0.45	17,954	0.04	0.48	172	0.3	0.3	N	2005	2008	2014	2016
Pacific white-sided dolphin (California/Oregon/Washington)	26,814	0.28	21,195	0.04	0.45	191	7.5	1.1	N	2005	2008	2014	2016
Risso’s dolphin (California/Oregon/Washington)	6,336	0.32	4,817	0.04	0.48	46	≥3.7	≥3.7	N	2005	2008	2014	2016
Common Bottlenose dolphin (California Coastal)	453	0.06	346	0.04	0.48	2.7	≥2.0	≥1.6	N	2009	2010	2011	2016
Common Bottlenose dolphin (California/Oregon/Washington Offshore)	1,924	0.54	1,255	0.04	0.45	11	≥1.6	≥1.6	N	2005	2008	2014	2016
Striped dolphin (California/Oregon/Washington)	29,211	0.20	24,782	0.04	0.48	238	≥0.8	≥0.8	N	2005	2008	2014	2016
Common dolphin, short-beaked (California/Oregon/Washington)	969,861	0.17	839,325	0.04	0.5	8,393	≥40	≥40	N	2005	2008	2014	2016
Common dolphin, long-beaked (California)	101,305	0.49	68,432	0.04	0.48	657	≥35.4	≥32.0	N	2005	2008	2014	2016
Northern right whale dolphin (California/Oregon/Washington)	26,556	0.44	18,608	0.04	0.48	179	3.8	3.8	N	2005	2008	2014	2016
Killer whale (Eastern N Pacific Offshore)	240	0.49	162	0.04	0.5	1.6	0	0	N	2005	2008	2014	2016
Killer whale (Eastern N Pacific Southern Resident)	81	n/a	81	0.035	0.1	0.14	0	0	S	2013	2014	2015	2016
Short-finned pilot whale (California/Oregon/Washington)	836	0.79	466	0.04	0.48	4.5	1.2	1.2	N	2005	2008	2014	2016
Baird’s beaked whale (California/Oregon/Washington)	847	0.81	466	0.04	0.5	4.7	0	0	N	2001	2005	2008	2013
Mesoplodont beaked whales (California/Oregon/Washington)	694	0.65	389	0.04	0.5	3.9	0	0	S	2001	2005	2008	2013
Cuvier’s beaked whale (California/Oregon/Washington)	6,590	0.55	4,481	0.04	0.5	45	0	0	S	2001	2005	2008	2013
Pygmy Sperm whale (California/Oregon/Washington)	4,111	1.12	1,924	0.04	0.5	19	0	0	N	2005	2008	2014	2016

Appendix 3. Pacific reports revised in 2016 are highlighted. S=strategic stock, N=non strategic stock. unk=unknown, undet=undetermined, n/a=not applicable.

Species (Stock Area)	N est	CV N est	N min	R max	Fr	PBR	Total Annual Mortality + Serious Injury	Annual Fishery Mortality + Serious Injury	Strategic Status	Recent Abundance Surveys			SAR Last Revised
Dwarf sperm whale (California/Oregon/Washington)	unk	unk	unk	0.04	0.5	undet	0	0	N	2005	2008	2014	2016
Sperm whale (California/Oregon/Washington)	2,106	0.58	1,332	0.04	0.1	2.7	1.7	1.7	S	2001	2005	2008	2014
Gray whale (Eastern N Pacific)	20,990	0.05	20,125	0.062	1.0	624	132	4.25	N	2009	2010	2011	2014
Gray whale (Western N Pacific)	140	0.04	135	0.062	0.1	0.06	unk	unk	S			2011	2014
Humpback whale (California/Oregon/Washington)	1,918	0.03	1,876	0.08	0.3	11.0	≥ 6.5	≥ 5.3	S	2005	2008	2014	2016
Blue whale (Eastern N Pacific)	1,647	0.07	1,551	0.04	0.3	2.3	0.9	0	S	2005	2008	2011	2015
Fin whale (California/Oregon/Washington)	9,029	0.12	8,127	0.04	0.5	81	≥ 2.0	≥ 0.2	S	2005	2008	2014	2016
Sei whale (Eastern N Pacific)	519	0.4	374	0.04	0.1	0.75	0	0	S	2005	2008	2014	2016
Minke whale (California/Oregon/Washington)	636	0.72	369	0.04	0.48	3.5	≥ 1.3	≥ 1.3	N	2005	2008	2014	2016
Bryde’s whale (Eastern Tropical Pacific)	unk	unk	unk	0.04	0.5	undet	unk	unk	N	n/a	n/a	n/a	2015
Rough-toothed dolphin (Hawaii)	6,288	0.39	4,581	0.04	0.5	46	unk	unk	N		2002	2010	2013
Rough-toothed dolphin (American Samoa)	unk	unk	unk	0.04	0.5	undet	unk	unk	unk	n/a	n/a	n/a	2010
Risso’s dolphin (Hawaii)	7,256	0.41	5,207	0.04	0.5	42	0.6	0.6	N		2002	2010	2013
Common Bottlenose dolphin (Hawaii Pelagic)	5,950	0.59	3,755	0.04	0.5	38	0.2	0.2	N		2002	2010	2013
Common Bottlenose dolphin (Kaua'i and Ni'ihau)	184	0.11	168	0.04	0.5	1.7	unk	unk	N	2003	2004	2005	2013
Common Bottlenose dolphin (O'ahu)	743	0.54	485	0.04	0.5	4.9	unk	unk	N	2002	2003	2006	2013
Common Bottlenose dolphin (4 Islands Region)	191	0.24	156	0.04	0.5	1.6	unk	unk	N	2002	2003	2006	2013
Common Bottlenose dolphin (Hawaiian Island)	128	0.13	115	0.04	0.5	1.1	unk	unk	N	2002	2003	2006	2013
Pantropical Spotted dolphin (Hawaii Pelagic)	15,917	0.40	11,508	0.04	0.5	115.0	0	0	N		2002	2010	2013
Pantropical Spotted dolphin (O'ahu)	unk	unk	unk	0.04	0.5	undet	unk	unk	N			n/a	2013
Pantropical Spotted dolphin (4 Islands Region)	unk	unk	unk	0.04	0.5	undet	unk	unk	N			n/a	2013
Pantropical Spotted dolphin (Hawaii Island)	unk	unk	unk	0.04	0.5	undet	unk	unk	N			n/a	2013
Spinner dolphin (Hawaii Pelagic)	unk	unk	unk	0.04	0.5	undet	0	0	N		2002	2010	2013
Spinner dolphin (Hawaii Island)	631	0.04	585	0.04	0.5	5.9	unk	unk	N	1994	2003	2011	2013
Spinner dolphin (O'ahu / 4 Islands)	355	0.09	329	0.04	0.5	3.3	unk	unk	N	1993	1998	2007	2013
Spinner dolphin (Kaua'i / Ni'ihau)	601	0	509	0.04	0.5	5.1	unk	unk	N	1995	1998	2005	2013
Spinner dolphin (Kure / Midway)	unk	unk	unk	0.04	0.5	undet	unk	unk	N		1998	2010	2013
Spinner dolphin (Pearl and Hermes Reef)	unk	unk	unk	0.04	0.5	undet	unk	unk	N			n/a	2013
Spinner dolphin (American Samoa)	unk	unk	unk	0.04	0.5	undet	unk	unk	unk			n/a	2010
Striped dolphin (Hawaii Pelagic)	20,650	0.36	15,391	0.04	0.5	154	unk	unk	N		2002	2010	2013
Fraser’s dolphin (Hawaii)	16,992	0.66	10,241	0.04	0.5	102	0	0	N		2002	2010	2010
Melon-headed whale (Hawaiian Islands)	5,794	0.20	4,904	0.04	0.5	49	0	0	N		2002	2010	2013

Appendix 3. Pacific reports revised in 2016 are highlighted. S=strategic stock, N=non strategic stock. unk=unknown, undet=undetermined, n/a=not applicable.

Species (Stock Area)	N est	CV N est	N min	R max	Fr	PBR	Total Annual Mortality + Serious Injury	Annual Fishery Mortality + Serious Injury	Strategic Status	Recent Abundance Surveys			SAR Last Revised
Melon-headed whale (Kohala Resident)	447	0.12	404	0.04	0.5	4.0	0	0	N			2009	2013
Pygmy killer whale (Hawaii)	3,433	0.52	2,274	0.04	0.5	23.0	0	0	N		2002	2010	2013
False killer whale (NW Hawaiian Islands)	617	1.11	290	0.04	0.4	2.3	0.4	0.4	N			2010	2016
False killer whale (Hawaii Pelagic)	1,540	0.66	928	0.04	0.5	9.3	10.3	10.3	S		2002	2010	2016
False killer whale (Palmyra Atoll)	1,329	0.65	806	0.04	0.4	6.4	0.3	0.3	N			2005	2013
False killer whale (Main Hawaiian Islands Insular)	151	0.20	92	0.04	0.1	0.18	0.1	0.1	S	2012	2013	2014	2016
False killer whale (American Samoa)	unk	unk	unk	0.04	0.5	undet	unk	unk	unk	n/a	n/a	n/a	2010
Killer whale (Hawaii)	101	1.00	50	0.04	0.5	1.0	0	0	N		2002	2010	2013
Pilot whale, short-finned (Hawaii)	12,422	0.43	8,782	0.04	0.4	70	0.1	0.1	N		2002	2010	2013
Blainville’s beaked whale (Hawaii Pelagic)	2,338	1.13	1,088	0.04	0.5	11.0	0	0	N		2002	2010	2013
Longman's Beaked Whale (Hawaii)	4,571	0.65	2,773	0.04	0.5	28.0	0	0	N		2002	2010	2013
Cuvier’s beaked whale (Hawaii Pelagic)	1,941		1,142	0.04	0.5	11.4	0	0	N		2002	2010	2013
Pygmy sperm whale (Hawaii)	unk	unk	unk	0.04	0.5	undet	0	0	N		2002	2010	2013
Dwarf sperm whale (Hawaii)	unk	unk	unk	0.04	0.5	undet	0	0	N		2002	2010	2013
Sperm whale (Hawaii)	3,354	0.34	2,539	0.04	0.1	10.2	0.7	0.7	S		2002	2010	2013
Blue whale (Central N Pacific)	81	1.14	38	0.04	0.1	0.1	0	0	S		2002	2010	2013
Fin whale (Hawaii)	58	1.12	27	0.04	0.1	0.1	0	0	S		2002	2010	2013
Bryde’s whale (Hawaii)	798	0.28	633	0.04	0.5	6.3	0	0	N		2002	2010	2013
Sei whale (Hawaii)	178	0.90	93	0.04	0.1	0.2	0.2	0.2	S		2002	2010	2013
Minke whale (Hawaii)	unk	unk	unk	0.04	0.5	undet	0	0	N		2002	2010	2013
Humpback whale (American Samoa)	unk	unk	150	0.106	0.1	0.4	0	0	S	2006	2007	2008	2009
Sea Otter (Southern)	2,826	n/a	2,723	0.06	0.1	8	≥0.8	≥0.8	S	2006	2007	2008	2008
Sea Otter (Washington)	n/a	n/a	1,125	0.2	0.1	11	≥0.2	≥0.2	N	2006	2007	2008	2008

SOUTHERN SEA OTTER (*Enhydra lutris nereis*)

U.S. Fish and Wildlife Service, Ventura, California

STOCK DEFINITION AND GEOGRAPHIC RANGE

Southern sea otters are listed as threatened under the Endangered Species Act. They occupy nearshore waters along the mainland coastline of California from San Mateo County to Santa Barbara County (Figure 1). A small colony of southern sea otters also exists at San Nicolas Island, Ventura County, as a result of translocation efforts initiated in 1987. Under Public Law 99-625, the San Nicolas Island colony was formerly considered to be an experimental population (52 FR 29754; August 11, 1987), but the experimental population designation was removed upon termination of the translocation program and its respective translocation and management zones (77 FR 75266; December 19, 2012). With the termination of the translocation program, the special status afforded to southern sea otters within the management and translocation zones pursuant to Public Law 99-625 also ended.

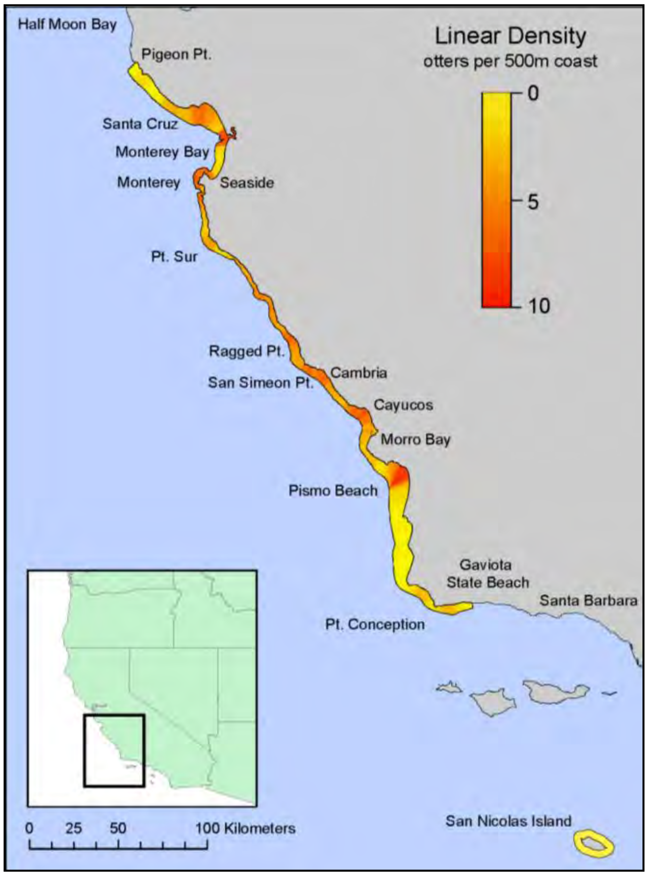

Figure 1. Current range of the southern sea otter (2013 census). Source: U.S. Geological Survey, http://www.werc.usgs.gov/seaottercount

Historically, southern sea otters ranged from Punta Abreojos, Baja California, Mexico to Oregon (Valentine *et al.* 2008), or possibly as far north as Prince William Sound, Alaska (reviewed in Riedman and Estes 1990). During the 1700s and 1800s, the killing of sea otters for their pelts extirpated the subspecies throughout most of its range. A small population of southern sea otters survived near Bixby Creek in Monterey County, California, numbering an estimated 50 animals in 1914 (Bryant 1915). Since receiving protection under the International Fur Seal Treaty in 1911, southern sea otters have gradually expanded northward and southward along the central California coast. The estimated carrying capacity of California is approximately 16,000 animals (Laidre *et al.* 2001).

Sea otter abundance varies considerably across the range, with the highest densities occurring in the center part of the range (Monterey peninsula to Estero Bay), where sea otters have been present for the longest. Sea otter densities tend to be most stable from year-to-year in rocky, kelp-dominated areas that are primarily occupied by females, dependent pups, and territorial males. In contrast, sandy and soft-bottom habitats (in particular those in Monterey Bay, Estero Bay, and Pismo Beach to Pt. Sal) tend to be occupied by non-territorial males and sub-adult animals of both sexes (but rarely by adult females and pups) and are more variable in abundance from year to year.[1] This variation is apparently driven in part by the long-distance movements and seasonal redistribution of males (Tinker *et al.* 2006a). The variability of counts at the south end of the range is also related to seasonal movements: many males migrate to the range peripheries during the winter and early spring, apparently to take advantage of more abundant prey resources, but then return to the range center during the period when most breeding occurs (June to November) in search of estrous females (Jameson 1989, Ralls *et al.* 1996, Tinker *et al.* 2006a). Pupping of southern sea otters takes place year round, but a birth peak extending over several months occurs in the spring, and a secondary birth peak occurs in the fall (Siniff and Ralls 1991, Riedman *et al.* 1994).

All sea otters of the subspecies *Enhydra lutris nereis* are considered to belong to a single stock because of their recent descent from a single remnant population. Southern sea otters are geographically isolated from the other two recognized subspecies of sea otters, *E. l. lutris* and *E. l. kenyoni*, and have been shown to be distinct from these subspecies in studies of cranial morphology (Wilson *et al.* 1991) and variation at the molecular level (Sanchez 1992; Cronin *et al.* 1996; Larson *et al.* 2002).

POPULATION SIZE

Data on population size have been gathered for more than 50 years. In 1982, a standardized survey technique was adopted to ensure that subsequent counts were comparable (Estes and Jameson 1988). This survey method involves shore-based censuses of approximately 60% of the range, with the remainder surveyed from the air. These surveys are conducted once each year (in spring). At San Nicolas Island, counts are conducted from shore (formerly quarterly, but semi-annually as of 2013). The highest of the counts is used as the official count for the year. In 2013, the official population index reported by the U.S. Geological Survey (2,941) included the 3-year running average for the mainland population (2,882) and the previous year's high count at San Nicolas Island (59). The 2011 mainland spring census was not completed due to weather conditions; therefore, the mainland 3-year running average is calculated from only the 2012 and 2013 raw counts (2,719 and 2,865, respectively) (U.S. Geological Survey, http://www.werc.usgs.gov/seaottercount).

Minimum Population Estimate

The minimum population estimate for the southern sea otter stock is taken as the lesser of the latest raw count or the latest 3-year running average for the mainland population, plus the count for San Nicolas Island. In 2013, the mainland count was 2,865. The 3-year running average was slightly higher, 2,882. Therefore, the minimum population estimate is 2,865 plus 59, or 2,924 animals.

Current Population Trend

As recommended in the Final Revised Recovery Plan for the Southern Sea Otter (U.S. Fish and Wildlife Service 2003), 3-year running averages are used to characterize trends in the mainland population to dampen the effects of anomalous counts in any given year. Based on 3-year running averages of the annual spring counts, population performance along the mainland coastline has been mixed over the past several years, increasing between 2006 and 2008,

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[1] Personal communication, M. Tim Tinker, 2008. Research Wildlife Biologist, USGS-Western Ecological Research Center, Santa Cruz Field Station, and Department of Ecology & Evolutionary Biology, University of California at Santa Cruz, 100 Shaffer Road, Santa Cruz, CA 95060.

decreasing between 2008 and 2010, and increasing again between 2010 and 2013 (Figure 2). The overall trend for the past 5 years has been essentially flat (0.16 percent), although this average growth rate masks considerable regional variation within the range. Growth of the colony at San Nicolas Island has averaged approximately 7.6 percent per year over the past 5 years (U.S. Geological Survey, http://www.werc.usgs.gov/seaottercount).

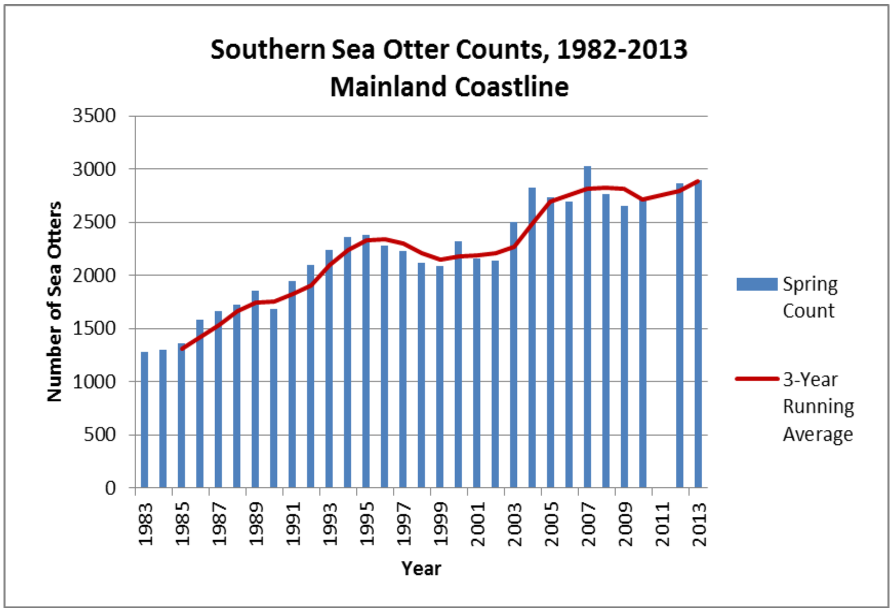

Figure 2. Southern sea otter counts 1983-2013 (mainland population). Data source: U.S. Geological Survey, http://www.werc.usgs.gov/seaottercount.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

We use the 5-year population trend to characterize current net productivity rates. As stated above, the average growth rate for this period is approximately 0.16 percent annually for the mainland population and approximately 7.6 percent annually for the San Nicolas Island population.

The maximum growth rate (R_{max}) for southern sea otters along the mainland coastline since the early 1980s (when reliable trend data first become available) appears to be 6 percent per year, although localized sub-populations have been observed to grow at much higher rates immediately after re-colonization.[2] In contrast, recovering or translocated populations at Attu Island, southeast Alaska, British Columbia, and Washington state all exhibited growth rates of up to 17 or 20 percent annually during the early stages of recovery (Estes 1990, Jameson and Jeffries 1999, Jameson and Jeffries 2005).

Although there has been speculation that the slower rate of population growth observed for the southern sea otter reflects some fundamental difference in survival or reproduction relative to northern sea otter populations, recent data and analyses call this assumption into question. First, a variety of evidence in recent years supports the conclusion that sea otters throughout much of central California are at or very near carrying capacity of the local environment, which explains the lack of growth in these areas (*i.e.*, further growth is limited by available food resources) (Tinker *et al.* 2006b, Tinker *et al.* 2008). Second, radio-tagging studies report age- and sex-specific rates of survival and reproduction that are comparable for southern sea otters and northern sea otters, at least when status with respect to carrying capacity is controlled for (Monson *et al.* 2000, Tinker *et al.* 2006b). Finally, recent modeling analyses

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[2] Personal communication, M. Tim Tinker, 2013. Research Wildlife Biologist, USGS-Western Ecological Research Center, Santa Cruz Field Station, and Department of Ecology & Evolutionary Biology, University of California at Santa Cruz, 100 Shaffer Road, Santa Cruz, CA 95060.

indicate that the spatial configuration of available habitat (the long narrow strip of coastal shelf characteristic of California versus the bays, islands, and complex matrices of inland channels characteristic of the habitat in Washington, British Columbia, and Alaska), combined with the high degree of spatial structure in sea otter populations (due to limited mobility of reproductive females), will result in greatly different expected population growth rates over the long term, and may account in large part for the differences in trends between the southern sea otter and northern sea otter populations.[3]

From the early 1900s to the mid-1970s, the southern sea otter population is thought to have increased at about 5 percent annually (Estes 1990), although consistent surveys and trend data from early years are lacking. From 1983 to 1995, annual growth averaged about 6 percent. The population declined during the late 1990s, resumed growth in the early 2000s, and ceased growth again beginning in 2008. Growth rates at San Nicolas Island averaged approximately 9 percent annually from the early 1990s to the mid-2000s and approximately 7.6 percent over the past 5 years.

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of three elements: the minimum population estimate (N_{min}); half the maximum net productivity rate ($0.5\ R_{max}$); and a recovery factor (F_r). This can be written as: $PBR = (N_{min})$ (½ of R_{max})(F_r).

For the southern sea otter stock, $N_{min} = 2{,}924$, $R_{max} = 6$ percent, and $F_r = 0.1$. A recovery factor of 0.1 is used for the southern sea otter stock because, although the population appears to be stable, Nmin is below 5,000, and the species is vulnerable to a natural or human-caused catastrophe, such as an oil spill, due to its restricted geographic distribution in nearshore waters (Taylor *et al.* 2002). Therefore, the PBR for the southern sea otter stock is 8.77, which when rounded down to the nearest whole animal is 8. It is important to note that take of southern sea otters incidental to commercial fishing operations cannot be authorized under the MMPA. Thus, the provisions governing the authorization of incidental take in commercial fisheries at MMPA Sections 101(a)(5)(E) and 118, which include requirements to develop take reduction plans with the goal of reducing incidental mortality or serious injury of marine mammals to levels less than the PBR, do not apply with respect to southern sea otters.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Sea otters are susceptible to entanglement and drowning in gill nets. The set gill net fishery in California is estimated to have killed from 48 to 166 (average of 103) southern sea otters per year from 1973 to 1983 (Herrick and Hanan 1988) and 80 sea otters annually from June 1982 to June 1984 (Wendell *et al.* 1986). A 1991 closure restricted gill and trammel nets to waters deeper than 30 fathoms (55 meters) throughout most of the southern sea otter's range (California Senate Bill No. 2563). In 1990, NMFS started an observer program using at-sea observers, which provided data on incidental mortality rates relative to the distribution of fishing effort. The observer program was active through 1994, discontinued from 1995 to 1998, and reinstated in the Monterey Bay area in 1999 and 2000 because of concern over increased harbor

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[3] Personal communication, M. Tim Tinker, 2013. Research Wildlife Biologist, USGS-Western Ecological Research Center, Santa Cruz Field Station, and Department of Ecology & Evolutionary Biology, University of California at Santa Cruz, 100 Shaffer Road, Santa Cruz, CA 95060.

porpoise mortality. Based on a detailed analysis of fishing effort, sea otter distributions by depth, and regional entanglement patterns during observed years, NMFS estimated southern sea otter mortality in the halibut set gill net fishery to have been 64 in 1990, zero from 1991 to 1994, 3 to 13 in 1995, 2 to 29 in 1996, 6 to 47 in 1997, 6 to 36 in 1998, 5 in 1999, and zero in 2000 (Cameron and Forney 2000; Carretta 2001; Forney *et al.* 2001). The increase in estimated mortality from 1995 to 1998 was attributed to a shift in set gill net fishing effort into areas where sea otters are found in waters deeper than 30 fathoms (55 meters).

Fishing with gill nets has since been further restricted throughout the range of the southern sea otter. An order prohibiting the use of gill and trammel nets year-round in ocean waters of 60 fathoms or less from Point Reyes, Marin County, to Point Arguello, Santa Barbara County was made permanent in September 2002. In the waters south of Point Arguello, the Marine Resources Protection Act of 1990 (California Constitution Article 10B) defined a Marine Resources Protection zone in which the use of gill and trammel nets is banned. This zone includes waters less than 70 fathoms (128 meters) or within one nautical mile (1.9 kilometers), whichever is less, around the Channel Islands, and waters generally within three nautical miles (5.6 kilometers) offshore of the mainland coast from Point Arguello to the Mexican border. Although sea otters occasionally dive to depths of 328 feet (100 meters), the vast majority (>99 percent) of dives are to depths of 131 feet (40 meters) or less.[4] Because of these restrictions and the current extent of the southern sea otter's range, southern sea otter mortalities resulting from entanglement in gill nets are likely to be at or near zero. Nevertheless, sea otters may occasionally transit areas that are not subject to closures, and levels of observer coverage of gill and trammel net fisheries are insufficient to confirm an annual incidental mortality and serious injury rate of zero in these fisheries (see Table 1) (Barlow 1989, Babcock *et al.* 2003). An estimated 50 vessels participate in the CA halibut/white seabass and other species set gillnet (>3.5" mesh) fishery (78 FR 53336, August 29, 2013). Approximately 30 vessels participate in the CA yellowtail, barracuda, and white seabass drift gillnet fishery (mesh size ≥3.5" and <14") (78 FR 53336, August 29, 2013). Approximately 25 vessels participate in the CA thresher shark/swordfish drift gillnet fishery (≥14" mesh) (78 FR 53336, August 29, 2013).

Three southern sea otter interactions with the California purse seine fishery for Northern anchovy and Pacific sardine have been documented. In 2005, a contract observer in the NOAA Fisheries California Coastal Pelagic Species observer program documented the incidental, non-lethal capture of two sea otters that were temporarily encircled in a purse seine net targeting Northern anchovy but escaped unharmed by jumping over the corkline. In 2006, a contract observer in the same program documented the incidental, non-lethal capture of a sea otter in a purse seine net targeting Pacific sardine. Again, the sea otter escaped the net at end of the haul without assistance.[5] Based on these observations and the levels of observer coverage in each year, 58 and 20 such interactions are estimated to have occurred in the CA sardine purse seine fishery in 2005 and 2006, respectively, but these estimates are accompanied by considerable uncertainty because of the low levels of observer coverage.[6] There are no data available to assess whether sea otter interactions with purse-seine gear are currently resulting in mortality or

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[4] Personal communication, M. Tim Tinker, 2008. Research Wildlife Biologist, USGS-Western Ecological Research Center, Santa Cruz Field Station, and Department of Ecology & Evolutionary Biology, University of California at Santa Cruz, 100 Shaffer Road, Santa Cruz, CA 95060.

[5] Personal communication, Lyle Enriquez, 2006. Southwest Regional Office, NOAA, U.S. National Marine Fisheries Service, 501 West Ocean Boulevard, Long Beach, CA 90802.

[6] Personal communication, Jim Carretta, 2008. Southwest Fisheries Science Center, NOAA, U.S. National Marine Fisheries Service, 8604 La Jolla Shores Drive, La Jolla, CA 92037.

serious injury. The 2007 list of fisheries reorganized purse seine fisheries targeting anchovy and sardines into the “CA anchovy, mackerel, sardine purse seine” fishery. An estimated 65 vessels participate in the CA anchovy, mackerel, and sardine purse seine fishery (78 FR 53336, August 29, 2013).

The potential exists for sea otters to drown in traps set for crabs, lobsters, and finfish, but only limited documentation of mortalities is available. Hatfield and Estes (2000) summarize records of 18 sea otter mortalities in trap gear, 14 of which occurred in Alaska. With the exception of one sea otter, which was found in a crab trap, all of the reported Alaska mortalities involved Pacific cod traps and were either recorded by NMFS observers or reported to NMFS observers by fishers. Four sea otters are known to have died in trap gear in California: one in a lobster trap near Santa Cruz Island in 1987; a mother and pup in a trap with a 10-inch diameter opening (presumed to be an experimental trap) in Monterey Bay in 1987; and one in a rock crab trap 0.5 miles off Pt. Santa Cruz, California (Hatfield and Estes 2000). In 1995, the U.S. Geological Survey began opportunistic efforts to observe the finfish trap fishery in California. These efforts were supplemented with observations by the California Department of Fish and Game (CDFG) in 1997 and two hired observers in 1999. No sea otters were found in the 1,624 traps observed (Hatfield and Estes 2000). However, a very high level of observer coverage would be required to see any indication of trap mortality, even if mortality levels were high enough to substantially reduce the rate of population growth (Hatfield *et al.* 2011).

Controlled experiments conducted by the U.S. Geological Survey and the Monterey Bay Aquarium demonstrated that sea otters would enter a baited commercial finfish trap with inner trap funnel openings of 5.5 inches in diameter (Hatfield and Estes 2000). Hatfield *et al.* (2011) confirmed that some sea otters exposed to finfish, lobster, and mock Dungeness crab traps in a captive setting would succeed in entering them. Based on experiments with carcasses and live sea otters, they concluded that finfish traps with 5-inch-diameter circular openings would largely exclude diving sea otters; that circular openings of 5.5 to 6 inches in diameter and rectangular openings 4 inches high (typical of Dungeness crab pots) would allow the passage of sea otters up to about 2 years of age; and that the larger fyke openings of spiny lobster pots and finfish traps with openings larger than 5 inches would admit larger sea otters. Reducing the fyke-opening height of Dungeness crab traps by one inch (to 3 inches) would exclude nearly all diving sea otters while not significantly affecting the number or size of harvested crabs (Hatfield *et al.* 2011). Since January 2002, CDFG has required 5-inch sea-otter-exclusion rings to be placed in live-fish traps used along the central coast from Pt. Montara in San Mateo County to Pt. Arguello in Santa Barbara County. No rings are required for live-fish traps used in the waters south of Point Conception, and no rings are currently required for lobster or crab traps regardless of their location in California waters. Estimates of the number of vessels participating in pot and trap fisheries off California are given in parentheses: CA Dungeness crab pot (534); CA coonstripe shrimp, rock crab, tanner crab pot or trap (305); CA spiny lobster (225); and CA nearshore finfish live trap/hook-and-line (93) (78 FR 53336, August 29, 2013).

Available information on incidental mortality and serious injury of southern sea otters in commercial fisheries is very limited. Due to the lack of observer coverage, a reliable, science-based estimate of the annual rate of mortality and serious injury cannot be determined. Commercial fisheries believed to have the potential to kill or injure southern sea otters are listed in Table 1. Due to the nature of potential interactions (entrapment or entanglement followed by drowning), serious injury is unlikely to be detected prior to the death of the animal.

Table 1. Summary of available information on incidental mortality and serious injury of southern sea otters in commercial fisheries that have the potential to interact with southern sea otters.

Fishery Name	Year(s)	Number of Vessels[1]	Data Type	Percent Observer Coverage[2]	Observed Mortality/ Serious Injury	Estimated Mortality/ Serious Injury	Mean Annual Mortality/ Serious Injury
CA halibut/white seabass and other species set gillnet (>3.5")	2008	50	observer	17.8%	0	n/a	n/a
	2009		n/a	not observed	n/a		
	2010		observer	12.5%	0		
	2011		observer	8%	0		
	2012		observer	5.5%	0		
CA yellowtail, barracuda, and white seabass drift gillnet (≥3.5" and <14")	2008	30	n/a	not observed	n/a	n/a	n/a
	2009		n/a	not observed	n/a		
	2010		n/a	not observed	n/a		
	2011		observer	3.3%	0		
	2012		observer	0.7%	0		
CA thresher shark/swordfish drift gillnet fishery (≥14")	2008	25	observer	13.5%	0	n/a	n/a
	2009			13.3%	0		
	2010			11.9%	0		
	2011			19.5%	0		
	2012			18.6%	0		
CA anchovy, mackerel, and sardine purse seine	2008	65	observer	~5%	0	n/a	n/a
	2009		n/a	not observed	n/a		
	2010		n/a	not observed	n/a		
	2011		n/a	not observed	n/a		
	2012		n/a	not observed	n/a		
CA Dungeness crab pot	2008	534	n/a	not observed	n/a	n/a	n/a
	2009						
	2010						
	2011						
	2012						
CA coonstripe shrimp, rock crab, tanner crab pot or trap[3]	2008	305	n/a	not observed	n/a	n/a	n/a
	2009						
	2010						
	2011						
	2012						
CA spiny lobster[3]	2008	225	n/a	not observed	n/a	n/a	n/a
	2009						
	2010						
	2011						
	2012						
CA nearshore finfish live trap/hook and line[3]	2008	93	n/a	not observed	n/a	n/a	n/a
	2009						
	2010						
	2011						
	2012						
Unknown hook and line	2008	n/a	stranding data	—	0	≥0	≥0
	2009				0		
	2010				0		
	2011				0		
	2012				0		
Unknown net	2008	n/a	stranding data	—	0	≥1	≥0.2
	2009				0		
	2010				0		
	2011				1[4]		
	2012				0		

Note: n/a indicates that data are not available or are insufficient to estimate mortality/serious injury.

[1] Vessel numbers are from the final List of Fisheries for 2013 (78 FR 53336, August 29, 2013).

[2] Personal communication, Jim Carretta, 2010, 2011, 2013. Southwest Fisheries Science Center, NOAA, U.S. National Marine Fisheries Service, 8604 La Jolla Shores Drive, La Jolla, CA 92037.

[3] This fishery is classified as a Category III fishery (78 FR 53336, August 29, 2013). Category III fisheries are not required to accommodate observers aboard vessels due to the remote likelihood of mortality and serious injury of marine mammals.

[4] This sea otter was also shot, apparently after becoming entangled in the net.

Other Mortality

Variation in reproductive success and survival rates of sea otters in central California appears to be influenced primarily by density-dependent resource limitation (Tinker 2013). Physiological condition and nutritional status in turn influence the susceptibility of sea otters to environmental stressors (including pathogens, pollutants, and intoxicants produced during harmful algal blooms), which may result in death by a variety of proximate causes, including infectious disease, intra-specific aggression, intoxication, and other pathological conditions (Tinker 2013).

Common causes of death identified for fresh beach-cast carcasses necropsied from 1998 to 2001 included protozoal encephalitis, acanthocephalan-related disease, shark attack, and cardiac disease (Kreuder *et al.* 2003, Kreuder *et al.* 2005). Encephalitis caused by *Toxoplasma gondii* was associated with shark attack and heart disease (Kreuder *et al.* 2003). Diseases (due to parasites, bacteria, fungi, or unspecified causes) were identified as the primary cause of death in 63.8 percent of the sea otter carcasses examined (Kreuder *et al.* 2003). Unusually high numbers of stranded southern sea otters were recovered in 2003, prompting declaration of an Unusual Mortality Event for the period from 23 May to 1 October 2003. The increase in strandings was not attributable to any one cause, although intoxication by domoic acid produced by blooms of the alga *Pseudonitzchia australis* is believed to have been an important contributor (Jessup *et al.* 2004).

From 2008 through 2012, the number of strandings relative to the spring count averaged 10.4 percent (Figure 3; the entry for 2011 is missing because the spring survey was not completed that year). However, relative strandings have increased sharply over this period, with record highs in 2010 and 2012, 11.2 and 12.8 percent of the spring count, respectively (U.S Geological Survey unpublished data). These spikes in relative strandings appear to be due largely to an upswing in shark bite mortality in the northern and southern portions of the range (north of Seaside and, most markedly, south of Cayucos) (Tinker *et al.* 2013). Increasing shark-bite mortality is also a longer-term trend. The proportion of sea otter deaths caused by shark bites has increased 4-fold over the last 20 years and accounts for 45 percent of the variation in population trends during this period (Tinker *et al.* 2013). The reasons for the increase in shark bite mortality are unknown.

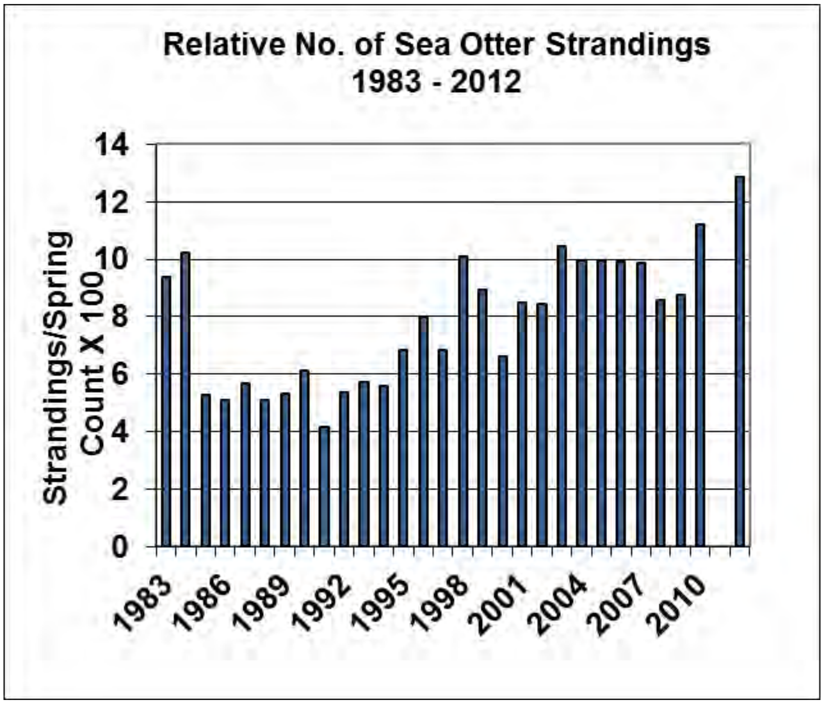

Figure 3. Strandings of southern sea otters relative to the spring count, 1983-2012. The entry for 2011 is missing because the spring survey was not completed that year. Source: U.S. Geological Survey unpublished data.

Non-fishery-related anthropogenic mortality of sea otters is a result of indirect and direct causes. The ocean discharge of freshwater microcystins (persistent biotoxins produced by cyanobacteria of the genus *Microcystis*, which can form toxic blooms under conditions of elevated nutrient concentration, salinity, and temperature), has been linked to the deaths of more than 30 sea otters (through 2012), with the earliest known case occurring in 1999 and the greatest number of cases occurring in 2007 (Miller *et al.* 2010; CDFG unpublished data). Boat strikes typically cause several deaths each year. Shootings are a relatively low but persistent source of anthropogenic mortality. Other rare sources of anthropogenic mortality include debris entanglement and complications associated with research activities. Stranding data indicate that during the period from 2008 through 2012, at least 10 sea otters died of microcystin intoxication, 2 were shot[7], 12 were suspected to have been struck by boats, 1 was entangled in debris, and 3 died as a result of complications related to research activities (U.S. Geological Survey and CDFG unpublished data). Total observed anthropogenic mortality from 2008-2012, excluding any fisheries-related mortality, is 28, yielding an estimated mortality of ≥ 28 and a mean annual mortality of ≥ 5.6. Disease is an important proximate cause of death in sea otters, but due to several complicating factors (including the complexity of the pathways by which sea otters are being exposed to land-borne pathogens, the synergistic relationship between sea otter susceptibility to disease and density-dependent resource limitation, and other factors), the anthropogenic contribution to disease-related mortality in sea otters is not well understood. Therefore, animals that died of disease (other than acute liver failure resulting from microcystin poisoning) are not included in the anthropogenic mortalities reported here.

It should be noted that the mean annual mortality/serious injury reported here and in Table 1 are minimum estimates.[8] Documentation of these sources of mortality comes primarily from necropsies of beach-cast carcasses, which constitute a subset (roughly half) of all dead southern sea otters and likely do not represent an unbiased sample with respect to cause of death because carcass deposition and retrieval are dependent on carcass size, location, wind, currents and other factors, including the cause of death itself (Gerber *et al.* 2004, Tinker *et al.* 2006a). Within this subset, the cause of death of many recovered carcasses is unknown, either because the carcass is too decomposed for examination or because cause of death cannot be determined (Gerber *et al.* 2004).[9] Because it is unknown to what extent the levels of human-caused mortality documented in beach-cast carcasses are representative of the relative contributions of known causes or of human-caused mortality as a whole, we are unable to give upper bounds for these estimates.

STATUS OF STOCK

The southern sea otter is designated a fully protected mammal under California State law (California Fish and Game Code §4700) and was listed as a threatened species in 1977 (42 FR 2965) pursuant to the federal Endangered Species Act, as amended (16 U.S.C. 1531 et seq.). As a consequence of its threatened status, the southern sea otter is considered to be a "strategic stock" and "depleted" under the MMPA.

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[7] An additional animal, not included in this total, was also shot, apparently after becoming entangled in a net (fishery unknown).

[8] This statement applies to all causes of death mentioned here except research-related mortalities. Research-related mortalities are unlikely to be undetected because of the intensive monitoring that tagged sea otters receive.

[9] In 2012, the cause of death of approximately 35 percent of recovered carcasses was unknown. Personal communication, Brian Hatfield, 2013. Wildlife Biologist, USGS-Western Ecological Research Center, Hwy. 1, P.O. Box 70. San Simeon, CA 93452.

The status of the southern sea otter in relation to its optimum sustainable population (OSP) level has not been formally determined, but population counts are well below the estimated lower bound of the OSP level for southern sea otters, about 8,400 animals (U.S. Fish and Wildlife Service 2003), which is roughly 50 percent of the estimated carrying capacity of California (Laidre *et al.* 2001). Because of the lack of observer data for several commercial fisheries that may interact with sea otters, it is not possible to make a science-based determination of whether the total mortality and serious injury of sea otters due to interactions with commercial fisheries is insignificant and approaching a zero mortality and serious injury rate.

Habitat Issues

Sea otters are particularly vulnerable to oil contamination (Kooyman and Costa 1979; Siniff *et al.* 1982), and oil spill risk from large vessels that transit the California coast remains a primary threat to the southern sea otter. Studies of contaminants have documented accumulations of dichlorodiphenyltrichloro-ethane (DDT), dichlorodiphenyl-dichloroethylene (DDE) (Bacon 1994; Bacon *et al.* 1999), and polychlorinated biphenyls (PCBs) in stranded sea otters (Nakata *et al.* 1998), as well as the presence of butyltin residues, which are known to be immunosuppressant (Kannan *et al*. 1998). Kannan *et al.* (2006, 2007) found a significant association between infectious diseases and elevated concentrations of perfluorinated contaminants and polychlorinated biphenyls (PCBs) in the livers of sea otters, suggesting that chemical contaminants may influence patterns of sea otter mortality. Harmful algal blooms are increasingly recognized as a source of mortality (*e.g.,* Miller *et al.* 2010). Food limitation and nutritional deficiencies appear to be the primary driver of sea otter mortality (particularly in the central portion of the range from Seaside to Cayucos), either directly or as a consequence of dietary specialization (by increasing the exposure to protozoal pathogens of sea otters that specialize on non-preferred prey types) (Bentall 2005, Tinker *et al.* 2006b, Tinker *et al.* 2008, Johnson *et al.* 2009, Tinker 2013). Changes in the carbonate chemistry of the oceans due to increasing atmospheric CO_2 levels (ocean acidification) may pose a serious threat to marine organisms, particularly calcifying organisms (Kroeker *et al.* 2010, Kurihara *et al.* 2008, Stumpp *et al.* 2011), many of which are important prey for sea otters. However, effects on sea otters will depend on numerous factors (such as potential ecological shifts arising from variable responses among marine organisms) that cannot currently be predicted.

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SEA OTTER (*Enhydra lutris kenyoni*)
WASHINGTON STOCK

U.S. Fish and Wildlife Service
Lacey, Washington

STOCK DEFINITION AND GEOGRAPHIC RANGE

The northern sea otter, *Enhydra lutris kenyoni*, historically ranged throughout the North Pacific, from Asia along the Aleutian Islands, originally as far north as the Pribilof Islands and in the eastern Pacific Ocean from the Alaska Peninsula south along the coast to Oregon (Wilson et al. 1991). In Washington, areas of sea otter concentration were reported from the Columbia River to along the Olympic Peninsula coast (Scheffer 1940). Sea otters were extirpated from most of their range during the 1700s and 1800s as the species was exploited for its fur. Washington's sea otter population was extirpated by the early 1900s. In 1969 and 1970, a total of 59 sea otters were captured at Amchitka Island, Alaska, and released near Point Grenville and LaPush off Washington's Olympic Peninsula coast (Jameson et al. 1982; Jameson et al. 1986). Washington's current sea otter population originated from the Amchitka Island genotype (*Enhydra lutris kenyoni*).

Figure 1. Approximate distribution of Washington sea otter stock.

For management purposes pursuant to the Marine Mammal Protection Act (MMPA), the range of the Washington sea otter stock is within the marine waters of Washington State. However, if the stock expands southward into Oregon or northward into British Columbia, a revised stock assessment would consider this expanded range.

In 2006, the distribution of the majority of the Washington sea otter stock ranged from Pillar Point in the Strait of Juan de Fuca, west to Cape Flattery and as far south as Cape Elizabeth on the outer Olympic Peninsula coast (Figure 1). However, scattered individuals (usually one or two individuals at a time) have been seen outside of this range. For example, sick or injured sea otters have come ashore as far south as Ocean Shores and repeated sightings have been reported in Grays Harbor and as far east as Port Townsend. Sightings around the San Juan Islands, near Deception Pass, off Dumas Bay, off the Nisqually River, and in southern Puget Sound near Squaxin and Hartstene Islands have also been reported. Several of the sea otters in Puget Sound became relatively "tame," and in some cases local residents were feeding these individuals and promoting their "friendly" behavior. The U. S. Fish and Wildlife Service (USFWS) and Washington Department of Fish and Wildlife (WDFW) intervened, to the extent necessary, when these individual sea otters exhibited behaviors that presented a danger to themselves or to human health and safety.

In waters to the north of the Washington stock is the British Columbia sea otter population, which originated from animals also translocated from Amchitka Island and additional individuals from Prince William Sound, Alaska (Watson 2000). British Columbia's sea otter population, which is also increasing, includes at least 3,180 animals distributed mainly along the west coast of Vancouver Island from Barkley Sound to Cape Scott with a separate population along the mainland coast near Goose Island in Queen Charlotte Sound (COSEWIC 2007). Although most of the British Columbia sea otter population remains north of Estevan Point along the west coast of Vancouver Island, groups of 100 to 150 animals have recently been observed south of Estevan Point near Hesquiat Harbor and Flores Island just north of Tofino. Small numbers of animals have also been reported in Barkley Sound and scattered along the coast of the Strait of Juan de Fuca to Victoria. Currently there is no evidence of interchange between the Washington and British Columbia sea otter populations. However, as the Washington and British Columbia populations grow and expand their respective ranges, movement between these populations can be expected.

Sea otters breed and give birth year-round (Riedman and Estes 1990). Pupping period for Washington's sea otter stock is not well defined, with dependent pups observed in all months. However, births in Washington sea otters are believed to occur primarily from March to April, with peak numbers of dependent pups expected to be present from May to September (Ron Jameson, pers. comm.).

POPULATION SIZE

Original Washington Translocation

Fifty-nine sea otters were released off the Washington coast in 1969 and 1970, although almost half of the otters released in 1969 died. Sightings of sea otters were sporadic for several years after the translocations and during surveys through 1976, no more than 10 otters were observed at a time (Jameson et al. 1982). The current Washington sea otter population descended from no more than 43 otters and possibly as few as 10 (Jameson et al. 1982). Reproduction was first documented in 1974 (Jameson et al. 1982) and pups have been observed in all subsequent surveys.

Minimum Population Estimate

The first comprehensive post-release surveys of Washington's sea otter population were conducted by boat in 1977 and again in 1981 (Jameson et al. 1986). Boat, ground, and aerial surveys for sea otters were conducted biennially from 1981 to 1989. Starting in 1989 and continuing to present, Washington's sea otter population estimate has been developed from a combined aerial and ground survey conducted in early July by United States Geological Survey and/or WDFW. Based on the 2007 survey (actual count), the minimum population estimate of the Washington sea otter population is 1,125 individuals (Jameson and Jeffries 2008). No correction factor for missed animals has been applied to count data to determine a total population estimate from survey counts for Washington.

Current Population Trend

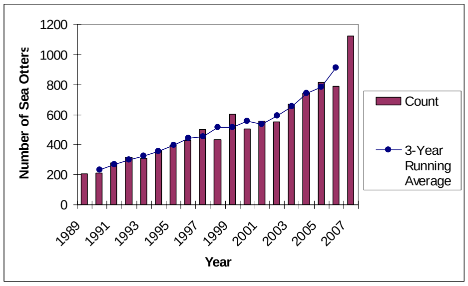

Figure 2. Annual and three-year running average of population estimates (1989-2007).

Based on count totals from 1977 to 1989, the Washington sea otter population increased at an annual rate of 20 percent (Jameson and Jeffries 1999). As has been done for the southern sea otter (*Enhydra lutris nereis*), three-year running averages are used to characterize population trends to dampen the effects of anomalous counts in any given year (U.S. Fish and Wildlife Service 2003). Jameson and Jeffries (2006) indicate "the finite rate of increase for this population since 1989 is 8 percent." Survey data indicate the Washington stock is nearing equilibrium density north of La Push, where the rate of increase has shown no growth since 2000 (Jameson and Jeffries 2008). South of La Push, the stock has been growing at about 20 percent per year since 1989 (Jameson and Jeffries 2006).

Laidre et al. (2002) provides a carrying capacity (K) estimate of 1,019 sea otters (95 percent CI 754-1,284) for Washington's sea otter stock to reoccupy rocky habitat from Destruction Island to Neah Bay (e.g., Seal and Sail Rocks). Laidre et al. (2002) also provide a total carrying capacity estimate for Washington of 1,836 sea otters (95 percent CI 1,386-2,286) based on an assumption that sea otters will reoccupy most of their historic habitat along the outer Washington coast (excluding reoccupation of the Columbia River, Willapa Bay, and Grays Harbor estuaries due to significant human alterations and use) and eastward into the Strait of Juan de Fuca as far as Protection Island. The Washington sea otter stock appears to be approaching equilibrium in the rocky habitat along the Olympic Peninsula coast; the reasons why the population has not dispersed into the unoccupied portions of its historic range are unclear.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The maximum annual growth rate (R_{max}) for sea otter populations for which data are available has been reported as 17 to 20 percent (Estes 1990). From 1977 to 1989, the Washington stock grew at 20 percent (Jameson and Jeffries 1999) and appears to still be growing at this rate south of La Push (Jameson and Jeffries 2008). However, between 1989 and 2007, the growth rate of the entire Washington sea otter stock has slowed to an annual rate of 8 percent (Jameson and Jeffries 2008).

POTENTIAL BIOLOGICAL REMOVAL

The Potential Biological Removal (PBR) is the product of three elements: the minimum population estimate (N_{min}); half the maximum net productivity rate ($0.5\ R_{max}$); and a recovery factor (F_r). For the Washington sea otter stock, N_{min}=1,125; R_{max} uses a maximum sea otter growth rate of 20 percent; and F_r=0.1. A F_r of 0.1 was used for the Washington sea otter stock because even though the population is increasing, the minimum population size is less than 1,500 and the population is restricted in its geographical range making it vulnerable to natural or human-caused catastrophe (Taylor et al. 2002). Therefore, the calculated PBR for the Washington sea otter stock is 11 animals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Sea otters are susceptible to drowning in gillnets and have been taken in the Makah Northern Washington Marine Set-gillnet Fishery (Gearin et al. 1996). Based on observer data collected from 1988 through 2001, a total of 11 sea otters were taken when fishing effort occurred (Makah Tribe/Makah Tribal Resources and National Marine Fisheries Service (NMFS)/National Marine Mammal Lab (NMML) observer data). Although the fishing effort in this fishery began declining in the mid 1990s, sea otters continue to be taken in this fishery (Table 1). Pre-2000 data indicates sea otter mortalities are likely to occur when there is fishing effort in Areas 4 and 4A (Makah Bay). Only mortalities, not serious injuries, are reflected in Table 1 because the nets set by the Makah fishery do not rise to the surface of the water and any otters that get caught in the nets will likely drown. Due to inconsistent reporting between fishing areas, years, and the associated fishing effort, observer coverage, and otter mortalities (see Table 1), a reliable estimation of the annual sea otter mortality and serious injury in the Makah Northern Washington Marine Set Gillnet Fishery is assumed to be a minimum of 2 when there is fishing effort. In order to provide a more accurate estimate of the annual mortality and serious injury associated with this fishery, the USFWS requested information from the NMFS and the Makah Tribe. The information provided by the NMFS and the Makah Tribe was not sufficient to provide a more accurate estimate.

Table 1. Summary of sea otter incidental mortality in Northern Washington Marine Set-Gillnet Fishery. (Source: NMFS/NMML observer program, BIA, and Makah Tribe)

Fishery Name	Year	Fishing Effort[a] (Yes/No)	Observer Coverage	Observed/Reported mortality (Number of Otters)
Northern WA Marine Set Gillnet Areas 4/4A/4B/5	2003	Yes	None	-
	2004	Yes	1-11 net days observed[b]	2
	2005	Yes	None	-
	2006	Yes	None	-
	2007	Yes	None	-

[a] Overall fishing effort is not available
[b] Observer coverage is presented in format supplied to USFWS

Other fisheries that occur within the range of the sea otter in Washington include treaty and non-treaty gillnet fisheries in the Strait of Juan de Fuca, Puget Sound, and Grays Harbor. Neither the USFWS or the NMFS have received any voluntary or observer reports of sea otters killed or seriously injured in these fisheries. However, the lack of information cannot be interpreted to mean that no sea otters have been killed or seriously injured because there has not been marine mammal observer coverage of these fisheries since 1994, rather, incidental takings of marine mammals in these fisheries are reported to NMFS through self-reporting (Sources: Treaty/Non-treaty sum of landings submitted to the USFWS as part of Biological Opinion reporting requirements, USDC NMFS 2003). The fisheries subject to self-reporting do not include tribal fisheries. An accurate estimate of sea otter mortality and serious injury associated with these fisheries requires instituting an observer program and obtaining fishing effort data. Because this information is not currently available, we cannot provide an accurate estimate of the annual mortality and serious injury associated with these fisheries. Sea otter densities along the Strait of Juan de Fuca in the summer and fall are low, when the fisheries generally operate, so few entanglements would be expected. However, as the Washington sea otter population continues to grow, the possibility of fisheries-related incidental take in these gillnet fisheries will grow.

Other fisheries that also occur within the range of the Washington sea otter stock include: 1) treaty set-gillnet fisheries that occur in the coastal rivers (Quinault, Queets, Hoh, Quillayute, Hoko, and Waatch); 2) treaty and non-treaty groundfish trawl fisheries that occur offshore of the Olympic Peninsula coast; and 3) treaty and non-treaty drift gillnet fisheries that occur in Willapa Bay. These fisheries are unlikely to result in mortality or serious injury because sea otters are unlikely to occur in these areas.

As sea otters expand their range eastward into the Strait of Juan de Fuca or south along the outer Washington coast, they will also encounter important sport and commercial shellfish fisheries (urchins, razor clams, Dungeness crabs, steamer clams, geoducks). “Evidence from California and Alaska suggests that the potential for incidental take of sea otters in crab traps will increase as the population expands its range south of Destruction Island into prime Dungeness crab habitat” (Lance et al. 2004). In addition, the potential exists for increased interactions with invertebrate fisheries, particularly sea urchins and geoducks, as the sea otter population expands eastward into the Strait of Juan de Fuca (Gerber and VanBlaricom 1999).

Other Human-Caused Mortality and Serious Injury

Other sources of human-caused mortality and serious injury affecting the Washington sea otter population are not well documented. Documented sources of human-caused mortality for the southern sea otter include shooting, boat strikes, capture and relocation efforts, oil spills, and possibly elevated levels of polychlorinated biphenyls and other toxic contaminants. In 2003, one Washington sea otter death was presumed to have been caused by a boat strike because of the type of injuries observed during necropsy. However, these injuries could also have been sustained in a variety of other ways.

In the past decade, a number of oil spills have occurred within the range of Washington’s sea otter population, with one documented oil related death recorded during one of these spills (Jameson 1996). Additionally, with the increasing volume of shipping traffic into and out of the Strait of Juan de Fuca, the potential for a catastrophic spill exists and most, if not all, of the Washington sea otter population and range is vulnerable to the effects of such a spill. Significant oil-related mortalities and habitat damage would be expected to occur if an oil spill of this nature were to happen and impinge directly on sea otter habitat along Washington’s Olympic Peninsula and Strait of Juan de Fuca coastlines.

However, due to the lack of documented mortalities or serious injuries resulting from other human-caused sources and the unpredictability of oil spills, we are unable to provide an estimate of the annual mortality and serious injuries associated with other human-caused mortality and serious injury.

Harvest by Northwest treaty Indian tribes

A number of Native American tribes of the Pacific Northwest have treaty rights to harvest various fish and wildlife resources in Washington State. Currently there is no authorization for harvest of sea otters by Native Americans; however, there is a developing interest in such a program. As affirmed by the Court of Appeals for the Ninth Circuit in Anderson v. Evans (9th Cir. June 7, 2004), any take of sea otters by Native Americans other than Alaskan natives residing in Alaska has to be authorized under the MMPA.

STATUS OF STOCK

The Washington sea otter stock is not listed as "depleted" under the MMPA nor listed as "threatened" or "endangered" under the Endangered Species Act. Sea otters are listed by the State of Washington as "State endangered" under Revised Code of Washington 77.12.020 and Washington Administrative Code (WAC) 232.12.014 due to small population size, restricted distribution, and vulnerability (Lance et al. 2004). The WDFW finalized their sea otter recovery plan in 2004 (Lance et al. 2004).

This stock is not classified as strategic because the population is growing and is not listed as "depleted" under the MMPA or "threatened" or "endangered" under the Endangered Species Act of 1973.

The lower end of the Optimum Sustainable Population (OSP) range is assumed to occur at approximately 60 percent of the maximum population size the environment will support (i.e. carrying capacity) (DeMaster et al. 1996). The total carrying capacity estimate for Washington is 1,836 sea otters (95 CI 1,386 – 2,286) (Laidre et al. 2002). The current population estimate of 1,125 (Jameson and Jeffries 2008) is above the lower end of the OSP (60 percent of 1,836).

The mortality and serious injury for the Makah Northern Washington Marine Set Gillnet Fishery is estimated to be a minimum of two mortalities annually when there is fishing effort. We are unable to provide an estimate of the annual mortality and serious injury associated with other fisheries and other sources of human-caused mortality and serious injury, due to the lack of information. Therefore, we are unable to determine whether the level of human-caused mortalities and serious injuries are insignificant and approaching a zero mortality and serious injury rate.

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