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U.S. PACIFIC MARINE MAMMAL STOCK ASSESSMENTS: 2005

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Jason Baker, Brad Hanson, and Mark S. Lowry

with contributions from
Dale Sweetnam, Chris Yates, Don Petersen, and Joe Cordaro

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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southwest Fisheries Science Center

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NOAA Technical Memorandum NMFS
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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. This report presents revised stock assessments for 5 Pacific marine mammal stocks under NMFS jurisdiction: 1) the California stock of harbor seals 2) Hawaiian monk seal 3) Eastern North Pacific humpback whale 4) Hawaii false killer whale 5) Southern Resident killer whale and 6) the California/Oregon/Washington stock of short-finned pilot whale. Information on the remaining 56 Pacific region stocks is reprinted without revision in this report and also appears in the 2004 reports (Carretta *et al.* 2005). Stock Assessments for Alaskan marine mammals are published by the National Marine Mammal Laboratory (NMML) in a separate report.

The five revised stock assessments in this report include those studied by the Southwest Fisheries Science Center (SWFSC, La Jolla, California), the Pacific Islands Fisheries Science Center (PIFSC, Honolulu, Hawaii), the National Marine Mammal Laboratory (NMML, Seattle, Washington), and the Northwest Fisheries Science Center in Seattle, WA. Staff of the Northwest Fisheries Science Center prepared the report on the Eastern North Pacific Southern Resident killer whale. Pacific Islands Fisheries Science Center staff prepared the report on the Hawaiian monk seal. Southwest Fisheries Science Center staff prepared stock assessments for the remaining four stocks. Updated estimates of abundance are available for California harbor seals (Lowry et al. 2005), Eastern North Pacific humpback whales (Calambokidis et al. 2004), Southern Resident killer whales, and Hawaiian monk seals. Updated calculations of potential biological removal (PBR) are available for California harbor seals, Eastern North Pacific humpback whales, and Hawaiian false killer whales.

New information on U.S. commercial fisheries that may interact with marine mammals is presented in Appendix 1. We thank Chris Yates for reviewing and providing input on the Hawaii pelagic longline fishery update.

Earlier versions of these stock assessment reports were reviewed by the Pacific Scientific Review Group in January 2005. The authors also wish to thank those who provided unpublished data, especially Robin Baird and Joseph Mobley, who provided valuable information on Hawaiian cetaceans. Any omissions or errors are the sole responsibility of the authors.

This is a working document and individual stock assessment reports will be updated as new information becomes available and as changes to marine mammal stocks and fisheries occur. 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.

These Stock Assessment Reports summarize information from a wide range of sources and an extensive bibliography of all sources is given in each report. We strongly urge users of this document to refer to and cite original literature sources rather than citing this report or previous Stock Assessment Reports. If the original sources are not available, the citation should follow the format: [Original source], as cited in [this Stock Assessment Report citation].

<u>Cover photograph:</u> Humpback whale near Chatham Strait, Alaska, 2004. Photographed by Jay Barlow during the 2004 SWFSC SPLASH cruise.

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Revised 12/15/2003

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The California sea lion *Zalophus californianus* includes three subspecies: *Z. c. wollebaeki* (on the Galapagos Islands), *Z. c. japonicus* (in Japan, but now thought to be extinct), and *Z. c. californianus* (found from southern Mexico to southwestern Canada; herein referred to as the California sea lion). 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). These three geographic regions are used to separate this subspecies into three stocks: (1) the United States stock begins at the U.S./Mexico border and extends northward into Canada; (2) the Western Baja California stock extends from the U.S./Mexico border to the southern tip of the Baja California Peninsula; and (3) the Gulf of California stock which includes the Gulf of California from the southern tip of the Baja California peninsula and across to the mainland and extends to southern Mexico (Lowry et al. 1992). Some movement has been documented between these geographic stocks, but rookeries in the United States are widely separated from the major rookeries of western Baja California, Mexico. Males from western Baja California rookeries may spend most of the year in the United States. Genetic differences have been found between the U.S. stock and the Gulf of California stock (Maldonado et al. 1995). There are no international agreements for joint management of California sea lions between the U.S., Mexico, and Canada.

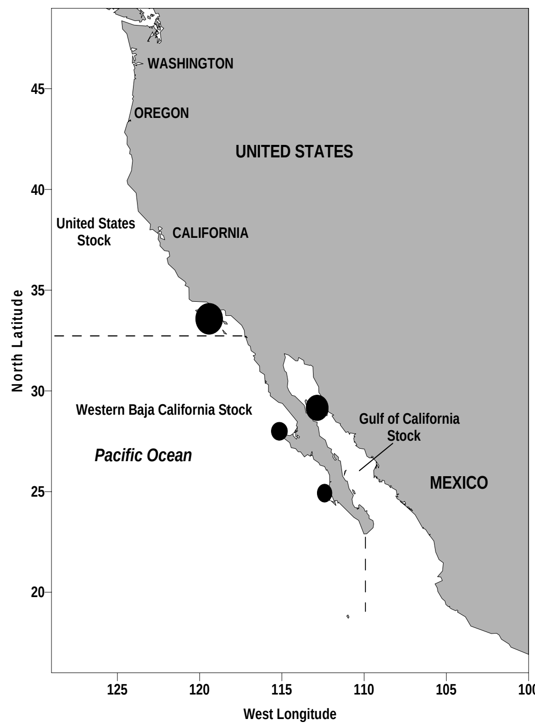

Figure 1. Geographic range of California sea lions showing stock boundaries and locations of major rookeries. The United States stock ranges north into Canadian waters.

POPULATION SIZE

The entire population cannot be counted because all age and sex classes are never 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. The size of the population is then estimated from the number of births and the proportion of pups in the population.

Censuses are conducted in July after all pups have been born. To estimate the number of pups born, the pup count in 2001 (49,078) was adjusted for an estimated 15% pre-census mortality (Boveng 1988; Lowry et al. 1992), giving an estimated 56,440 live births in the population. The fraction of newborn pups in the population (23.1% to 23.8%) 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% to 6.1% yr^{-1}, respectively, see below). Multiplying the number of pups born by the inverse of these fractions (4.32 to 4.20) results in population estimates ranging from 244,000 to 237,000 (respectively).

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 during the 2001 breeding season. The minimum population size of the U.S. stock is 138,881(NMFS unpubl. data). It includes all California sea lions counted during the July 2001 census at the four rookeries in southern California and at the haulout sites located between Point Conception and the Oregon/California border. *An additional unknown number of California sea lions are at sea or hauled out at locations that were not censused.*

Current Population Trend

Records of pup counts from 1975 to 2001 (Figure 2) were compiled from the literature, NMFS reports, unpublished NMFS data, and Lowry 1999 (the literature up to 1992 is listed in Lowry et al. 1992). Pup counts from 1975 through 2001 were examined for four rookeries in southern California and for haulouts in central and northern California. Log-linear interpolation between adjacent counts was used to estimate counts for rookeries when they were not censused in a given year: (1) 1980 at Santa Barbara Is.; (2) 1978-1980 at San Clemente Is.; (3) 1978, 1979, 1988, and 1989 at San Nicolas Is. The mean was used when more than one count was available for a given rookery. Also, an index was used for San Miguel Island because some years lacked data for certain areas. Three major declines in the number of pups counted occurred during El Niño events in 1983, 1992-93, and 1998 (Figure 2). A regression of the natural logarithm of the pup counts against year indicates that the counts of pups increased at an annual rate of 5.4% between 1975 and 2001. When pup counts for El Niño years (1983, 1992, 1993, and 1998) are removed from the 1975-2001 time series, the count of pups increased at an annual rate of 6.1%.

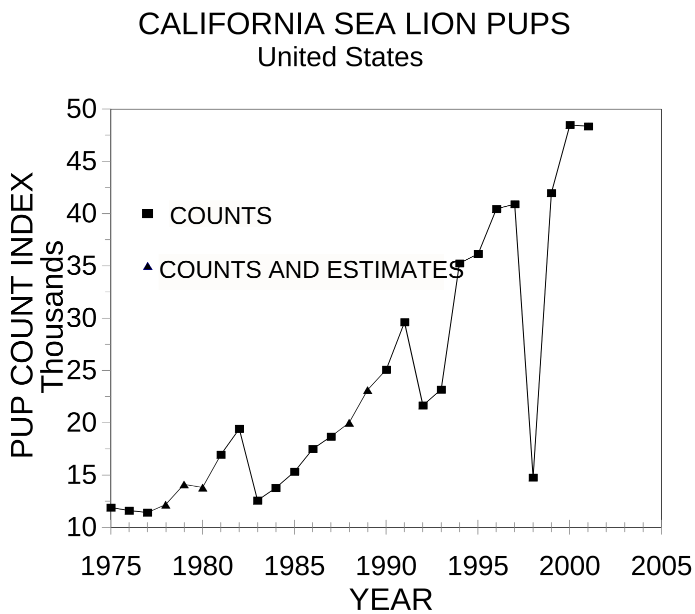

Figure 2. U.S. pup count index for California sea lions (1975-2001).

The 1975-2001 time series of pup counts shows the effect of three El Niño events on the sea lion population. Pup production decreased by 35 percent in 1983, 27 percent in1992, and 64 percent in 1998. After the 1992-93 and 1997-98 El Niños, pup production rebounded by 52 percent and 185 percent, respectively, but there was no rebound after the 1983-84 El Niño (Figure 2). Unlike the 1992-93 and 1997-98 El Niños, the 1983-84 El Niño affected adult female survivorship (DeLong et al 1991) which prevented the rebound in pup production after the event was over because there were fewer adult females available in the population to produce a pup (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, NMFS unpubl. data) which affect future recruitment into the adult population for the affected cohorts. The long term effects of the 1992-93 event, which resulted in fewer females being recruited into the adult population, is manifested in lower net productivity rates for 1997 and 1999 (relative to 1997; Figure 2) because fewer females reached reproductive age (females reach reproductive age at three to five years). The severity, timing, length, and frequency of future El Niños will govern the growth rate of the sea lion population in the future.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The rate of net production is greater than the observed growth rate because human-related mortalities take a fraction of the net production. Net productivity was, therefore, calculated for 1980-2001 as the realized rate of population growth (increase in pup counts from year *I* to year *I*+1, divided by pup count in year *I*) plus human related mortalities (fishery and non-fishery mortalities in year *I* divided by population size in year *I*). For California sea lions, the total mortalities estimated from NMFS, California Dept. of Fish and Game, Columbia River Area observer programs, and reports from stranding programs and from salmon net pen fisheries were 1,967, 1,967, 1,967, 4,344, 2,476, 2,364, 4,417, 2,847, 3,753, 2,315, 2,757, 1,905, 3,522, 2,039, 948, 834, 1,166, 1,558, 1,587, 1,560, 1,672 and 1,373 for 1980 to 2001, respectively (Miller et al. 1983; Hanan et al. 1988; Hanan and Diamond 1989; Brown and Jeffries 1993; Barlow et al. 1994, Julian 1997, Julian and Beeson 1998, Cameron and Forney 1999, NMFS unpubl. data).

Between 1980 and 2001 the net production rate averaged 15.1% (Figure 3). A regression (thin line) shows a slight increase in net production rates, but the regression is strongly influenced by the El Niño years (1983, 1992, and 1998) and the high net production rate during El Niño recovery years (1994 and 1999). When El Niño years (1983, 1992, 1993, and 1998) and El Niño recovery years (1994 and 1999) are removed, the regression line shows a slight decrease (thick line) and net production averages 12.5%. Maximum net productivity rates cannot be estimated from available data.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (138,881) times one half the default maximum net growth rate for pinnipeds (½ of 12%) times a recovery factor of 1.0 (for a stock of unknown status that is growing, Wade and Angliss 1997); resulting in a PBR of 8,333 sea lions per year.

ANNUAL HUMAN-CAUSED MORTALITY

Historical Depletion

Records of 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). Lowry et al. (1992) stated that there were few historical records to document the effects of such exploitation on sea lion abundance.

Fisheries Information

California sea lions are killed incidentally in set and drift gillnet fisheries (Hanan et al. 1993; Barlow et al. 1994; Julian 1997; Julian and Beeson, 1998, Cameron and Forney 1999; Table 1). Detailed information on these fisheries is provided in Appendix 1. Mortality estimates for the California the set and drift gillnet fisheries are included in Table 1 for the five most recent years of monitoring, 1997-2001 (Julian 1997; Cameron and Forney 1999, 2000; Carretta 2001, 2002). A controlled experiment during 1996-97 demonstrated that the use of acoustic warning devices (pingers) reduced sea lion entanglement rates considerably within the drift gillnet fishery (Barlow and Cameron 2003). However, entanglement rates increased again during the 1997 El Niño and continued during 1998. The reasons for the increase in entanglement rates are unknown. However, it has been suggested that sea lions may have foraged further offshore in response to limited food supplies near rookeries, which would provide opportunity for increased interactions with the drift gillnet fishery. Because of interannual variability in entanglement rates, additional years of data will be required to fully evaluate the effectiveness of pingers for reducing mortality of this particular species. Mortality estimates from the drift gillnet fishery are based on 1997-2001 observer data (~20% observer coverage). Estimates of mortality for the halibut/angel shark set gillnet fishery in southern California are based on 1991-94 kill rates and current levels of fishing effort, except for the Monterey portion of the fishery, which was observed in 1999 and 2000 (Table 1). Mortalities from these and other fisheries result in an average estimate of 1,476 (CV = 0.03) California sea lions taken annually (Table 1).

Logbook and observer data, and fisher reports, indicate that mortality of California sea lions occurs, or has occurred in the past, also in the following fisheries: (1) California, Oregon, and Washington salmon troll fisheries; (2) Oregon and Washington non-salmon troll fisheries; (3) California herring purse seine fishery; (4) California anchovy, mackerel, and tuna purse seine fishery; (5) California squid purse seine fishery, (6) Washington, Oregon, California and British Columbia, Canada salmon net pen fishery, (7) Washington, Oregon, California groundfish trawl fishery, and (8) Washington, Oregon and California commercial passenger fishing vessel fishery (NMFS 1995, M. Perez pers. comm, and P. Olesiuk pers. comm.). The OR Columbia River gillnet fishery has been reduced to such levels that California sea lion mortality, if any, is negligible (J. Scordino, per. comm.). The California and Oregon/Washington Marine Mammal Stranding Network databases maintained by the National Marine Fisheries Service contain records of human-related fishery mortalities of stranded California sea lions. These records show that at least five additional mortalities and nine injuries occurred in 2001 as a result of fishing net entanglement and two additional mortalities and six injuries from hook and line fisheries.

Drift gillnet fisheries for swordfish and sharks exist along the entire Pacific coast of Baja California, Mexico and may take animals from the same 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).

Table 1. Summary of available information on the mortality and serious injury of California sea lions in commercial fisheries that might take this species (Cameron and Forney 1999, 2000; Carretta 2001; 2002, M. Perez per. comm, Appendix 1). Mean annual takes are based on 1997-2001 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 driftnet fishery for sharks and swordfish	1997 1998 1999 2000 2001	observer	23.0% 20.0% 20.0% 22.9% 20.4%	36 23 6 13 2	201(0.34) 114 (0.23) 30 (0.36) 50 (0.43) 9 (0.69)	81 (0.19)
CA set gillnet fishery for halibut and angel shark	1997 1998 1999 2000 2001	extrapolated estimate	0% 0% 4% 1.8% 0%	- - 13 28 0	1,206 (0.06)[1] 1,228 (0.07)[1] 1,360 (0.07)[1] 1,346 (0.07)[1] 1,194 (0.07)[1]	1,267 (0.03)[1]
WA, OR, CA domestic groundfish trawl fishery (At-sea processing Pacific whiting fishery only)	1997 1998 1999 2000 2001	observer	65.7% 77.3% 68.6% 80.6% 96.2%	0 1 1 0 0	0 1 (0.48) 3 (0.55) 0 0	0.8 (0.43)
WA, OR salmon net pen fishery	1997 1998 1999 2000 2001	MMAP n/a		9 12 n/a	9 12 n/a	11
Canada: BC salmon pen fishery	1997 1998 1999 2000 2001	MMAP		52 88 134 217 88	52 88 134 217 88	116
Minimum total annual takes						1,476 (0.03)

[1] The California set gillnets were not observed after 1994; mortality was extrapolated from effort estimates and previous entanglement rates, except for Monterey Bay, where 20-25% of the fishery was observed in 1999 and 2000. Changes in the distribution of effort in this fishery add considerable uncertainty to these estimates and associated CVs are likely to be underestimated.

Other Mortality

California sea lions that were injured by entanglement in gillnet and other man-made debris have been observed at rookeries and haulouts (Stewart and Yochem 1987, Oliver 1991). The proportion of those entangled ranged from 0.08% to 0.35% of those present on land, with the majority (52%) entangled with monofilament gillnet material. Data from a marine mammal rehabilitation center showed that 87% of 87 rescued California sea lions were entangled in 4-4.5 inch square-mesh monofilament gillnet (Howorth 1994). Of California sea lions entangled in gillnets, 0.8% in set gillnets and 5.4% in drift gillnets were observed to be released alive from the net by fishers during 1991-95 (Julian and Beeson 1998). Clearly, some are escaping from gillnets; however, the rate of escape from gillnets, as well as the mortality rate of these injured animals, is unknown.

Live strandings and dead beach-cast California sea lions have also been observed with gunshot wounds in California (Lowry and Folk 1987, Deiter 1991, Barocchi et al. 1993, Goldstein et al. 1999). A summary of records for 2001 from the California Marine Mammal Stranding Network (CMMSN) and the Oregon and Washington stranding databases shows the following non-fishery related mortality: boat collision (three mortalities), entrainment in power plants (21 mortalities), and shootings (54 mortalities and three injuries). Stranding records are a gross under-estimate of injury and mortality. However, CMMSN stranding records indicate a higher mortality rate as a result of shootings and hook and line entanglements during the1997-98 El Niño period (115 shootings, 26 hook and line entanglements) than during the 1995-96 non-El Niño period (61 shootings, five hook and line entanglements). There are currently no estimates of the total number of California sea lions being killed or injured by guns, boat collisions, entrainment in power plants, marine debris, or gaffs, but the minimum number in 2001 was 78.

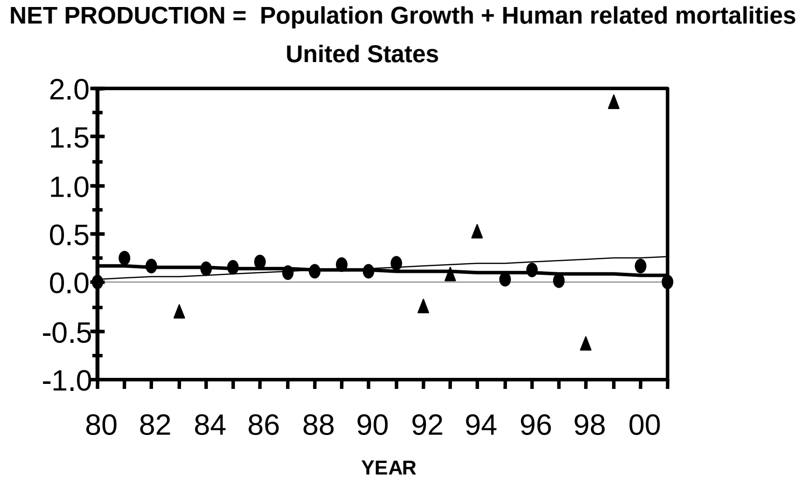

Figure 3. Net production rates and regression lines estimated from pup counts with corrections for incidental human-related mortalities. Thick line excludes El Niño years and El Niño recovery years (i.e., triangles); thin line includes all years.

Several Pacific Northwest treaty Indian tribes have promulgated tribal regulations allowing tribal members to exercise treaty rights for subsistence harvest of sea lions. Current estimates of annual take are zero to two animals per year.

Sea lion mortalities in 1998 along the central California coast have recently been linked to the algal-produced neurotoxin domoic acid (Scholin et al. 2000). Future mortalities may be expected to occur, due to the periodic nature of such harmful algal blooms.

STATUS OF STOCK

Lowry et al. (1992) concluded that there was no evidence of a density dependent signal in counts of California sea lions between 1983 and 1990, and that it was not possible to determine the status of this stock relative to OSP. They are not listed as "endangered" or "threatened" under the Endangered Species Act or as "depleted" under the MMPA. They are not considered a "strategic" stock under the MMPA because total human-caused mortality (1,483 fishery-related mortalities plus 78 from other sources) is less than the PBR (8,333). The total fishery mortality and serious injury rate for this stock is not less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching a zero mortality and serious injury rate. The population has been growing recently at 5.4% to 6.1% per year.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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. richardsi* in the eastern North Pacific. The latter subspecies inhabits near-shore coastal and estuarine areas from Baja California, Mexico, to the Pribilof Islands in Alaska. These seals do not make extensive pelagic migrations, but do travel 300-500 km on occasion to find food or suitable breeding areas (Herder 1986; D. Hanan unpublished data). 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. 2005).

Within the subspecies *P. v. richardsi*, abundant evidence of geographic structure comes from differences in mitochondrial DNA (Huber et al. 1994; 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 (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. Although we know that 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 (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. 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 will be again treated as a separate stock in this report (Fig. 1). Other Marine Mammal Protection Act (MMPA) stock assessment reports cover the five other stocks that are recognized along the U.S. west coast: Oregon/Washington outer coastal waters, Washington inland waters, and three stocks in Alaska coastal and inland waters.

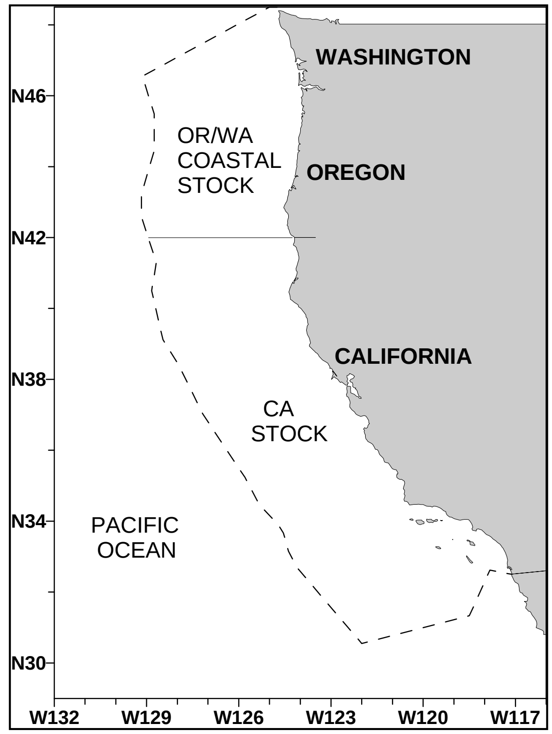

Figure 1. Stock boundaries for the California and Oregon/Washington coastal stocks of harbor seals. Dashed line represents the U.S. EEZ.

POPULATION SIZE

A complete count of all harbor seals in California is impossible because some are always away from the haulout sites. A complete pup count (as is done for other pinnipeds in California) is also not possible because harbor seals are precocious, with pups entering 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 the inverse of the estimated fraction of seals on land. Boveng (1988) reviewed studies estimating the proportion of seals hauled out to those in the water and suggested that a correction factor for harbor seals is likely to be between 1.4 and 2.0. Huber (1995) estimated a mean correction factor of 1.53 (CV=0.065) for harbor seals in Oregon and Washington during the peak pupping season. Hanan (1996) estimated that 83.3% (CV=0.17) of harbor seals haul out at some time during the day during the May/June molt, and he estimated a correction factor of 1.20 based on those data. Neither correction factor is directly applicable to an aerial photographic count in California: the 1.53 factor was measured at the wrong time of year (when fewer seals are hauled out) and in a different area and the 1.20 factor was based on the fraction of seals hauled out over an entire 24-hour day (correction factors for aerial counts should be based on the fraction of seals hauled out at the time of the survey). Hanan (pers. comm.) revised his haul-out correction factor to 1.3 by using only those seals hauled out between 0800 and 1700 hrs which better corresponds to the timing of his surveys. Based on the most recent harbor seal counts (26,333 in May-July 2004; Lowry et al. 2005) and Hanan's revised correction factor, the harbor seal population in California is estimated to number 34,233.

Minimum Population Estimate

Because of the way it was calculated (based on the fraction of seals hauled out at any time during a 24 hr day), Hanan's (1996) correction factor of 1.2 can be viewed as a minimum estimate of the fraction hauled out at a given instant. A population size estimated using this correction factor provides a reasonable assurance that the true population is greater than or equal to that number, and thus fulfills the requirement of a minimum population estimate. The minimum size of the California harbor seal population is therefore 31,600.

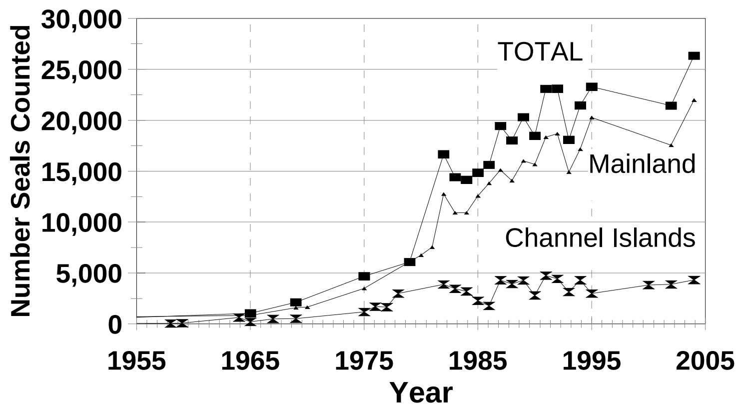

Figure 2. Harbor seal haulout counts in California during May/June (Hanan 1996; R. Read, CDFG unpubl. data; NMFS unpubl. data from 2002 and 2004 surveys).

Current Population Trend

Counts of harbor seals in California showed a rapid increase from approximately 1972 (when the MMPA was first passed) to 1990 (Fig. 2). Net production rates appeared to be decreasing from 1982 to 1994 (Fig. 3). Although earlier analyses were equivocal (Hanan 1996) and there has been no formal determination that the California stock has reached OSP (Optimal Sustainable Population level as defined by the MMPA), the decrease in population growth rate has occurred at the same time as a decrease in human-caused mortality and may indicate that the population is approaching its environmental carrying capacity. Population growth has also slowed or stopped for the harbor seal stock on the outer coasts of Oregon and Washington (see separate Stock Assessment Report).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A realized rate of increase was calculated for the 1982-1995 period (when annual counts were available) by linear regression of the natural logarithm of total count versus year. The slope of this regression line was 0.035 (s.e.=0.007) which gives an annualized growth rate estimate of 3.5%. The current rate of net production is greater than this observed growth rate because fishery mortality takes a fraction of the net production. Annual gillnet mortality may have been as high as 5-10% of the California harbor seal population in the mid-1980s; a kill this large would have depressed population growth rates appreciably. Net productivity was therefore calculated for 1980-1994 as the realized rate of population growth (increase in seal counts from year *i* to year *i*+1, divided by the seal count in year *i*) plus the human-caused mortality rate (fishery mortality in year *i* divided by population size in year *i*). Between 1983 and

1994, the net productivity rate for the California stock averaged 9.2% (Fig. 3). A regression shows a decrease in net production rates, but the decline is not statistically significant. Maximum net productivity rates cannot be estimated because measurements were not made when the stock size was very small.

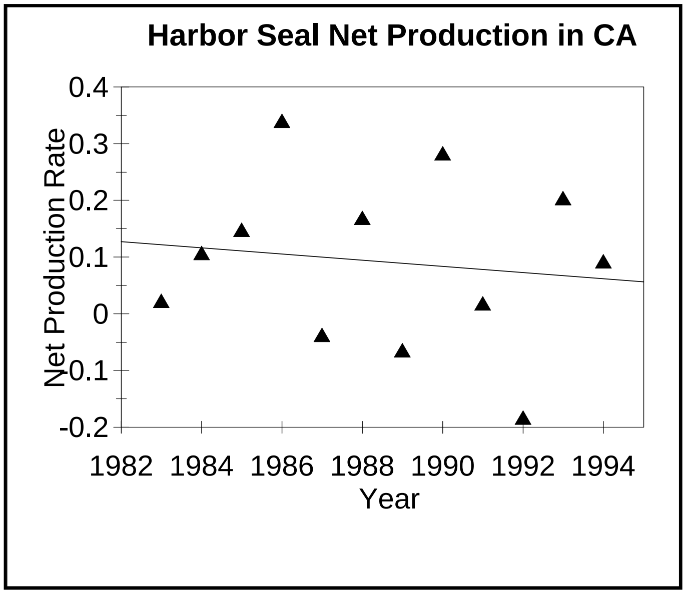

Figure 3. Net production rates and regression line estimated from haulout counts and fishery mortality.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (31,600) <u>times</u> one half the default maximum net productivity rate for pinnipeds (½ of 12%) <u>times</u> 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 1,896.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

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 this century, the population has increased dramatically.

Fishery Information

A summary of known fishery mortality and injury for this stock of harbor seals is given in Table 1. More detailed information on these fisheries is provided in Appendix 1. Because the vast majority of harbor seal mortality in California fisheries occurs in the set gillnet fishery, because that fishery has undergone dramatic reductions and redistributions of effort, and because the entire fishery has not been observed since 1994, average annual mortality cannot be accurately estimated for the recent years (1999-2003). Rough estimates for 1999-2003 have been made by extrapolation of prior kill rates using recent effort estimates and observations in the Monterey portion of the fishery from 1999 and 2000 (Table 1). Observations from the Monterey Bay portion of the fishery included 57 and 24 harbor seals taken in 1999 and 2000, respectively. Stranding data reported to the California Marine Mammal Stranding Network from 1999-2003 include harbor seal deaths and injuries caused by hook-and-line fisheries (four deaths, two injuries) and gillnet fisheries (two deaths, two injuries). The locations and timing of harbor seal strandings attributed to gillnet fisheries suggest that the halibut/angel shark or white seabass set gillnet fishery are responsible for the interactions (see Appendix 1 for fishery descriptions).

Other Mortality

The California Marine Mammal Stranding database maintained by the National Marine Fisheries Service, Southwest Region, contains the following records of human-related harbor seal mortalities and injuries in 1999-2003: (1) boat collision (eight mortalities, two injuries), (2) entrainment in power plants (26 mortalities), (3) shootings (15 mortalities), and (4) all-terrain vehicle (ATV) collision (one injury).

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 (Cameron and Forney 2000; Carretta 2001, 2002; Carretta et al. 2003; Carretta and Chivers 2004). n/a indicates that data are not available. Mean annual takes are based on 1999-2003 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 drift gillnet fishery	1998-2003	observer data	20-23%	0	0,0,0,0,0	0[1]
CA angel shark/halibut and other species large mesh (>3.5") set gillnet fishery	1999 2000	observer data	4.0%[3] 1.7%[3]	57 24	662 (0.10)[1] 415 (0.08)[1]	386 (0.05)[1]
	2001 2002 2003	extrapolated estimate	0.0%[3] 0.0%[3] 0.0%[3]	- - -	329 (0.09)[1] 337 (0.11)[1] 186 (0.09)[1]	
CA, OR, and WA salmon troll fishery	1990-92	logbook data	-		Avg. Annual take = 7.33	n/a
CA herring purse seine fishery	1990-92	logbook data	-		Avg. Annual take = 0	n/a
CA anchovy, mackerel, and tuna purse seine fishery	1990-92	logbook data	-		Avg. Annual take = 0.67	n/a
WA, OR, CA groundfish trawl	1999 2000 2001 2002 2003	observer data	68.6% 80.6% 96.2% 100% 100%	0 2 0 0 0	0 3 (0.21) 0 0 0	0.6 (0.21)
	1999-2003	unmonitored hauls		1	1	0.2 (n/a)
CA squid purse seine fishery	1997-2001	logbook data	Warden obs 2-3 trips/month	0	Avg. Annual take = 0	n/a
(unknown net and hook fisheries)	1999-2003	stranding data		6		1.5
Total annual takes						388 (0.05)

[1]The CA set gillnets were not observed after 1994, except for Monterey Bay, where the fishery was observed in 1999 and 2000. Mortality in other regions was extrapolated from current (1999-2003) effort estimates and 1990-94 entanglement rates, thus the CV of the mortality estimate for this fishery is likely to be underestimated by an unknown amount. There was no observer coverage in this fishery in 2001-2003.

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). They are not listed as "endangered" or "threatened" under the Endangered Species Act nor as "depleted" under the MMPA. Total fishing mortality cannot be accurately estimated for recent years, but extrapolations from past years indicate that fishing mortality (388 per year) is less than the calculated PBR for this stock (1,896), and thus they would <u>not</u> be considered a "strategic" stock under the MMPA. The average rate of incidental fishery mortality for this stock is likely to be greater than 10% of the calculated PBR; therefore, fishery mortality cannot be considered insignificant and approaching zero mortality and serious injury rate. The population appears to be stabilizing at what may be their carrying capacity and the fishery mortality is declining. There are no known habitat issues that are of particular concern for this stock. Two unexplained harbor seal mortality events occurred in Point Reyes National Park involving at least 90 seals in 1997 and 16 seals in 2000. Necropsy of three seals in 2000 showed severe pneumonia; tests for morbillivirus were negative, but attempts are being made to identify another virus isolated from one of the three (F. Gulland, pers. comm.). 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 richardsi*): 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 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 (174 km) and along the U.S. west coast (up to 550 km) have been recorded (Pitcher and McAllister 1981, Brown and Mate 1983, Herder 1986). Harbor seals have also displayed strong fidelity for haulout sites (Pitcher and Calkins 1979, Pitcher and McAllister 1981).

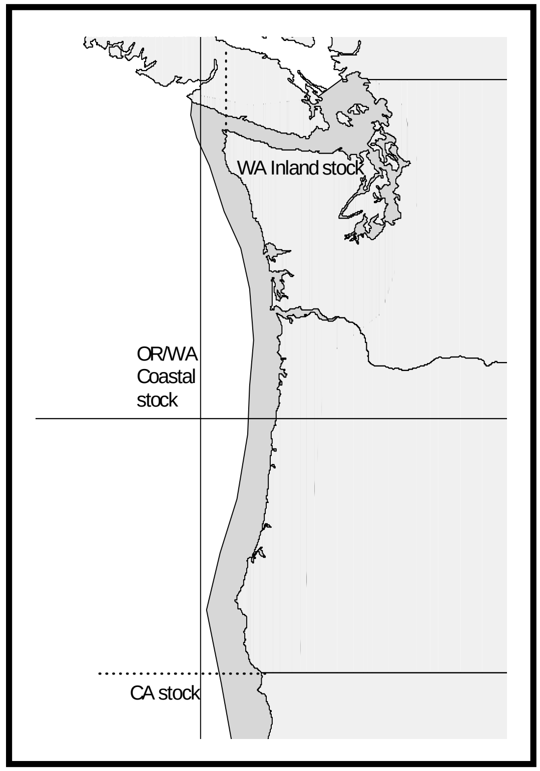

Figure 1. Approximate distribution of harbor seals in the U.S. Pacific Northwest (shaded area). Stock boundaries separating the three stocks are shown.

For management purposes, 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 (see Fig. 1). Recent genetic analyses provide additional support for this stock structure (Huber et al. 1994, Burg 1996, Lamont et al. 1996). Samples from Washington, Oregon, and California demonstrate a high level of genetic diversity and indicate that the harbor seals of inland Washington waters possess unique haplotypes not found in seals from the coasts of Washington, Oregon, and California (Lamont et al. 1996). This report considers only the Oregon/Washington Coast stock. Harbor seal stocks that occur in the inland and coastal waters of Alaska are discussed separately in the Stock Assessment Reports for the Alaska Region.

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, unpubl. 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, unpubl. data).

Minimum Population Estimate

The log-normal 20th percentile of the 1999 population estimate for this stock is 22,380 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 Marine Mammal Protection Act (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, unpubl. data).

Between 1983 and 1996, the annual rate of increase for this stock was 4%, with the peak count of 18,667 seals occurring in 1992. From 1991 to 1996, however, this stock declined 1.6% (t=3.25; p=0.083) annually (Jeffries et al. 1997), which may indicate that this population has exceeded equilibrium levels. Analyzing only the Oregon data (average annual rate of increase was 0.3% from 1988-96) indicates that the Oregon segment of the stock may be approaching equilibrium (Brown 1997).

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). This value of R_{MAX} is higher than the default pinniped population growth rate value of 12%; however, since it applies to only a portion of the stock, the actual rate for the entire stock is uncertain. Therefore, until additional data for the entire stock become available, the pinniped default maximum theoretical net productivity rate (R_{MAX}) of 12% will be employed for this harbor seal stock (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population estimate (22,380) <u>times</u> one-half the default maximum net growth rate for pinnipeds (½ of 12%) <u>times</u> a recovery factor of 1.0 (for stocks thought to be within OSP, Wade and Angliss 1997), resulting in a PBR of 1,343 harbor seals per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

NMFS observers monitored the northern Washington marine set gillnet fishery in 1997, 1998, and 2000. There was no observer coverage in 1999 or 2001; the total fishing effort was four and 46 net days, respectively, in those years and occurred only in inland waters (Gearin et al. 1994, 2000; P. Gearin, unpubl. data). For the entire fishery (coastal + inland waters), observer coverage ranged from approximately 40 to 98% during observed years. Fishing effort is conducted within the range of both stocks of harbor seals (Oregon/Washington Coast and Washington Inland Waters stocks) occurring in Washington State waters. For the purposes of this stock assessment report, the animals taken in the inland portion of the fishery are assumed to have belonged to the Washington Inland Waters stock and the animals taken in the coastal portion of the fishery are assumed to have belonged to the Oregon/Washington Coast stock. 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). Accordingly, Table 1 includes data only from that portion of the northern Washington marine set gillnet fishery occurring within the range of the Oregon/Washington Coast stock (those waters south and west of Cape Flattery), where observer coverage was 100% in 1997 and 2000. No fishing effort occurred in the coastal portion of the fishery in 1998, 1999, or 2001. The mean estimated mortality for this fishery in 1997-2001 is 3.2 (CV=0.79) harbor seals per year from this stock.

The WA/OR/CA groundfish trawl fishery (Pacific whiting component) was monitored for incidental take during 1997-2001 (Perez 2003). The only harbor seal mortalities occurred in 1997 and 2000. The mortality in 1997 occurred during an unmonitored haul and therefore was not used to estimate mortality for the entire fishery that year.

However, observer coverage (based on observed tons) was 66% in 1997, observers monitored 100% of the vessels during the fishery, and the reported mortality is thought to be the only harbor seal mortality in the fishery that year. In 1997-2001, the mean estimated mortality in this fishery is 0.8 (CV=1.0) harbor seals per year (from monitored hauls), plus 0.2 animals per year (from unmonitored haul data).

Table 1. Summary of available information on the incidental mortality and 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. All entanglements resulted in the death of the animal. Mean annual takes are based on 1997-2001 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 fishery in coastal waters: areas 4 and 4A)	97 98 99 00 01	obs data	100% no fishery no fishery 100% no fishery	13 0 0 3 0	13 0 0 3 0	3.2 (0.79)
WA/OR/CA groundfish trawl (Pacific whiting component)	97 98 99 00 01	obs data	65.7% 77.3% 68.6% 80.6% 96.2%	0 0 0 2 0	0 0 0 4 0	0.8 (1.0)
	97	unmonitored hauls		1		0.2 (n/a)
WA Grays Harbor salmon drift gillnet	91-93	obs data	4-5%	0, 1, 1	0, 10, 10	6.7 (0.50)
WA Willapa Bay drift gillnet	91-93	obs data	1-3%	0, 0, 0	0, 0, 0	0
WA Willapa Bay drift gillnet	90-93	self reports	n/a	0, 0, 6, 8	n/a	≥3.5 (n/a) see text
Unknown west coast fisheries	97-01	strand data	n/a	0, 0, 1, 0, 0		≥0.2 (n/a)
Minimum total annual takes						≥14.6 (0.4)

The Washington and Oregon Lower Columbia River drift gillnet fishery was monitored during the entire year in 1991-1993 (Brown and Jeffries 1993, Matteson et al. 1993c, Matteson and Langton 1994a). Harbor seal mortalities, incidental to the fishery, were observed only in the winter season and were extrapolated to estimate total harbor seal mortality. However, the structure of the fishery has changed substantially since the 1991-1992 fishing seasons, and this level of take no longer applies to the current fishery (see Appendix 1). The Oregon Department of Fish and Wildlife (ODFW) conducted test fisheries in the lower Columbia River in 2000-2002 to evaluate the use of small-mesh (3½"-6") tangle (tooth) nets in commercial, spring chinook fisheries to effectively harvest target stocks, while allowing the live release of non-target stocks and species (G. Whisler, pers. comm.). An experimental commercial permit fishery and a full-fleet commercial demonstration fishery were also conducted in 2001 and 2002, respectively, to test the small-mesh gear. Data on marine mammal interactions (predation, entanglement), recorded by observers during the permit and demonstration fisheries, have not yet been summarized; however, no marine mammal mortalities or serious injuries were reported to NMFS by vessel operators. The test fishery in the lower Columbia River is expected to continue in 2003.

The Washington Grays Harbor salmon drift gillnet fishery was also monitored in 1991-1993 (Herczeg et al. 1992a; Matteson and Molinaar 1992; Matteson et al. 1993a; Matteson and Langton 1994b, 1994c). During the 3-year period, 98, 307 and 241 sets were monitored, representing approximately 4-5% observer coverage in each year. No mortalities were recorded in 1991. In 1992, observers recorded one harbor seal mortality incidental to the fishery, resulting in an extrapolated estimated total kill of 10 seals (CV=1.0). In 1993, observers recorded one harbor seal mortality incidental to the fishery, though a total kill was not extrapolated. Similar observer coverage in 1992 and 1993 (4.2% and 4.4%, respectively) suggests that 10 is also a reasonable estimate of the total kill in 1993.

Thus, the mean estimated mortality for this fishery in 1991-1993 is 6.7 (CV=0.50) harbor seals per year (Table 1). No observer data are available for this fishery after 1993, however, harbor seal takes are unlikely to have increased since the fishery was last observed, due to reductions in the number of participating vessels and available fishing time (see details in Appendix 1). Fishing effort and catch have declined throughout all salmon fisheries in the region due to management efforts to recover ESA-listed salmonids.

Combining the estimates from the northern Washington marine set gillnet (3.2), WA/OR/CA groundfish trawl (0.8 from monitored hauls + 0.2 from unmonitored haul data), and Washington Grays Harbor salmon drift gillnet (6.7) fisheries results in an estimated mean mortality rate in observed fisheries of 10.9 harbor seals per year from this stock.

The Washington Willapa Bay drift gillnet fishery was also monitored at low levels of observer coverage in 1991-1993 (Herczeg et al. 1992a, 1992b; Matteson and Molinaar 1992; Matteson et al. 1993b; Matteson and Langton 1994c, 1994d). In those years, 752, 576 and 452 sets were observed representing approximately 2.5%, 1.4% and 3.1% observer coverage, respectively. No harbor seal mortalities were reported by observers. However, because mortalities were self-reported by fishers in 1992 and 1993, the low level of observer coverage failed to document harbor seal mortalities which had apparently occurred. Due to the low level of observer coverage for this fishery, the self-reported fishery mortalities have been included in Table 1 and represent a minimum mortality estimate resulting from that fishery (3.5 harbor seals per year). Harbor seal takes are unlikely to have increased since the fishery was last observed in 1993, due to reductions in the number of participating vessels and available fishing time (see details in Appendix 1). Fishing effort and catch have declined throughout all salmon fisheries in the region due to management efforts to recover ESA-listed salmonids.

An additional source of information on the number of harbor seals killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1997 and 2001, there were no fisher self-reports of any harbor seal mortalities. However, because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. Logbook data are available for part of 1989-1994, after which incidental mortality reporting requirements were modified. Under the new system, logbooks are no longer required; instead, fishers provide self-reports. Data for the 1994-1995 phase-in period is fragmentary. After 1995, the level of reporting dropped dramatically, such that the records are considered incomplete and estimates of mortality based on them represent minimums (see Appendix 7 in Angliss et al. 2001 for details).

Strandings of harbor seals entangled in fishing gear or with injuries caused by interactions with gear are a final source of fishery-related mortality information. One fishery-related stranding was reported in 1999 (B. Norberg, pers. comm.) and, since it could not be attributed to a particular fishery, it is listed in Table 1 as occurring in an unknown west coast fishery. Fishery-related strandings during 1997-2001 resulted in an estimated annual mortality of 0.2 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).

Other Mortality

According to Northwest Marine Mammal Stranding Network records, maintained by the NMFS Northwest Region, a total of eight human-caused harbor seal mortalities or serious injuries were reported from non-fisheries sources in 1997-2001. Seven animals were shot (one each in 1997, 1999, and 2000 and two each in 1998 and 2001) and one animal was struck by an off-road-vehicle (in 1997), resulting in an estimated mortality of 1.6 harbor seals per year 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

Several Pacific Northwest treaty Indian tribes have promulgated tribal regulations allowing tribal members to exercise treaty rights for subsistence harvest of harbor seals. There have been only a few reported takes of harbor seals from directed tribal subsistence hunts. It is possible that very few seals have been taken in directed hunts because tribal fishers use seals caught incidentally to fishing operations, in the northern Washington marine set gillnet fishery, for their subsistence needs before undertaking a ceremonial or subsistence hunt. From communications with the tribes, the NMFS Northwest Regional Office (J. Scordino, pers. comm.) believes that 5-10 harbor seals from this stock may be taken annually in directed subsistence harvests.

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 level of human-caused mortality and serious injury (14.6 + 1.6 + 5-10 = 21.2-26.2) is not known to exceed the PBR (1,343). Therefore, the Oregon/Washington Coast stock of harbor seals is not classified as a "strategic" stock. The minimum total fishery mortality and serious injury for this stock (14.6: based on observer data (10.9) and self-reported fisheries information (3.5) or stranding data (0.2) where observer data were not available or failed to detect harbor seal mortality) appears to be less than 10% of the calculated PBR (134) and, therefore, appears to be insignificant and approaching zero mortality and serious injury rate. The stock size increased until 1992, but has declined in recent years. At this time it is not possible to assess the status of this stock relative to its Optimum Sustainable Population (OSP) level.

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HARBOR SEAL (*Phoca vitulina richardsi*): Washington Inland Waters 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 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 (174 km) and along the U.S. west coast (up to 550 km) have been recorded (Pitcher and McAllister 1981, Brown and Mate 1983, Herder 1986). Harbor seals have also displayed strong fidelity for haulout sites (Pitcher and Calkins 1979, Pitcher and McAllister 1981).

For management purposes, 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 (see Fig. 1). Recent genetic analyses provide additional support for this stock structure (Huber et al. 1994, Burg 1996, Lamont et al. 1996). Samples from Washington, Oregon, and California demonstrate a high level of genetic diversity and indicate that the harbor seals of inland Washington waters possess unique haplotypes not found in seals from the coasts of Washington, Oregon, and California (Lamont et al. 1996). In this report only the Washington Inland Waters stock is addressed. Harbor seal stocks that occur in the inland and coastal waters of Alaska are reported separately in the Stock Assessment Reports for the Alaska Region.

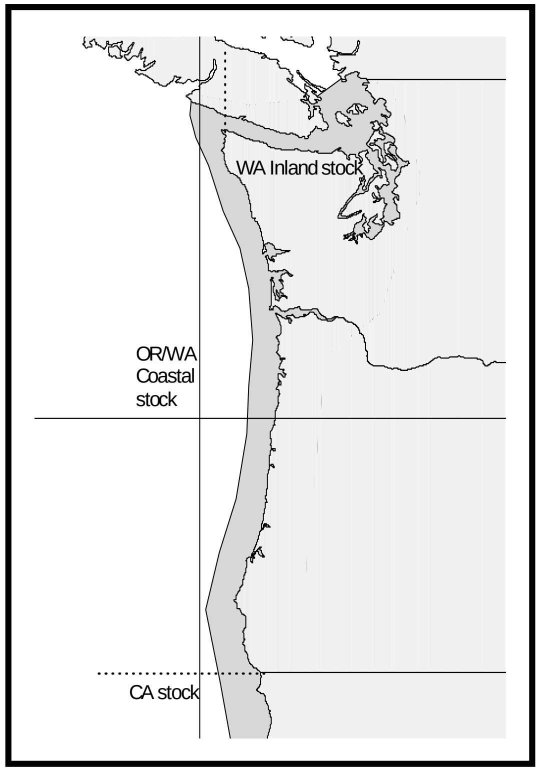

Figure 1. Approximate distribution of harbor seals in the U.S. Pacific Northwest (shaded area). Stock boundaries separating the three stocks are shown.

POPULATION SIZE

Aerial surveys of harbor seals in Washington were conducted during the pupping season in 1999, during which time the total number of hauled-out seals (including pups) were counted. In 1999, the mean count of harbor seals occurring in Washington's inland waters was 9,550 (CV=0.14) animals (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 estimate of 14,612 (9,550 x 1.53; CV=0.15) for the Washington Inland Waters stock of harbor seals (Jeffries et al. 2003).

Minimum Population Estimate

The log-normal 20th percentile of the 1999 population estimate for this stock is 12,844 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 protection provided by 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).

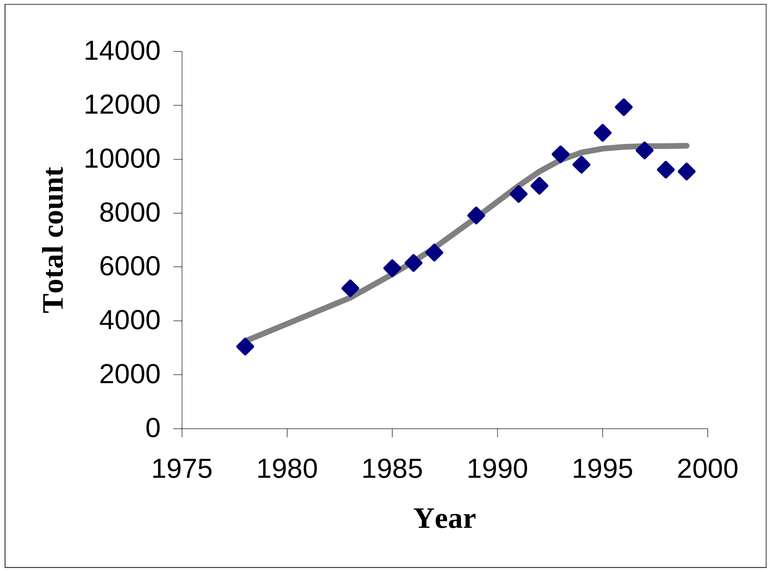

Figure 2. Generalized logistic population growth curve for the Washington Inland Waters stock of harbor seals, 1978-1999 (Jeffries et al. 2003).

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

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (12,844) <u>times</u> one-half the default maximum net growth rate for pinnipeds (½ of 12%) <u>times</u> a recovery factor of 1.0 (for stocks within OSP, Wade and Angliss 1997), resulting in a PBR of 771 harbor seals per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

NMFS observers monitored the northern Washington marine set gillnet fishery in 1997, 1998, and 2000; there was no observer coverage in 1999 or 2001 (Gearin et al. 1994, 2000; P. Gearin, unpubl. data). For the entire fishery (coastal + inland waters), observer coverage ranged from approximately 40 to 98% during observed years. Fishing effort is conducted within the range of both stocks of harbor seals (Oregon/Washington Coast and Washington Inland Waters stocks) occurring in Washington State waters. For the purposes of this stock assessment report, the animals taken in the inland portion of the fishery are assumed to have belonged to the Washington Inland Waters stock and the animals taken in the coastal portion of the fishery are assumed to have belonged to the Oregon/Washington Coast stock. 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). Accordingly, Table 1 includes data only from that portion of the northern Washington marine set gillnet fishery occurring within the range of the Washington Inland Waters stock (those waters east of Cape Flattery), where observer coverage ranged from 40 to 80% between 1997 and 2001 and fishing effort ranged from 4-46 net days per year (1 net day equals a 100-fathom length net In 1993, as a pilot for future observer programs, NMFS, in conjunction with the Washington Department of Fish and Wildlife (WDFW) monitored all non-treaty components of the Washington Puget Sound Region salmon gillnet fishery (Pierce et al. 1994). Observer coverage was 1.3% overall, ranging from 0.9% to 7.3% for the various components of the fishery. Two harbor seal mortalities were reported (Table 1). Pierce et al. (1994) cautioned against extrapolating these mortalities to the entire Puget Sound fishery due to the low observer coverage and potential biases inherent in the data. The area 7/7A sockeye landings represented the majority of the non-treaty salmon landings in 1993, approximately 67%. Results of this pilot study were used to design the 1994 observer programs discussed below.

Table 1. Summary of available information on the incidental mortality and injury of harbor seals (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. All entanglements resulted in the death of the animal. Mean annual takes are based on 1997-2001 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: areas 4B and 5)	97 98 99 00 01	obs data	80% 40% 0% 58% 0%	0 0 n/a 0 n/a	0 0 n/a 0 n/a	0[1]
	97-01	self-reports		0, 0, 0, 0, 2		≥0.4 (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)	93	obs data	1.3%	2	n/a	see text
Puget Sound non-treaty chum salmon gillnet (areas 10/11 and 12/12B)	94	obs data	11%	1	10	10 (n/a)
Puget Sound treaty chum salmon gillnet (areas 12, 12B, and 12C)	94	obs data	2.2%	0	0	0
Puget Sound treaty chum and sockeye salmon gillnet (areas 4B, 5, and 6C)	94	obs data	7.5%	0	0	0
Puget Sound treaty and non-treaty sockeye salmon gillnet (areas 7 and 7A)	94	obs data	7%	1	15	15 (1.0)
WA salmon net pens	97-01	self reports	n/a	10, 5, 0, 0, 0	n/a	≥3 (n/a)
Unknown Puget Sound fishery	97-01	strand data	n/a	1, 1, 0, 2, 2	n/a	≥1.2 (n/a)
Minimum total annual takes						≥29.6 (1.0)

[1]1997-98 and 2000 mortality estimates are included in the average.

In 1994, NMFS, in conjunction with WDFW conducted an observer program during the Puget Sound non-treaty chum salmon gillnet fishery (areas 10/11 and 12/12B). A total of 230 sets were observed during 54 boat trips, representing approximately 11% observer coverage of the 500 fishing boat trips comprising the total effort in this fishery, as estimated from fish ticket landings (Erstad et al. 1996). One harbor seal was taken in the fishery, resulting in an entanglement rate of 0.02 harbor seals per trip (0.004 harbor seals per set), which extrapolated to approximately 10 mortalities for the entire fishery. The Puget Sound treaty chum salmon gillnet fishery in Hood Canal (areas 12, 12B, and 12C) and the Puget Sound treaty sockeye/chum gillnet fishery in the Strait of Juan de

Fuca (areas 4B, 5, and 6C) were also monitored in 1994 (NWIFC 1995). No harbor seal mortalities were reported in the observer programs covering these treaty salmon gillnet fisheries, where observer coverage was estimated at 2.2% (based on % of total catch observed) and approximately 7.5% (based on % of observed trips to total landings), respectively.

Also in 1994, NMFS, in conjunction with WDFW and the Tribes, monitored the Puget Sound treaty and non-treaty sockeye salmon gillnet fishery (areas 7 and 7A). During this fishery, observers monitored 2,205 sets, representing approximately 7% of the estimated number of sets in the fishery (Pierce et al. 1996). There was one observed harbor seal mortality (two others were entangled and released unharmed), resulting in a mortality rate of 0.00045 harbor seals per set, which was extrapolated to 15 mortalities (CV=1.0) for the entire fishery.

In 1996, Washington Sea Grant Program conducted a test fishery in the non-treaty sockeye salmon gillnet fishery (area 7) to compare entanglement rates of seabirds and marine mammals and catch rates of salmon using three experimental gears and a control (monofilament mesh net). The experimental nets incorporated highly visible mesh in the upper quarter (50 mesh gear) or upper eighth (20 mesh gear) of the net or had low-frequency sound emitters attached to the corkline (Melvin et al. 1997). In 642 sets during 17 vessel trips, there were two harbor seal mortalities (one other was released alive with no apparent injuries).

Combining the estimates from the northern Washington marine set gillnet fishery (0.4), the Puget Sound non-treaty chum salmon gillnet fishery in areas 10/11 and 12/12B (10), and the Puget Sound treaty and non-treaty sockeye salmon gillnet fishery in areas 7 and 7A (15) results in an estimated minimum annual mortality rate in observed fisheries of 25.4 harbor seals from this stock. It should be noted that the 1994 observer programs did not sample all segments of the Washington Puget Sound Region salmon set/drift gillnet fishery and, further, the extrapolations of total kill did not include effort for the unobserved segments of this fishery. Therefore, 25.4 is an underestimate of the harbor seal mortality due to the entire fishery. The percentage of the overall Washington Puget Sound Region salmon set/drift gillnet fishery effort that was observed in 1994 was not quantified. However, the areas having the highest salmon catches and in which a majority of the vessels operated in 1994 were covered by the 1994 observer programs (J. Scordino, pers. comm.). Harbor seal takes in the Washington Puget Sound Region salmon drift gillnet fishery are unlikely to have increased since the fishery was last observed in 1994, due to reductions in the number of participating vessels and available fishing time (see details in Appendix 1). Fishing effort and catch have declined throughout all salmon fisheries in the region due to management efforts to recover ESA-listed salmonids.

An additional source of information on the number of harbor seals killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1994 and 2001, there were no fisher self-reports of harbor seal mortalities from the Washington Puget Sound Region salmon set/drift gillnet fishery. Unlike the 1994 observer program data, the self-reported fishery data cover the entire fishery (including treaty and non-treaty components). There were fisher self-reports of 15 harbor seal mortalities due to entanglement in Washington salmon net pens in 1997-2001, 10 in 1997 and five in 1998 (Table 1), resulting in an estimated annual mortality of three harbor seals from this stock. However, because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. Logbook data are available for part of 1989-1994, after which incidental mortality reporting requirements were modified. Under the new system, logbooks are no longer required; instead, fishers provide self-reports. Data for the 1994-1995 phase-in period is fragmentary. After 1995, the level of reporting dropped dramatically, such that the records are considered incomplete and estimates of mortality based on them represent minimums (see Appendix 7 in Angliss et al. 2001 for details).

Strandings of harbor seals entangled in fishing gear or with injuries caused by interactions with gear are a final source of fishery-related mortality information. During the period from 1997 to 2001, small numbers of fishery-related strandings of harbor seals have occurred in most years (B. Norberg, pers. comm.). As the strandings could not be attributed to a particular fishery, they have been included in Table 1 as occurring in an unknown Puget Sound fishery. Fishery-related strandings during 1997-2001 resulted in an estimated annual mortality of 1.2 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).

The minimum estimated fishery mortality and serious injury for this stock is 29.6 harbor seals per year, based on observer program data (25.4), fisher self-reports (3), and stranding data (1.2).

Other Mortality

According to Northwest Marine Mammal Stranding Network records, maintained by the NMFS Northwest Region, a total of 18 human-caused harbor seal mortalities or serious injuries were reported from non-fisheries sources in 1997-2001. Fifteen animals were shot (seven, two, one, three and two each year, respectively), two were struck by ships (one each in 1999 and 2001), and one was found with neck injuries in 1999, resulting in an estimated mortality of 3.6 harbor seals per year from this stock. This estimate is considered a minimum because not all stranded animals are found, reported, or cause of death determined (via necropsy by trained personnel).

Subsistence Harvests by Northwest Treaty Indian Tribes

Several Pacific Northwest treaty Indian tribes have promulgated tribal regulations allowing tribal members to exercise treaty rights for subsistence harvest of harbor seals. There have been only a few reported takes of harbor seals from directed tribal subsistence hunts. It is possible that very few seals have been taken in directed hunts because tribal fishers use seals caught incidentally to fishing operations, in the northern Washington marine set gillnet and Washington Puget Sound Region treaty salmon gillnet fisheries, for their subsistence needs before undertaking a ceremonial or subsistence hunt. From communications with the tribes, the NMFS Northwest Regional Office (J. Scordino, pers. comm.) believes that 0-5 harbor seals from this stock may be taken annually in directed subsistence harvests.

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 level of human-caused mortality and serious injury (29.6 + 3.6 + 0-5 = 33.2-38.2) is not known to exceed the PBR (771). Therefore, the Washington Inland Waters stock of harbor seals is not classified as a “strategic” stock. At present, the minimum estimated fishery mortality and serious injury for this stock (29.6) appears to be less than 10% of the calculated PBR (77) and, therefore, appears to be insignificant and approaching zero mortality and serious injury rate. The stock is within its Optimum Sustainable Population (OSP) level (Jeffries et al. 2003).

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Revised 10/31/2002

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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). Males feed near the eastern Aleutian Islands and in the Gulf of Alaska, and females feed further south, south of 45°N (Stewart and Huber 1993; Le Boeuf et al. 1993). 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 were all originally derived from a few tens or a few hundreds of individuals surviving in Mexico after being nearly hunted to extinction (Stewart et al. 1994). Given the very recent derivation of most rookeries, no genetic differentiation would be expected. Although movement and genetic exchange continues between rookeries, most elephant seals return to their 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.

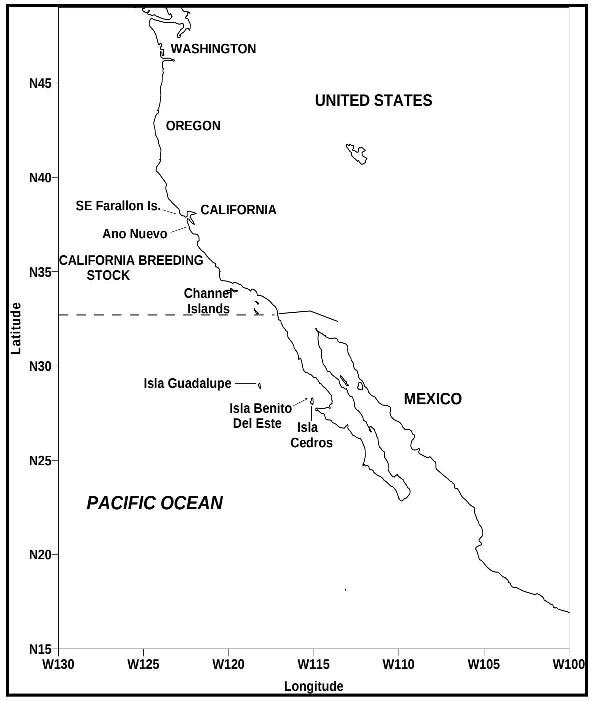

Figure 1. Stock boundary and major rookery areas for northern elephant seals in the U.S. and Mexico.

POPULATION SIZE

A complete population count of elephant seals is not possible because all age classes are not ashore at the same time. Elephant seal population size is typically estimated by counting the number of pups produced and multiplying by the inverse of the expected ratio of pups to total animals (McCann 1985). Stewart et al. (1994) used McCann's multiplier of 4.5 to extrapolate from 28,164 pups to a population estimate of 127,000 elephant seals in the U.S. and Mexico in 1991. The multiplier of 4.5 was based on a non-growing population. Boveng (1988) and Barlow et al.(1993) argue that a multiplier of 3.5 is more appropriate for a rapidly growing population such as the California stock of elephant seals. Based on the estimated 28,845 pups born in California in 2001 (Fig. 2) and this 3.5 multiplier, the California stock was approximately 101,000 in 2001.

Minimum Population Estimate

The minimum population size for northern elephant seals can be estimated very conservatively as 60,547, which is equal to twice the observed pup count (to account for the pups and their mothers) plus 2,317 males and 17 juveniles counted at the Channel Island sites in 2001 (Mark Lowry, NMFS unpubl. data) and 523 males counted at Año Nuevo sites in 1996 (Le Boeuf 1996). More sophisticated methods of estimating minimum population size could be applied if the variance of the multiplier used to estimate population size were known.

Current Population Trend

Based on trends in pupcounts, northern elephant seal colonies were continuing to grow in California through 2001 (Figure 2), but appear to be stable or slowly decreasing in Mexico (Stewart et al. 1994).

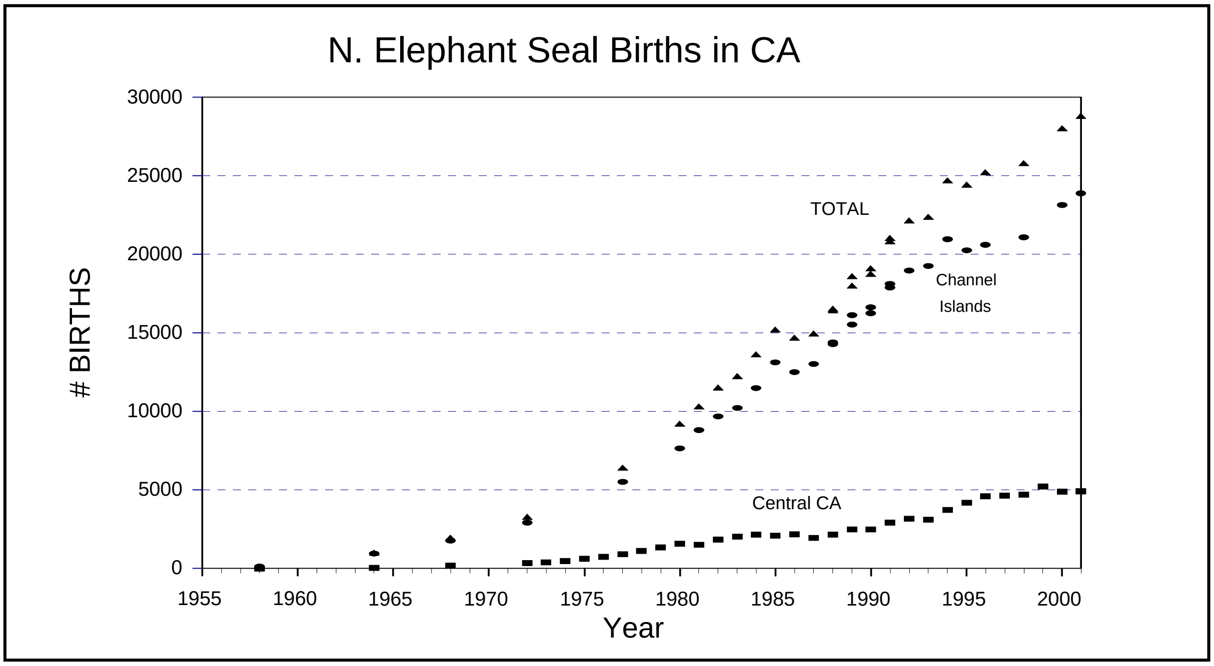

Figure 2. Estimated number of northern elephant seal births in California 1958-2001. Multiple independent estimates are presented for the Channel Islands 1988-91. Estimates are from Stewart et al. (1994), Lowry et al. (1996), and unpublished data from Sarah Allen, Dan Crocker, Brian Hatfield, Ron Jameson, Bernie Le Boeuf, Mark Lowry, Pat Morris, Guy Oliver, and William Sydeman.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATE

Although growth rates as high as 16% per year have been documented for elephant seal rookeries in the U.S. from 1959 to 1981 (Cooper and Stewart 1983), much of this growth was supported by immigration from Mexico. The highest growth rate measured for the whole U.S./Mexico population was 8.3% between 1965 and 1977 (Cooper and Stewart 1983). A continuous growth rate of 8.3% is consistent with an increase from approximately 100 animals in 1900 to the current population size. The "maximum estimated net productivity rate" as defined in the Marine Mammal Protection Act (MMPA) would therefore be 8.3%. In California, the net productivity rate appears

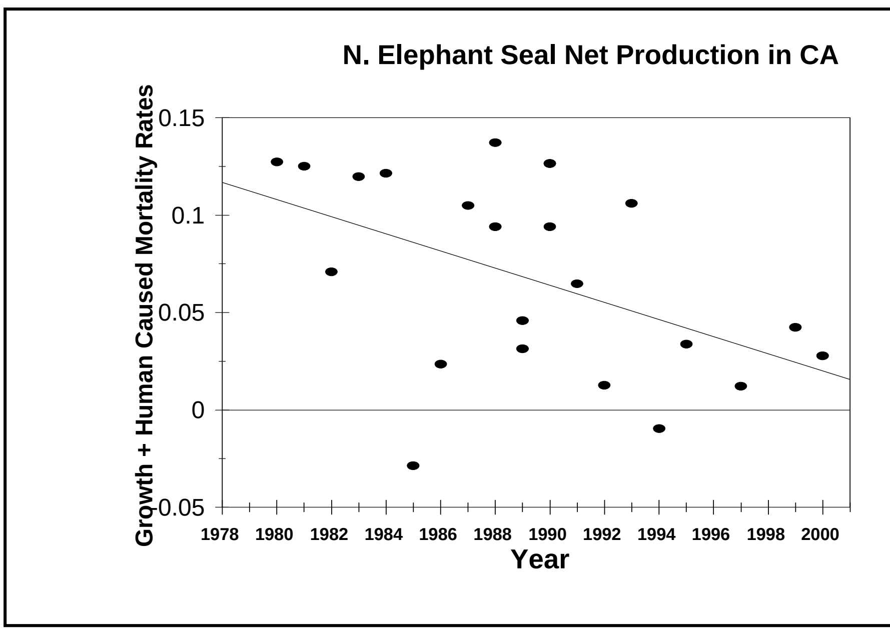

Figure 3. Net production rates for northern elephant seals in California based on pup births and fishery mortality. Annual mortality for 1980-87 is assumed to be 300, the average of 1988-90 values (Perkins et al. 1994).

to have declined in recent years [Figure 3; net production rate was calculated as the realized rate of population growth (increase in pup abundance from year *i* to year *i+1*, divided by pup abundance in year *i*) plus the harvest rate (fishery mortality in year *i* divided by population size in year *i*)].

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (60,547) times one half the observed maximum net growth rate for this stock (½ of 8.3%) 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 2,513.

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 (Julian 1997; Cameron and Forney 1999, 2000; Carretta 2001; Perez, in prep.; NMFS unpubl. data). n/a indicates information is not available. Mean annual takes are based on 1996-2000 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 drift gillnet fishery	1996 1997 1998 1999 2000	observer data	12.4% 22.8% 20.2% 20.0% 25.1%	4 8 4 1 6	37 (0.55) 45 (0.33) 20 (0.44) 10 (0.61) 26 (0.41)	25 (0.21) [1]
CA angel shark/halibut and other species large mesh (>3.5") set gillnet fishery	1996 1997 1998 1999 2000	observer data extrapo-lated estimate	0.0% 0.0% 0.0% 23.1% [3] 26.9% [3]	- - - 10 [†] 4 [†]	46 (0.23) [2] 60 (0.24) [2] 70 (0.26) [2] 76 (0.19) [2] 48 (0.23) [2]	60 (0.10)
WA, OR, CA groundfish trawl	1998	observer data	77%	1	1 (n/a)	1 (n/a)
WA Willapa Bay drift gillnet fishery (salmon)	1991	personal communication	n/a	2	2	n/a
Chehalis River salmon setnet fishery	1993	personal communication	n/a	4	4	n/a
Total annual takes						> 86 (0.14)

[1] Only 1997-2000 mortality estimates are included in the average because of gear modifications implemented within the fishery as part of a 1997 Take Reduction Plan. Gear modifications included the use of net extenders and acoustic warning devices (pingers). Following these changes in the fishery, entanglement rates of northern elephant seals declined.
[2] The CA set gillnets were not observed in 1995-98, and observations in 1999-2000 only included Monterey Bay; mortality for unobserved areas and times was extrapolated from effort estimates and 1991-94 entanglement rates.
[†] Observer coverage and observed mortality in 1999-2000 only includes the portion of the fishery in Monterey Bay.

HUMAN-CAUSED MORTALITY
Fisheries Information

A summary of known fishery mortality and injury for this stock of northern elephant seals is given in Table 1. More detailed information on these fisheries is provided in Appendix 1. The set gillnet fishery in Monterey was observed again in 1999-2000 after a lapse of four years. Entanglement rates of northern elephant seals were similar to extrapolated rates in the previous three years; therefore, mortality estimates for the five most recent years were averaged to give the mean annual take for that fishery. Current mortality could not be estimated for a few fisheries that have taken small numbers of elephant seals in the past; therefore, the overall mortality is likely to be slightly greater than 86 per year. Stranding data reported to the California Marine Mammal Stranding Network in 1996-2000 include elephant seal injuries caused by hook-and-line fisheries (two injuries) and gillnet fisheries (one injury).

Although all of the mortalities 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. Similar drift gillnet fisheries for swordfish and sharks exist along the entire Pacific coast of Baja California, Mexico and probably take northern elephant seal. Quantitative data are available only for the Mexican swordfish drift gillnet fishery, which has increased from two vessels in 1986 to 29 vessels in 1992 (Sosa-Nishizaki et al. 1993). The total number of sets in this fishery in 1992 can be estimated from data provided by these authors to be approximately 2,700, 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), but species-specific information is not available for the Mexican fisheries. There are currently efforts underway to convert the Mexican swordfish driftnet fishery to a longline fishery (David Holts, NMFS, SWFSC, pers. comm.). The number of set-gillnet vessels in this part of Mexico is unknown. The take of northern elephant seals in other North Pacific fisheries that have been monitored appears to be trivial (Barlow et al. 1993, 1994).

Other Mortality

The California Marine Mammal Stranding database maintained by the National Marine Fisheries Service, Southwest Region, contains the following records of human-related elephant seal mortalities and injuries in 1996-2000: (1) boat collision (2 mortalities, 1 injury), (2) automobile collision (5 mortalities), (3) shootings (three mortalities) and (4) entanglement in marine debris (1 injury). Protective measures were taken to prevent future automobile collisions in the vicinity of Piedras Blancas/San Simeon (Hatfield and Rathbun 1999).

STATUS OF STOCK

A review of elephant seal dynamics through 1991 concluded that their status could not be determined with certainty, but that they might be within their Optimal Sustainable Population (OSP) range (Barlow et al. 1993). They are not listed as "endangered" or "threatened" under the Endangered Species Act nor as "depleted" under the MMPA. Because their annual human-caused mortality is much less than the calculated PBR for this stock (2,513), they would <u>not</u> be considered a "strategic" stock under the MMPA. The average rate of incidental fishery mortality for this stock over the last five years (86) 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 is continuing to grow and fishery mortality is relatively constant. There are no known habitat issues that are of particular concern for this stock.

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Revised 12/15/2000

GUADALUPE FUR SEAL (*Arctocephalus townsendi*)

STOCK DEFINITION AND GEOGRAPHIC RANGE

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 (Fleischer 1987, Hanni et al. 1997; Figure 1). The capture of two adult males at Guadalupe Island in 1928 established the specie's continued existence (Townsend 1931); however, they were not seen again until 1954 (Hubbs 1956). 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). Individuals have stranded or been sighted as far north as Blind Beach, California (38° 26' 10" N, 123° 07' 20" W); inside the Gulf of California and as far south as Zihuatanejo, Mexico (17° 39' N, 101° 34'W; Hanni et al. 1997 and Aurioles-Gamboa and Hernadez-Camacho 1999). The population is considered to be a single stock because all are recent descendants from one breeding colony at Isla Guadalupe, Mexico.

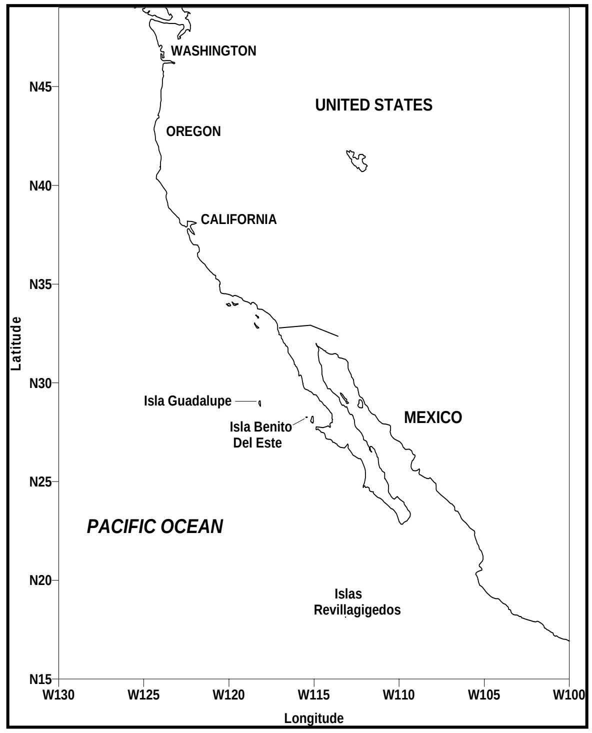

Figure 1. Geographic range of the Guadalupe fur seal, showing location of two rookeries at Isla Guadalupe and Isla Benito Del Este.

POPULATION SIZE

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 (Wedgeforth 1928, Hubbs 1956, Fleischer 1987). The population was estimated by Gallo (1994) to be about 7,408 animals in 1993. The population estimate was derived by multiplying the number of pups (counted and estimated) by a factor of 4.0.

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. Sub-sampling portions of the rookery indicate that only 47-55% of the seals present (i.e., hauled out) are counted during the census (Gallo 1994). The 1993 count of all age classes plus the estimate of missed animals was 6,443 (Gallo 1994). The minimum size of the population in Mexico can be estimated as the actual count of 3,028 hauled out seals [The actual count data were not reported by Gallo (1994); this number is derived by multiplying the estimated number hauled out by 47%, the minimum estimate of the percent counted]. In the United States, a few Guadalupe fur seals are known to inhabit California sea lion rookeries in the Channel Islands (Stewart et al. 1987).

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). A few of these counts were made during the breeding season, but the majority were made at other times of the year (Figure 1). 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). The natural logarithm of the counts was regressed against year to calculate the growth rate of the population. These data indicate that the population of Guadalupe fur seals is increasing exponentially at an average annual growth rate of 13.7% (Gallo 1994; Figure 2).

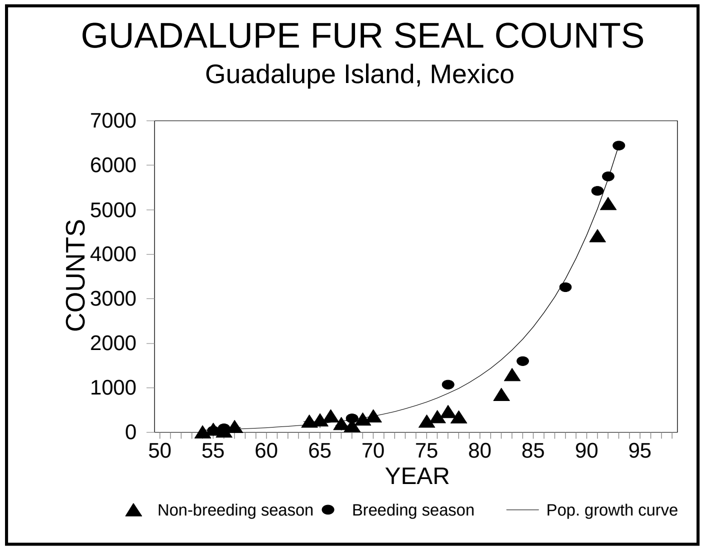

Figure 2. Counts of Guadalupe fur seals at Guadalupe Island, Mexico, and the estimated population growth curve derived from counts made during the breeding season.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The maximum net productivity rate can be assumed to be equal to the annual growth rate observed over the last 30 years (13.7%) because the population was at a very low level and should have been growing at nearly its maximum rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) for this stock is calculated as the minimum population size (3,028) <u>times</u> one half the default maximum net growth rate for pinnipeds (½ of 12%) <u>times</u> a recovery factor of 0.5 (for a threatened species, Wade and Angliss 1997), resulting in a PBR of 91 Guadalupe fur seals per year. The vast majority of this PBR would apply towards incidental mortality in Mexico.

HUMAN-CAUSED MORTALITYAND SERIOUS INJURY

Fisheries Information

Drift and set gillnet fisheries may cause incidental mortality of Guadalupe fur seals in Mexico and the United States. In the United States there have been no reports of mortalities or injuries for Guadalupe fur seals (Barlow et al.1994, Julian 1997, Julian and Beeson 1998, Cameron and Forney 1999. No information is available for human-caused mortalities or injuries in Mexico. However, similar drift gillnet fisheries for swordfish and sharks exist along the entire Pacific coast of Baja California, Mexico and may take animals from the same population. Quantitative data are available only for the Mexican swordfish drift gillnet fishery (Sosa-Nishizaki et al. 1993). The total number of sets in this fishery in 1992 can be estimated from data provided by these authors to be approximately 2,700, 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 1990-93 (0.15 marine mammals per set), but species-specific information is not available for the Mexican fisheries. There are currently efforts underway to convert the Mexican swordfish driftnet fishery to a longline fishery (D. Holts, pers. comm.). The number of set gillnets used in Mexico is unknown.

Other mortality

Juvenile female Guadalupe fur seals have stranded in central and northern California with net abrasions around the neck, fish hooks and monofilament line, and polyfilament string (Hanni et al. 1997).

STATUS OF STOCK

The state of California lists the Guadalupe fur seal as a fully protected mammal in the Fish and Game Code of California (Chap. 8, sec. 4700, d), and it is listed also as a threatened species in the Fish and Game Commission California Code of Regulations (Title 14, sec. 670.5, b, 6, H). The Endangered Species Act lists it as a threatened species, which automatically qualifies this as a "depleted" and "strategic" stock under the Marine Mammal Protection Act. There is insufficient information to determine whether the fishery mortality in Mexico exceeds the PBR for this stock. The total U.S. 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. The population is growing at approximately 13.7% per year.

Table 1. Summary of available information on the incidental mortality and injury of Guadalupe fur seals in commercial fisheries that might take this species (Julian 1997, Julian and Beeson 1998, Cameron and Forney 1999, M. Perez per. comm, Appendix 1). Mean annual takes are based on 1994-98 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 driftnet fishery for sharks and swordfish	1994 1995 1996 1997 1998	observer	17.9% 15.6% 12.4% 22.8% 20.2%	0 0 0 0 0	0 0 0 0 0	0[1]
CA set gillnet fishery for halibut and angel shark	1994 1995 1996 1997 1998	observer extrapolated estimates (1995-98)	7.7% 0% 0% 0% 0%	0 0 0 0 0	0 0[2] 0[2] 0[2] 0[2]	0[2]
WA, OR, CA ground fish trawl fishery (At-sea processing Pacific whiting fishery only)	1994 1995 1996 1997 1998	observer	53.8% 56.2% 65.2% 65.7% 77.3%	0 0 0 0 0	0 0 0 0 0	0
Minimum total annual takes						0

[1] Only 1997-98 mortality estimates are included in the average because of gear modifications implemented within the fishery as part of a 1997 Take Reduction Plan. Gear modifications included the use of net extenders and acoustic warning devices (pingers).
[2] The CA set gillnets were not observed after 1994; mortality was extrapolated from effort estimates and previous entanglement rates.

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Revised 12/15/2003

NORTHERN FUR SEAL (*Callorhinus ursinus*): San Miguel Island Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Northern fur seals occur from southern California north to the Bering Sea and west to the Okhotsk Sea and Honshu Island, Japan (Fig. 1). During the breeding season, approximately 74% 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 (Lander and Kajimura 1982). Of the seals in U.S. waters outside of the Pribilofs, approximately 1% of the population is found on Bogoslof Island in the southern Bering Sea and San Miguel Island off southern California (NMFS 1993). 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 outside of the breeding season (Fiscus 1983).

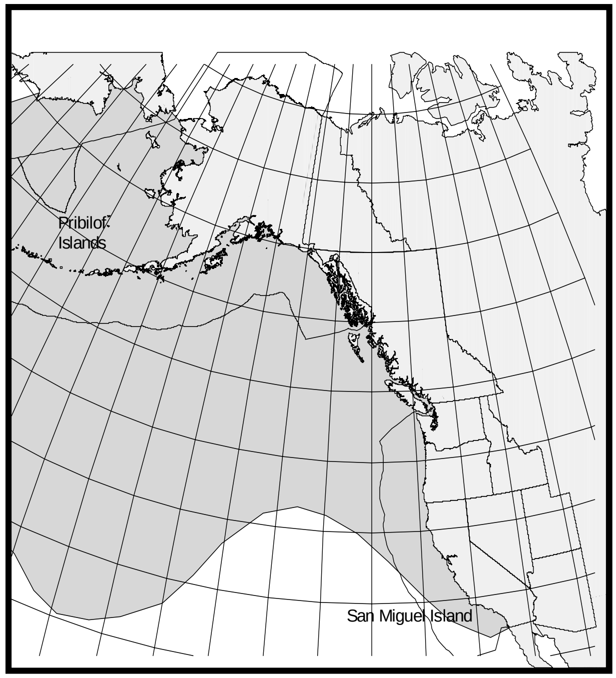

Figure 1. Approximate distribution of northern fur seals in the eastern North Pacific (shaded area).

Due to differing requirements during the annual reproductive season adult males and females typically occur ashore at different, though overlapping times. Adult males usually occur on shore during the 4-month period from May-August, though some may be present until November (well after giving up their territories). Adult females are found ashore for as long as six months (June-November). After their respective times ashore, seals of both genders spend the next 7-8 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 Oregon and California offshore waters. Many pups may remain at sea for 22 months before returning to their rookery of birth. Adult males from the Pribilof Islands generally migrate only as far south as the Gulf of Alaska (Kajimura 1984). There is considerable interchange of individuals between rookeries.

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 1993); 3) Phenotypic data: unknown; and 4) Genotypic data: unknown. Based on this information, two separate stocks of northern fur seals are recognized within U.S. waters: an Eastern Pacific stock and a San Miguel Island stock. The Eastern Pacific stock is reported separately in the Stock Assessment Reports for the Alaska Region.

POPULATION SIZE

The population estimate for the San Miguel Island stock of northern fur seals 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, a life table analysis was performed to estimate the number of yearlings, two year olds, three year olds, and animals at least four years old (Lander 1981). 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 the San Miguel Island stock is 4.0, based on the known increased immigration of recruitment-age females (DeLong 1982) and mortality and possible emigration of adults associated with the El Niño Southern Oscillation events in 1982-1983 and 1997-1998 (R. DeLong, pers. comm.). A 1998 pup count resulted in a total count of 627 pups, a 79.6% decrease from the 1997 count of 3,068 (Melin and DeLong 2000). In 1999, the population began to recover, and by 2002 the total pup count was 1,946 (S. Melin, unpubl. data). Based on the 2002 count and the expansion factor, the most recent population estimate of the San Miguel Island stock is 7,784 (1,946 x 4.0) northern fur seals. Currently, a CV for the expansion factor is unavailable.

Minimum Population Estimate

The survey technique utilized for estimating the abundance of northern fur seals within the San Miguel Island stock is a direct count, with no associated coefficient of variation (CV), as sites are surveyed only once. Additional estimates of the overall population size (i.e., N_{BEST}) and associated CV are also unavailable. Therefore N_{MIN} for this stock can not be estimated by calculating the log-normal 20th percentile of the population estimate. Rather, N_{MIN} is estimated as twice the maximum number of pups born in 2002 (to account for the pups and their mothers) plus the maximum number of adult and sub-adult males counted for the 2002 season, which results in an N_{MIN} of 4,190 ((1,946 x 2) + 298). This method provides a very conservative estimate of the northern fur seal population at San Miguel Island.

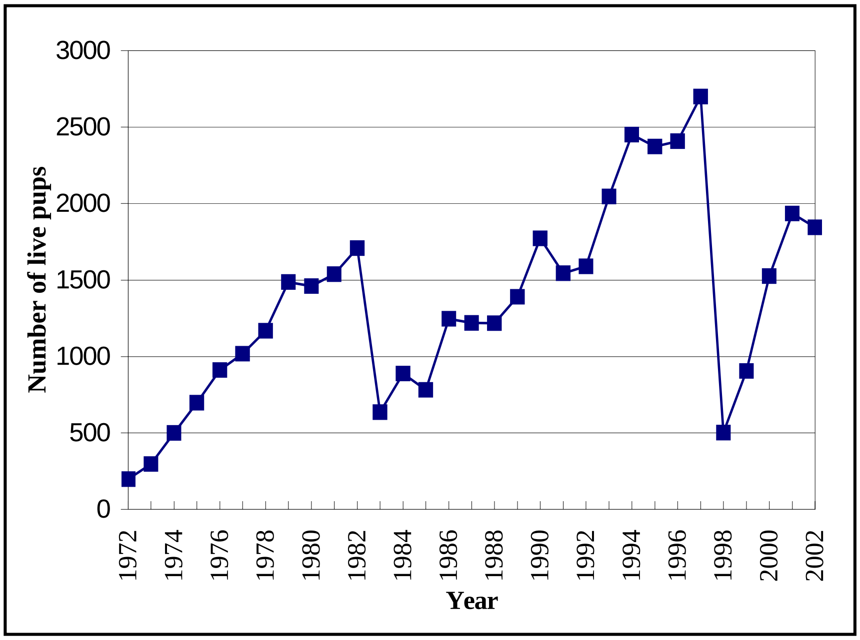

Figure 2. Northern fur seal live pup counts on San Miguel Island, 1972-2002.

Current Population Trend

The population of northern fur seals on San Miguel Island originated from the Pribilof Islands population 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 Southern Oscillation events in 1982-1983 and 1997-1998 (DeLong and Antonelis 1991, Melin and DeLong 2000). El Niño events, which occur periodically along the California coast, impact population growth of 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).

Specifically, live pup counts increased about 24% annually from 1972 through 1982, an increase due, in part, to immigration of females from the Bering Sea and the western North Pacific Ocean (DeLong 1982) (Fig. 2). The 1982-1983 El Niño event resulted in a 60.3% 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 occurred in addition to pup mortality (Melin and DeLong 1994). The 1992-1993 El Niño conditions resulted in reduced pup production in 1992, but the population recovered in 1993 and increased in 1994 (Melin et al. 1996).

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 3,068 pups, 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 was only 627 pups, a decline of 79.6% from 1997 (Melin and DeLong 2000). Although total production increased to 1,946 in 2002 (S. Melin, unpubl. data), recovery from the 1998 decline has been slowed by the adult female mortality which occurred in addition to the high pup mortality in 1997 and 1998 (Melin and DeLong 2000; S. Melin, unpubl. data).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The northern fur seal population in the Pribilof Islands increased steadily during 1912-1924 after the commercial harvest no longer included pregnant females. During this period, the rate of population growth was approximately 8.6% (SE=1.47) per year (A. York, unpubl. data), the maximum recorded for this species. This growth rate is similar and slightly higher than the 8.12% rate of increase (approximate SE=1.29) estimated by Gerrodette et al. (1985). Given the extremely low density of the population in the early 1900s, the 8.6% rate of increase is considered a reliable estimate of R_{MAX}.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population estimate (4,190) times one-half the observed maximum net growth rate (½ of 8.6%) 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 180 San Miguel Island northern fur seals per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Northern fur seals taken during the winter/spring along the west coast of the continental U.S. could be from the Pribilofs and, thus, belong to the Eastern Pacific stock. However, it is the intention of NMFS to consider any takes of northern fur seals by commercial fisheries in waters off California, Oregon, and Washington as being from the San Miguel Island stock. Information concerning the three observed fisheries that may have interacted with northern fur seals is listed in Table 1. There were no observer reports of northern fur seal mortalities in any observed fishery along the west coast of the continental U.S. during the period from 1997-2001 (Table 1; Cameron and Forney 1999, 2000; Carretta 2001, 2002; Perez 2003). The estimated mean mortality rate in observed fisheries is zero northern fur seals per year from this stock.

An additional source of information on the number of northern fur seals killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1997 and 2001, there were two fisher self-reports of northern fur seal mortalities in the Washington/Oregon/California groundfish trawl (Pacific whiting) fishery, resulting in an annual estimated mortality of 0.4 fur seals from this stock. However, because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. Logbook data are available for part of 1989-1994, after which incidental mortality reporting requirements were modified. Under the new system, logbooks are no longer required; instead, fishers provide self-reports. Data for the 1994-1995 phase-in period is fragmentary. After 1995, the level of reporting dropped dramatically, such that the records are considered incomplete and estimates of mortality based on them represent minimums (see Appendix 7 in Angliss et al. 2001 for details).

Strandings of northern fur seals entangled in fishing gear or with injuries caused by interactions with gear are a final source of fishery-related mortality information. One fishery-related stranding was reported in 2001 (J. Cordaro, pers. comm.) and, since it could not be attributed to a particular fishery, it is listed in Table 1 as occurring in an unknown west coast fishery. Fishery-related strandings during 1997-2001 resulted in an estimated annual mortality of 0.2 animals 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).

Other Mortality

According to California Marine Mammal Stranding Network records, maintained by the NMFS Southwest Region, one human-caused northern fur seal mortality (due to a head injury) was reported from a non-fisheries source in 1999, resulting in an estimated annual mortality of 0.2 northern fur seals in 1997-2001. 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 San Miguel Island northern fur seal stock is 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 estimated annual level of total human-caused mortality and serious injury (0.6 + 0.2 = 0.8) does not exceed the PBR (180). Therefore, the San Miguel Island stock of northern fur seals is not classified as a "strategic" stock. The minimum total fishery mortality and serious injury for this stock (0.6) is not known to exceed 10% of the calculated PBR (18) and, therefore, appears to be insignificant and approaching zero mortality and serious injury rate. The stock decreased 79.6% from 1997 to 1998, began to recover in 1999, and is currently at 63.4% of the 1997 level. The status of this stock relative to its Optimum Sustainable Population (OSP) level is unknown, unlike the Eastern Pacific northern fur seal stock which is formally listed as "depleted" under the MMPA.

Table 1. Summary of available information on the incidental mortality and injury of northern fur seals (San Miguel Island stock) in commercial 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 1997-2001 data unless noted otherwise.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean annual takes (CV in parentheses)
CA/OR thresher shark/ swordfish drift gillnet	97 98 99 00 01	obs data	23.0% 20.0% 20.0% 22.9% 20.4%	0 0 0 0 0	0 0 0 0 0	0
CA angel shark/halibut set gillnet	97 98 99 00 01	obs data	0% 0% 4% 1.8% 0%	0 0 0 0 0	0[1] 0[1] 0[1] 0[1] 0[1]	0
WA/OR/CA groundfish trawl (Pacific whiting component)	97 98 99 00 01	obs data	65.7% 77.3% 68.6% 80.6% 96.2%	0 0 0 0 0	0 0 0 0 0	0
WA/OR/CA groundfish trawl (Pacific whiting component)	97-01	self reports	n/a	2, 0, 0, 0, 0	n/a	≥0.4 (n/a)
Unknown west coast fishery	97-01	strand data	n/a	0, 0, 0, 0, 1	n/a	≥0.2 (n/a)
Minimum total annual takes						≥0.6 (n/a)

[1] The California set gillnets were not observed after 1994; mortality was extrapolated from effort estimates and previous entanglement rates, except for Monterey Bay, where the fishery was observed in 1999 and 2000.

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HAWAIIAN MONK SEAL (*Monachus schauinslandi*)

STOCK DEFINITION AND GEOGRAPHIC RANGE

Hawaiian monk seals are distributed throughout Hawaii predominantly in six Northwestern Hawaiian Islands (NWHI) subpopulations at French Frigate Shoals, Laysan and Lisianski Islands, Pearl and Hermes Reef, and Midway and Kure Atoll. Small numbers also occur at Necker, Nihoa, and the main Hawaiian Islands (MHI). Genetic variation among NWHI monk seals is extremely low and may reflect both a long-term history at low population levels and more recent human influences (Kretzmann et al. 1997, 2001). On average, 10-15% of the seals migrate among the NWHI subpopulations (Johnson and Kridler 1983; Harting 2002). Thus, the NWHI subpopulations are not isolated, though the different island subpopulations have exhibited considerable demographic independence. Observed interchange of individuals among the NWHI and MHI regions is extremely rare, suggesting these may be more appropriately designated as separate stocks. Further evaluation of a separate MHI stock will be pursued following genetic stock structure analysis (currently underway) and additional studies of MHI monk seals. In the mean time, the species is managed as a single stock.

POPULATION SIZE

The best estimate of the total population size is 1,252. This estimate is the sum of counts at the six main Northwest Hawaiian Islands subpopulations, an extrapolation of counts at Necker and Nihoa Islands, and counts at the main Hawaiian Islands. Abundance of the main reproductive subpopulations is currently estimated using the number of seals identified at each site, though efforts to develop improved methods are underway (Baker 2004, Baker et al. in review). Individual seals are identified by flipper-tags and applied bleach-marks, and distinctive natural features such as scars and pelage patterns. In 2003, identification efforts were conducted during two- to six-month studies at all main reproductive sites. A total of 1,100 seals (including 180 pups) were observed at the main reproductive subpopulations in 2003 (Johanos and Baker, in press). The estimated probability that known-aged seals are identified during a given field season average over 90% at French Frigate Shoals, Laysan Island, Midway Atoll and Kure atoll; approximately 85% at Lisianski Island, and approximately 80% at Pearl and Hermes Reef (Harting 2002). These probabilities likely represent the potential extent of negative bias in enumerating the subpopulations.

Monk seals also occur at Necker and Nihoa Islands, where counts are conducted from zero to a few times in a single year. Abundance is estimated by correcting the mean of all beach counts accrued over the past five years. The mean (±SD) of all counts (excluding pups) conducted between 1999-2003 were 16.4 (±6.9) at Necker Island and 17.0 (±7.6) at Nihoa Island (Johanos and Ragen 1999; Johanos and Baker 2000, 2001, 2002, 2004, in press). The relationship between mean counts and total abundance at the reproductive sites indicates that the total abundance can be estimated by multiplying the mean count by a correction factor (±SE) of 2.89 (±0.06, NMFS unpubl. data). Resulting estimates (plus the average number of pups known to have been born during 1999-2003) are 48.5 (± 19.9) at Necker Island and 51.7 (± 22.1) at Nihoa Island.

A 2001 aerial survey determined a minimum abundance of 52 seals in the MHI and remains the most recent available estimate (Baker and Johanos 2004). Seals in the MHI include those naturally occurring and any animals remaining from 21 seals translocated from the NWHI in 1994.

Minimum Population Estimate

The total number of seals identified at the six main NWHI reproductive sites is the best estimate of minimum population size at those sites (i.e., 1,100 seals). Minimum population sizes for Necker and Nihoa Islands (based on the formula provided by Wade and Angliss (1997) are 35 and 37, respectively. The minimum abundance estimate for the main Hawaiian Islands based upon the 2001 aerial survey is 52 seals. The minimum population size for the entire stock (species) is the sum of these estimates, or 1,224 seals.

Current Population Trend

The total of mean non-pup beach counts at the six main reproductive NWHI subpopulations in 2003 is approximately 60% lower than in 1958. A log-linear broken-line regression (two lines joined at a break point) is fitted with the break point chosen to minimize the sum of squares error[1]. This method estimates that the total counts declined 4.2% yr^{-1} until 1993, then declined at 1.9% yr^{-1} thereafter (Fig. 1). The broken line regression fit significantly better than a single regression line (p = 0.05). Thus, current population trend is estimated as -1.9 yr^{-1} (95% CI = -3.0% to –0.9 % yr^{-1}).

[1] (B. Venables, s-news website, http://www.biostat.wustl.edu/mailinglists/s_news/200004/msg00212.html)

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Using mean beach counts as a long-term index of total abundance, the current net productivity rate for this species is –0.019 yr^{-1} (see above). Trends in abundance vary considerably among the six main subpopulations. For example, the decline since the mid-1980's (Fig. 1) was largely due to a severe decline at French Frigate Shoals, where non-pup beach counts decreased by 70% from 1989-2003. Populations at Laysan and Lisianski Islands have remained relatively stable since approximately 1990, though the former has tended to increase slightly while the latter has decreased slowly.

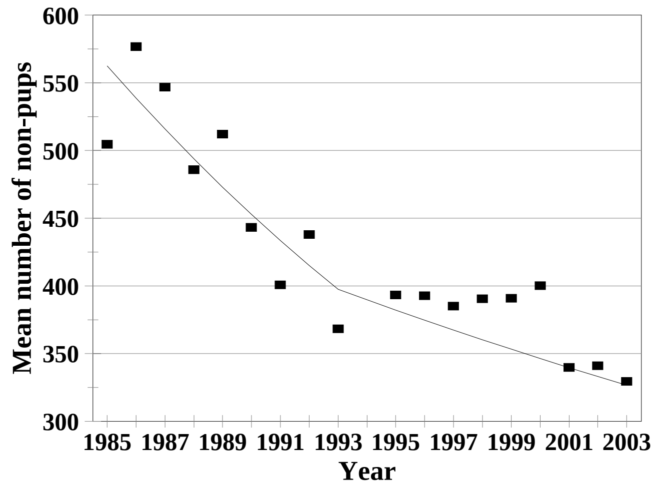

Figure 1. Mean beach counts of Hawaiian monk seals at the six main NWHI subpopulations, 1985-2003.

Until recently, the three westernmost subpopulations, Kure, Midway and Pearl and Hermes Reef exhibited substantial growth. The subpopulation at Kure Atoll grew at an average rate of 5% yr^{-1} from 1983 to 2000 (loglinear regression of beach counts; R^2 = 0.85, $p<0.001$), due largely to decreased human disturbance and introduced females. However, since 2000, counts at Kure have declined coinciding with very low survival of the 2000-2002 cohorts from weaning to age 1 yr (15% to 22%). The subpopulation at Pearl and Hermes Reef increased after the mid-1970s. The average growth rate from 1983-2000 was 6%yr^{-1} (loglinear regression of beach counts; R^2 = 0.84, $P<0.001$), and prior to 1999, growth rates of up to 7%yr^{-1} were observed. This is the highest estimate of the maximum net productivity rate (R_{max}) observed for this species. Growth of this subpopulation has slowed recently and early survival has declined. Recovery of the small subpopulation at Midway Atoll appears to have slowed or stopped, also accompanied by relatively poor juvenile survival. These demographic trends at the western end of the NWHI do not bode well for recovery, especially if recent low juvenile survival rates become chronic. While the MHI monk seal population may be on the rise (Baker and Johanos 2004), this remains unconfirmed and abundance appears to be too low to strongly influence current total stock trends.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal (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 reduced 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 declined 1.9% yr^{-1} on average for the past decade. Thus, for unknown reasons, the stock's dynamics do not conform to the underlying model for calculating PBR. The prescribed PBR calculation for this stock would be the minimum population size (1,224) times one half the maximum net growth rate (½ of 7%) times a recovery factor of 0.1 (for an endangered species, Wade and Angliss 1997), which yields 4.3 monk seals per year. However, given the stock's current status and trend, the intended standard for determining PBR, i.e., recovery to MNPL, will not be achieved in the foreseeable future if a take of 4.3 seals a year is realized. It also appears unlikely that some non-zero level of removal below 4.3 animals could explain the lack of recovery of this stock. Given this unique set of circumstances, PBR for the Hawaiian monk seal is undetermined.

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 trends at several sites appear to have been determined by human disturbance from military or U.S. Coast Guard activities (Ragen 1999; Kenyon 1972; Gerrodette and Gilmartin 1990). Currently, human activities in the NWHI are limited and human disturbance is relatively rare.

Fishery Information

Fishery interactions with monk seals include: operations/gear conflict, seal consumption of discarded fish, 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 below. Since 1976, four known fishery-related monk seal deaths have included the following (NMFS unpubl. data): one seal drowned in a nearshore gillnet off Kauai (1976), another seal died from entanglement in the bridle rope of lobster trap near Necker Island (1986), another died from entanglement in an illegally set gill net off Oahu (1994), and one ingested a fish hook and likely drowned off Kauai (1995). A total of 31 seals have been observed with embedded fish hooks from 1982 to 2003. The hooks were not always recovered and it was not possible to attribute each hooking event to a specific fishery. Among hooks that could be identified, sources included nearshore fisheries (esp. for *Caranx* sp. in the MHI) in State of Hawaii waters, bottomfish (handline) and longline fisheries in State and Federal waters (NMFS unpubl. data). A recent Biological Opinion summarized hookings and entanglements (NMFS 2002). The majority of these deaths and injuries have been observed incidental to land-based research or other activities. Monk seal/fisheries interactions are not monitored in a manner such that the rate of fisheries-related injury or mortality can be assessed .

Several fisheries have potential to interact with Hawaiian monk seals. The NWHI lobster fishery was closed in 2000 due to uncertainty in the estimates of biomass, and the fishery remains closed to date. In the past, interactions between the Hawaii-based domestic pelagic longline fishery and monk seals were documented (NMFS 2002). 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 longline fishery have been confirmed. Since 1991, there have been no observed or reported interactions of this fishery with monk seals.

The NWHI bottomfish handline fishery has been reported to interact with monk seals. This fishery occurred at low levels (< 50 t per year) until 1977, steadily increased to 460 metric tons in 1987, then dropped to 284 metric tons in 1988, and varied from 95-201 metric tons per year from 1989-2003 (Kawamoto 1995; Kawamoto, pers. comm.). The number of vessels peaked at 28 in 1987, then varied from 9 to 17 in 1988 through 2003 (Kawamoto 1995; Kawamoto, pers. comm.). NMFS prepared a Section 7 Biological Opinion on the Fishery Management Plan for the bottomfish fishery, and concluded that the operation of this fishery is not likely to jeopardize the continued existence of the Hawaiian monk seal nor would it likely destroy or adversely modify the monk seal's critical habitat (NMFS 2002). The Biological Opinion has no incidental take statement, though a MMPA Negligible Impact Determination is currently being prepared. An EIS for the bottomfish fishery management plan is also being prepared. Nitta and Henderson (1993) documented reports of seals taking bottomfish and bait off fishing lines, and reports of seals attracted to discarded bycatch. A Federal observer program of the fishery began in the fourth quarter of 2003 with 33% coverage and no monk seal interactions during that quarter. Fishermen indicate that they have engaged in mitigating activity over the past several years, e.g., holding discards on-board, etc. (NMFS pers. comm.). The ecological effects of this fishery on monk seals (e.g., competition for prey or alteration of prey assemblages) are unknown. However, published studies on monk seal prey selection based upon scat/spew analysis and seal-mounted video, rarely 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, Parrish et al. 2000). Fatty acid signature analysis is incomplete regarding the importance of commercial bottomfish in the monk seal diet, but this methodology continues to be pursued.

There have also been interactions between nearshore fisheries and monk seals in both the NWHI and the MHI. At least three seals were hooked at Kure Atoll before the U.S. Coast Guard vacated the atoll in 1993. In the main Hawaiian Islands (MHI), one seal was found dead in a nearshore (non-recreational) gillnet in 1994 and a second seal was found dead in 1995 with a hook lodged in its esophagus. A total of 20 seals have been observed with embedded hooks in the MHI during 1990-2003. Several incidents, including the dead hooked seal mentioned above, involved hooks used to catch ulua (jacks, *Caranx* spp.). Interactions in the MHI appear to be on the rise, as most hookings have occurred since 2000, and a seal was entangled in an actively fished nearshore gillnet off Oahu in 2002 (NMFS unpubl. data). The MHI bottomfish handline fishery also has potential to interact with monk seals, though no mortalities or serious injuries have been attributed to the fishery (Table 1).

Episodic interest in the harvest of precious coral in the NWHI represents a potential for future interactions with monk seals, as some seals forage at precious gold coral beds occurring over 500m in depth (Parrish et al., 2002). As a result, the Western Pacific Regional Fisheries Management Council recommended regulations to suspend or set to zero annual quotas for gold coral harvest at specific locations until data on impacts of such harvests become available.

Table 1. Summary of mortality and serious injury of Hawaiian monk seals due to fisheries and calculation of annual mortality rate. n/a indicates that sufficient data are not available.

Fishery Name	Year	Data Type	% Obs. coverage	Observed Mortality/ Serious Injury	Estimated Mortality/ Serious Injury	Mean Takes (CV)
NWHI Lobster	1999	data collector[1]	83%	0	n/a	n/a
	2000-present	fishery closed				
Pelagic Longline[2]	1999	observer	3.3%	0	0	
	2000	observer	10.4%	0	0	
	2001	observer	22.5%	0	0	0 (0)
	2002	observer	24.6%	0	0	
	2003	observer	22.2%	0	0	
NWHI Bottomfish	1999-2002	logbook	n/a	n/a	n/a	
	2003[3]	observer	33%	0	0	0 (0)
MHI Bottomfish[4]	1999			0		
	2000			0		
	2001	n/a	none	0	n/a	n/a
	2002			0		
	2003			0		
Nearshore[4]	1999			0		
	2000			1		
	2001	n/a	none	1	n/a	n/a
	2002			1		
	2003			2		

Fishery Mortality Rate

Data are unavailable to fully assess interaction with some fisheries in Hawaii, therefore, total fishery mortality and serious injury cannot be considered to be insignificant and approaching a rate of zero. Monk seals also die from entanglement in fishing gear and other debris (likely originating from various countries), and NMFS along with partner agencies, is pursuing a program to mitigate entanglement (see below).

Direct fishery interactions with monk seals remain to be thoroughly evaluated and the information above represents only observed interactions. Without further study, an accurate estimate cannot be determined. Indirect interactions (i.e., involving competition for prey or consumption of discards) remain the 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 238 cases of seals entangled in fishing gear or other debris have been observed through 2003 (Henderson 2001; NMFS, unpubl. data), including seven documented mortalities resulting from entanglement in fisheries 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 Hawaiian fisheries. For example, trawl net and monofilament gillnet accounted for approximately 35% and 34% 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). Yet there are no commercial trawl fisheries in Hawaii.

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[1] Fishery participants voluntarily hosted technicians to collect biological data, including protected species interactions. Because this was not conducted as an official observer program, mortality and serious injury rates were not estimated.

[2] Until 2000, interactions with protected species were assessed using Federal logbooks and observers (4-5% coverage). Since 2001, the observer program has maintained over 20% coverage of the Hawaii-based longline fleet.

[3] Observer coverage began in fourth quarter of 2003. Data for that quarter provided.

[4] Data for MHI bottomfish and nearshore fishery are based upon incidental observations (i.e., hooked seals). Following the method employed in a draft Negligible Impact Determination for the bottomfish fishery, 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.

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 entangled seals during annual population assessment activities at the main reproductive sites. During 1996-2003 debris survey and removal efforts, over 470,000 kg of derelict net and other debris were removed from the coral reef habitat in the NWHI (Donohue et al. 2000, Donohue et al. 2001; J. Asher, pers. comm).

Other Mortality

Since 1982, 23 seals died during rehabilitation efforts; additionally, two died in captivity, two died when captured for translocation, one was euthanized (an aggressive male known to cause mortality), three died during captive research and three died during field research (Baker and Johanos, 2002).

In 1986, a weaned pup died at East Island, French Frigate Shoals, after becoming entangled in wire left when the U.S. Coast Guard abandoned the island three decades earlier. In 1991, a seal died after becoming trapped behind an eroding seawall on Tern Island, French Frigate Shoals. The only documented case of illegal killing of an Hawaiian monk seal occurred when a resident of Kauai killed an adult female in 1989.

Other sources of mortality that may impede recovery include single and multiple-male aggression (mobbing), shark predation, and disease/parasitism. Multiple-male aggression is thought to be related to an imbalance in adult sex ratios, with males outnumbering females. When several males attempt to mount and mate with an adult female or immature animal of either sex, injury or death of the attacked seal often results. This has primarily been identified as a problem at Laysan and Lisianski Islands, though it has also been documented at other subpopulations. In 1994, 22 adult males were removed from Laysan Island, and only five seals are thought to have died from multiple-male aggression at this site since their removal (1995-2003).

Attacks by single adult males have resulted in several monk seal mortalities. This was most notable at French Frigate Shoals in 1997, where at least 8 pups died as a result of adult male aggression. Many more pups were likely killed in the same way but the cause of their deaths could not be confirmed. Two males that killed pups in 1997 were translocated to Johnston Atoll, 870 km to the southwest. Subsequently, mounting injury to pups have decreased.

Shark-related injury and mortality incidents appeared to have increased in the late 1980s and early 1990s at French Frigate Shoals, but such mortality was probably not the primary cause of the decline at this site (Ragen 1993). However, shark predation has accounted for a significant portion of pup mortality in recent years. At French Frigate Shoals in 1999, 17 pups were observed injured by large sharks, and at least 3 were confirmed to have died from shark predation (Johanos and Baker, 2001). As many as 22 pups of a total 92 born at French Frigate Shoals in 1999 were likely killed by sharks. After 1999, losses of pups to shark predation have been fewer, but this source of mortality remains a serious concern. Various mitigation efforts have been undertaken by NMFS in cooperation with the USFWS, which manages French Frigate Shoals as part of the Hawaiian Islands National Wildlife Refuge.

An Unusual Mortality Event (UME) contingency plan has recently been published for the monk seal (Yochem et al. 2004). While disease effects on monk seal demographic trends are uncertain, there is concern that diseases of livestock, feral animals, pets or humans could be transferred to naive monk seals in the main Hawaiian Islands and potentially spread to the core population in the NWHI. Recent diagnoses (R. Braun, pers. comm.) confirm that in 2003 and 2004, two deaths of free-ranging monk seals are attributable to diseases not previously found in the species: leptospirosis and toxoplasmosis. Leptospira bacteria are found in many of Hawaii's streams and estuaries and are associated with livestock and rodents. Cats, domestic and feral, are a common source of toxoplasma.

STATUS OF STOCK

In 1976, the Hawaiian monk seal was designated depleted under the Marine Mammal Protection Act of 1972 and as endangered under the Endangered Species Act of 1973. The species is well below its OSP and has not recovered from past declines. Therefore, the Hawaiian monk seal is characterized as a strategic stock.

Habitat Issues

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. The substantial decline at French Frigate Shoals is likely related to lack of available prey and subsequent emaciation and starvation. Two leading hypotheses to explain the lack of prey are 1) the local population reached its carrying capacity in the 1970s and 1980s, diminishing its own food supply, and 2) carrying capacity was simultaneously reduced by changes in oceanographic conditions and a subsequent decline in productivity (Polovina et al. 1994; Craig and Ragen 1999). Similarly, recently observed poor juvenile survival rates suggest that prey availability may be limiting recovery of other NWHI subpopulations.

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 2004*a,b*; Stewart and Yochem 2004 *a,b,c*). Preliminary studies to describe the foraging habitat of monk seals in the MHI were begun in 2004.

Tern Island is the site of a U.S. Fish and Wildlife refuge station, and is one of two sites in the NWHI accessible by aircraft. During World War II, the U.S. Navy enlarged the island to accommodate the runway, and a sheet-pile seawall was constructed to maintain the modified shape of the island. Degradation of the seawall created entrapment hazards for seals and other. Erosion of the sea wall also raised concerns about the potential release of toxic wastes into the ocean. The USFWS began construction on the Tern I. sea wall in 2004 to reduce entrapment hazards and protect the island shoreline. The USFWS considers this a high priority project to complete, and is pursuing funding to that end. A recent review suggests that significant loss of terrestrial habitat has occurred at French Frigate Shoals, where pupping and resting islets have shrunk or virtually disappeared (Antonelis et al. in press). This is a subject of considerable interest and is under further investigation.

There are indications that monk seal abundance is increasing in the main Hawaiian Islands (Baker and Johanos 2004). Further, the excellent condition of pups weaned on these islands suggests that there may be ample prey resources available. If the monk seal population does 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 1.2 million compared to less than 100 in the NWHI, so that the potential impact of disturbance in the MHI is great. As noted above, the hooking of monk seals by fishermen in the MHI is another source of injury and mortality. Finally, vessel traffic in the populated islands carries the potential for collision with seals and impacts from oil spills. Thus, issues surrounding monk seals in the main Hawaiian Islands will likely become an increasing focus for management and recovery of this species.

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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. 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).

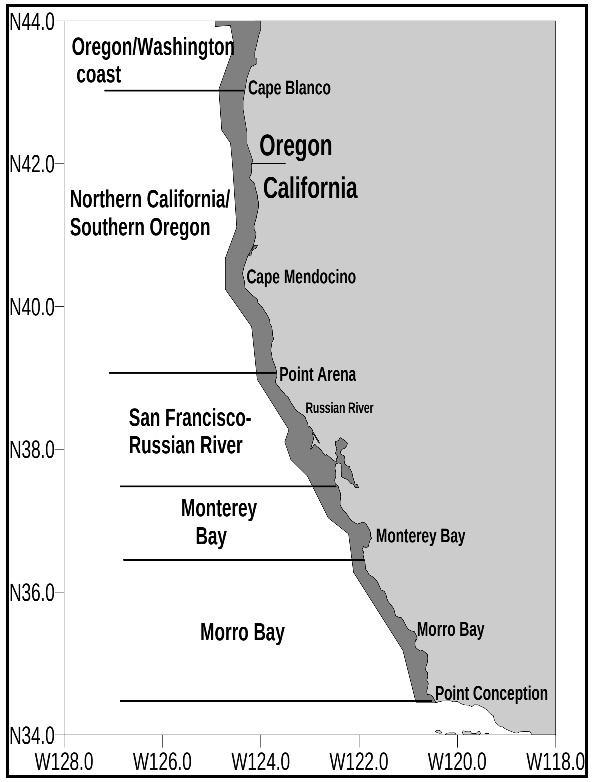

Figure 1. Stock boundaries and distributional range of harbor porpoise along the California/southern Oregon coast. Shaded area represents harbor porpoise habitat (0-200 m) along the U.S. west coast.

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 is 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 recent genetic findings (Chivers *et al.*, 2002), 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 2004 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) an 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 Monterey Bay, San Francisco-Russian River, northern California/southern Oregon, Oregon/Washington coast, and Inland Washington waters harbor porpoise 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 1999a). 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). A recent analysis of harbor porpoise trends including oceanographic data suggests that the proportion of California harbor porpoise in deeper waters may vary between years (Forney 1999b). In 1999 and 2002, aerial surveys 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. Based on 1999 and 2002 aerial surveys under good survey conditions (Beaufort #2, cloud cover #25%) the estimate of abundance for this stock is 1,656 animals (CV = 0.39) (Carretta and Forney 2004).

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 1999-2002 aerial surveys, or 1,206 animals.

Current Population Trend

Analyses of a 1986-95 time series of aerial surveys have been conducted to examine trends in harbor porpoise abundance in central California (Forney, 1995; 1999b). After controlling for the effects of sea state, cloud cover, and area on sighting rates, Forney (1995) found a negative trend in population size; however, that trend was no longer significant when sea surface temperature (a proxy measure of oceanographic conditions) was included in an updated non-linear trend analysis (Forney 1999b). The negative correlation between harbor porpoise sighting rates and sea surface temperatures indicates that apparent trends could be caused by changing oceanographic conditions and movement of animals into and out of the study area. Encounter rates for the 1997 survey, however, were very high (Forney 1999a) despite the warmer sea surface temperatures caused by strong El Niño conditions. These observations suggest that patterns of harbor porpoise movement are not directly related to sea surface temperature, but rather to the more complex distribution of potential prey species in this area. There has been an increasing trend in porpoise abundance in the Morro Bay stock since 1988, which is statistically significant ($p < 0.002$), Figure 2. More detailed studies of encounter rate patterns in relation to satellite-derived sea surface temperature are planned to shed light on potential oceanography-related movement patterns of harbor porpoise in this region.

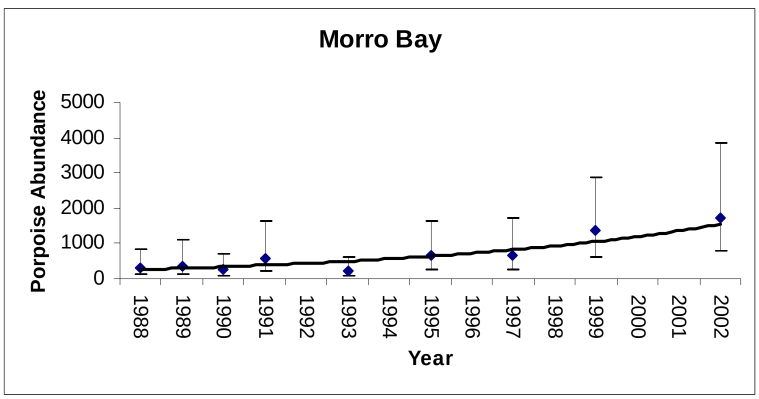

Figure 2. Aerial survey estimates of abundance for the Morro Bay stock of harbor porpoise, 1988-2002. Error bars represent lower and upper 95% confidence intervals. Solid line represents a linear regression on the natural logarithm of abundance over time. The slope of this regression is statistically significant ($p < 0.002$).

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 (Barlow and Boveng 1991). This maximum theoretical rate may not be achievable for any real population. [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 Morro Bay harbor porpoise, we use the default maximum net productivity rate (R_{MAX}) of 4% for cetaceans (Wade and Angliss 1997) be employed.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (1,206) <u>times</u> one half the default maximum net growth rate for cetaceans (½ of 4%) <u>times</u> a recovery factor of 0.4 (for a stock of unknown status with a mortality rate CV $ 0.80; Wade and Angliss 1997), resulting in a PBR of 10.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

The set gillnet fishery for halibut and angel shark has operated in the vicinity of Morro Bay, and fishing effort there peaked in 2001. A ban on set gillnets inshore of 60 fathoms from Point Arguello to Point Reyes, California, has been in place since September 2002. California Department of Fish and Game (CDFG) estimated fishing effort for 1998-2002 in this fishery is 139, 121, 284, 391, and 21 days respectively. Mortality rates of harbor porpoise in the set gillnet fishery in this region are available only from 43 trips observed between 1990-94 (Julian and Beeson 1998), in which one harbor porpoise was killed. This represents a kill rate of 0.023 porpoise/day fished (bootstrap CV = 0.97). Projected mortality levels based on this kill rate and effort levels for 1998-2002 are summarized in Table 1. It should be noted that this kill rate includes sets made in less than 30 fathoms of water, where the potential to entangle porpoise is higher. The white seabass set gillnet fishery also has operated in the vicinity of Morro Bay, and this fishery has been documented to take harbor porpoise in the past (Norris and Prescott 1961). Effort in the white seabass fishery in the vicinity of Morro Bay for the last five years (1998-2002) has been 26, 7, 61, 132, and 32 fishing days respectively. Because of the aforementioned depth restrictions for gillnets in this region, it is expected that harbor porpoise interactions with the white seabass set gillnet fishery would be near zero.

Table 1. Summary of available information on incidental mortality and injury of harbor porpoise (Morro Bay stock) in commercial fisheries that might take this species (Cameron and Forney 2000, Carretta 2001, Forney et al., 2001; Carretta 2002, Carretta and Chivers 2003). Mean annual takes are based on 1998-2002 data unless noted otherwise.

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed Mortality	Kill/Day	Estimated Mortality (CV in parentheses)	Mean Annual Takes (CV in parentheses)
CA angel shark / halibut and other species large mesh (>3.5") set gillnet fishery				-			
	1998	1990-94 observer data	0%	-	0.023[1]	3 (0.97)	4.5 (0.97)[2]
	1999		0%	-		3 (0.97)	
	2000		0%	-		7 (0.97)	
	2001		0%	-		9 (0.97)	
	2002	Fishery closed permanently in waters < 60 fathoms				0.5 (n/a)	
Minimum total annual takes							4.5 (0.97)[2]

[1]Mortality rate is based on 1 observed mortality from 43 observed trips in this region between 1990-94.
[2]Mean annual takes are based on 1998-2002 effort data and 1990-94 kill rates.

Both of the above central California gillnet fisheries were restricted by a series of emergency closures beginning in September 2000, because of concern over mortality of Common Murres and a decline in the southern sea otter population. During the emergency closure, fishing was allowed in waters deeper than 30 fathoms between Yankee Point (Monterey County) and Pt. Sal (Santa Barbara County) until April 2002, and fishing effort initially increased within the range of the Morro Bay harbor porpoise stock. A ban on the use of gill and trammel nets in all ocean waters 60 fathoms or less between Point Reyes (Marin County) and Point Arguello (Santa Barbara County) became effective on September 4, 2002. The ban is expected to virtually eliminate bycatch of Morro Bay harbor porpoise in these two gillnet fisheries, because this species is primarily found in waters shallower than 60 fathoms.

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.

Based on the last 5 years of fishing effort (1998-2002), mean annual takes are 4.5 porpoise per year, which is less than the PBR of 10 animals, resulting in a “non-strategic” classification. A set gillnet closure inside of 60 fathoms was finalized in September 2002, effectively eliminating set gillnets from most harbor porpoise habitat in the region of this stock. This is expected to reduce fishery mortality of Morro Bay harbor porpoise to near zero. Although in recent years the average fishery mortality exceeded 10% of the PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and injury rate, it is likely that this goal will be met following the 2002 gillnet closure. Research activities will continue to monitor the population size and to investigate population trends. There are no known habitat issues that are of particular concern for this stock.

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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. 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).

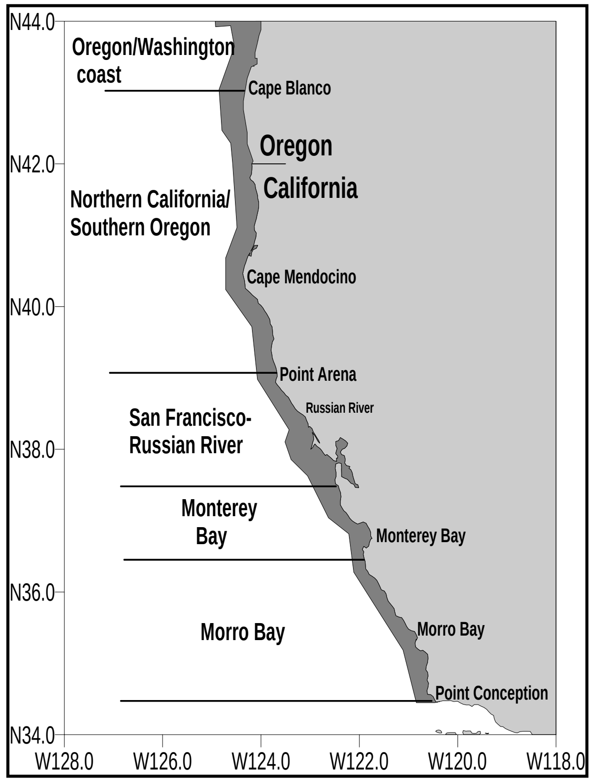

Figure 1. Stock boundaries and distributional range of harbor porpoise along the California/southern Oregon coast. Shaded are represents harbor porpoise habitat (0-200 m) along the U.S. west coast.

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 is 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 recent genetic findings (Chivers, *et al*. 2002), 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 2003 Marine Mammal Protection Act (MMPA) Stock Assessment Reports, other Pacific coast harbor porpoise stocks include: 1) a Morro Bay stock, 2) a San Francisco-Russian River stock, 3) a northern California/southern Oregon stock, 4) an Oregon/Washington coast stock, 5) a Washington Inland waters stock, 6) a Southeast Alaska stock, 7) a Gulf of Alaska stock, and 8) a Bering Sea stock. Stock assessment reports for Morro Bay, San Francisco-Russian River, northern California/southern Oregon, Oregon/Washington coast, and Inland Washington waters harbor porpoise 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 1999a). 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). A recent analysis of harbor porpoise trends including oceanographic data suggests that the proportion of California harbor porpoise in deeper waters may vary between years (Forney 1999b). In 1999 and 2002, 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. Based on 1999 and 2002 aerial surveys under good survey conditions (Beaufort #2, cloud cover #25%) the estimate of abundance for this stock is 1,613 animals (CV = 0.42) (Carretta and Forney 2004).

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 1999-2002 aerial surveys, or 1,149 animals.

Current Population Trend

Analyses of a 1986-95 time series of aerial surveys have been conducted to examine trends in harbor porpoise abundance in central California (Forney, 1995; 1999b). After controlling for the effects of sea state, cloud cover, and area on sighting rates, Forney (1995) found a negative trend in population size; however, that trend was no longer significant when sea surface temperature (a proxy measure of oceanographic conditions) was included in an updated non-linear trend analysis (Forney 1999b). The negative correlation between harbor porpoise sighting rates and sea surface temperatures indicates that apparent trends could be caused by changing oceanographic conditions and movement of animals into and out of the study area. Encounter rates for the 1997 survey, however, were very high (Forney 1999a) despite the warmer sea surface temperatures caused by strong El Niño conditions. These observations suggest that patterns of harbor porpoise movement are not directly related to sea surface temperature, but rather to the more complex distribution of potential prey species in this area. A linear regression of of the natural logarithm of abundance over time for the Monterey Bay stock is not statistically significant (p=0.64, Figure 2). More detailed studies of encounter rate patterns in relation to satellite-derived sea surface temperature during

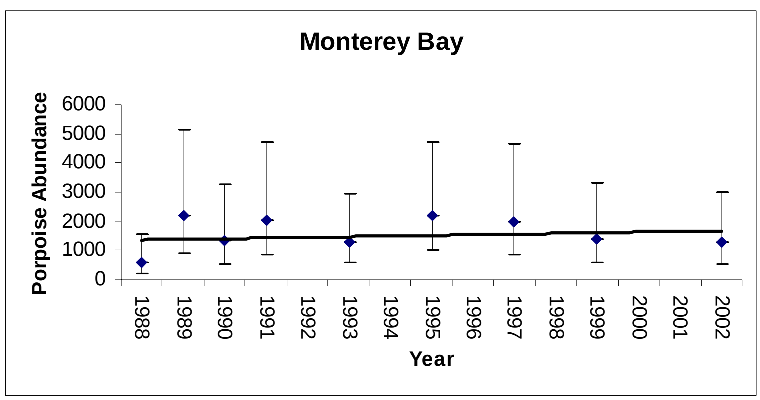

Figure 2. Aerial survey estimates of abundance for the Monterey Bay stock of harbor porpoise, 1988-2002. Error bars represent lower and upper 95% confidence intervals. Solid line represents a linear regression of the natural logarithm of abundance over time. The slope of this regression is not statistically significant (p = 0.64).

1993-99 are planned to shed light on potential oceanography-related movement patterns of harbor porpoise in this region.

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 (Barlow and Boveng 1991). This maximum theoretical rate may not be achievable for any real population. [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 Monterey Bay 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 (1,149) <u>times</u> one half the default maximum net growth rate for cetaceans (½ of 4%) <u>times</u> a recovery factor of 0.45 (or a stock of unknown status with a mortality rate CV $0.60 and # 0.80 ; Wade and Angliss 1997), resulting in a PBR of 10.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

The incidental capture of Monterey Bay harbor porpoise is largely limited to the halibut angel shark set gillnet fishery. Detailed information on this fishery is provided in Appendix 1. A summary of estimated fishery mortality and injury for this stock of harbor porpoise for 1998-2002 is given in Table 1. Mortality estimates for 1998 are based on total estimated fishing effort and prior-year entanglement rate data (Julian and Beeson 1998), because no observer program was in place that year. Mortality estimates for 1999-2001 are based on a National Marine Fisheries Service monitoring program in Monterey Bay (Cameron and Forney 2000, Carretta 2001; Carretta 2002, Carretta and Chivers 2003).

Table 1. Summary of available on incidental mortality and injury of harbor porpoise (central CA stock 1997-98; Monterey Bay stock 1999-2002) in commercial fisheries that might take this species (Cameron and Forney 2000, Carretta 2001, Carretta 2002, Forney et al., 2001). Mean annual takes are based on 2001-2002 data because of fishery restrictions implemented in late 2000. 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)
CA angel shark / halibut and other species large mesh (>3.5") set gillnet fishery				-	-		9.5 (0.66)[1]
	1998	1990-94 observer data	0%	-	-	57 (0.19)	
	1999	observer data	23.0%	28[2]	0.17	133 (0.23)[2]	
	2000		27.0%	7	0.10	26 (0.50)	
	2001	2000 observer data	0%	-	0.10	3 (0.77)	
	2002	Fishery closed permanently	0%	-	0.10	16 (0.77)	
Minimum total annual takes							9.5 (0.66)[1]

[1]Only 2001-2002 mortality estimates are included in the average because the fishery was largely closed under emergency regulations in September 2000. The closure was made permanent in September 2002.

[2] This includes one unidentified cetacean that was almost certainly a harbor porpoise; without this animal the mortality estimate would be 128 (CV=0.23).

All central California nearshore gill and trammel net fisheries were restricted by a series of emergency closures beginning in September 2000, because of concern over mortality of Common Murres and a decline in the southern sea otter population. During the emergency closures, fishing was prohibited in waters less than 60 fathoms in the region of the Monterey Bay harbor porpoise stock. There were an estimated 156 days of set gillnet fishing effort in Monterey Bay in 2002 following a brief lapse in the closure prior to a ban on set gillnets in this region on September 4, 2002. The ban is expected to virtually eliminate bycatch of Monterey Bay harbor porpoise in these gillnet fisheries, because this species is primarily found in waters shallower than 60 fathoms. Although mortality estimates for the most recent five years (1998-2002) are presented in Table 1, average annual takes in the setnet fishery are estimated using 2001-2002 data, because the fishery was largely closed under emergency regulations after September 2000. The closure was made permanent in September 2002. An annual average of 9.5 harbor porpoise (CV= 0.66) were killed in this fishery in Monterey Bay from 2001-2002.

Twelve fishery-related stranding mortalities of harbor porpoise were documented within the range of the Monterey Bay harbor porpoise stock between 1998 and 2002: 1998(1); 1999(2); 2000 (2); 2001 (2) and 2002 (5). The five strandings in 2002 occurred during March and April, prior to a September ban on gillnets inshore of 60 fathoms in this region. These mortalities probably originated from the halibut set gillnet fishery in Monterey Bay, and are thus accounted for in the mortality estimates for this fishery.

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.

The annual mortality for 2001, after implementation of the emergency closure for central California gillnet fisheries, was 9.5 harbor porpoise, which is less than the calculated PBR (10) for Monterey Bay harbor porpoise; therefore, the Monterey Bay harbor porpoise population is not considered "strategic" under the MMPA. A permanent set gillnet closure inside of 60 fathoms was implemented in September 2002, effectively eliminating set gillnets from most harbor porpoise habitat in the region of this stock. This is expected to virtually eliminate gillnet mortality of Monterey Bay harbor porpoise. Although in recent years the average fishery mortality exceeded the PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and injury rate, it is likely that this goal will be met following the 2002 permanent gillnet closure. Research activities will continue to monitor the population size and to investigate population trends. There are no known habitat issues that are of particular concern for this stock.

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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. 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).

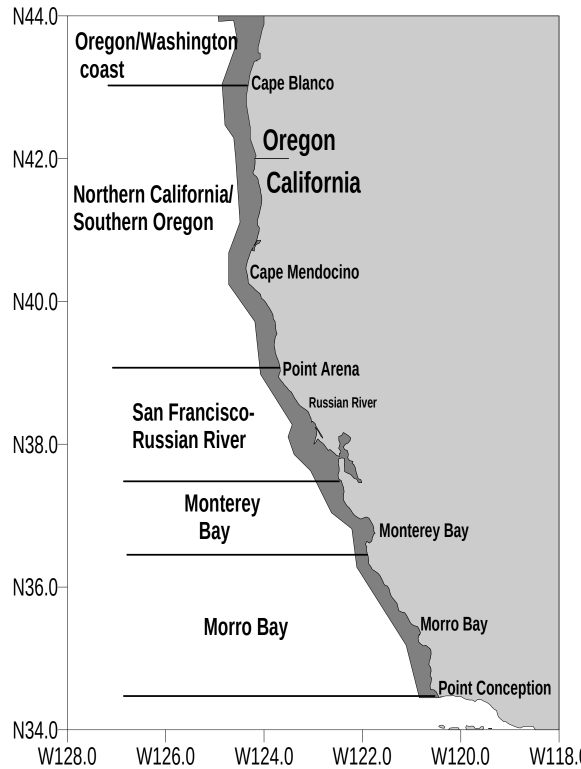

Figure 1. Stock boundaries and distributional range of harbor porpoise along the California and southern Oregon coast. Shaded area represents harbor porpoise habitat (0-200 m) along the U.S. west coast.

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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 1999a). 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). A recent analysis of harbor porpoise trends including oceanographic data suggests that the proportion of California harbor porpoise in deeper waters may vary between years (Forney 1999b). In 1999 and 2002, 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. Although two harbor porpoise sightings were made in offshore waters under poor conditions (Beaufort sea state 3), only good conditions have traditionally been included in abundance analyses for this species (Barlow and Forney 1994, Forney 1999a), and therefore no offshore sightings contributed to the abundance estimate for this stock. Based on 1999-2002 aerial surveys under good survey conditions (Beaufort #2, cloud cover #25%) the estimate of abundance for this stock is 8,521 animals (CV = 0.38) (Carretta and Forney 2004).

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 1999-2002 aerial surveys, or 6,254 animals.

Current Population Trend

Analyses of a 1986-95 time series of aerial surveys have been conducted to examine trends in harbor porpoise abundance in central California (Forney, 1995; 1999b). After controlling for the effects of sea state, cloud cover, and area on sighting rates, Forney (1995) found a negative trend in population size; however, that trend was no longer significant when sea surface temperature (a proxy measure of oceanographic conditions) was included in an updated non-linear trend analysis (Forney 1999b). The negative correlation between harbor porpoise sighting rates and sea surface temperatures indicates that apparent trends could be caused by changing oceanographic conditions and movement of animals into and out of the study area. Encounter rates for the 1997 survey, however, were very high (Forney 1999a) despite the warmer sea

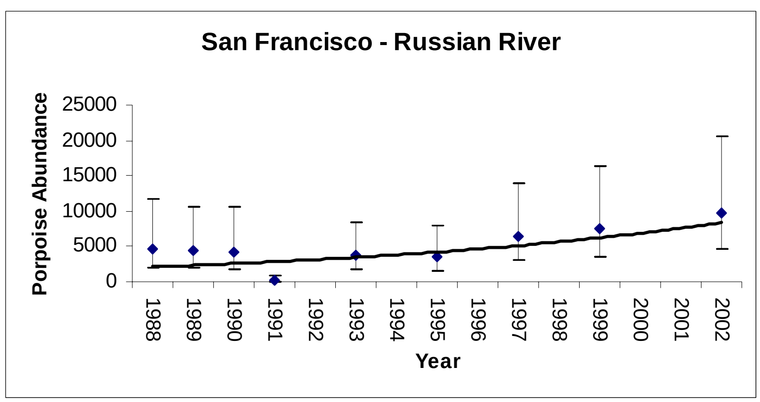

Figure 2. Aerial survey estimates of abundance for the San Francisco-Russian River stock of harbor porpoise, 1988-2002. Error bars represent lower and upper 95% confidence intervals. Solid line represents a linear regression of the natural logarithm over time. The slope of this regression line is not statistically significant (p=0.24).

surface temperatures caused by strong El Niño conditions. These observations suggest that patterns of harbor porpoise movement are not directly related to sea surface temperature, but rather to the more complex distribution of potential prey species in this area. Abundance of the San Francisco - Russian River harbor porpoise stock appeared to be stable or declining between 1988-1991 and has steadily increased since 1993. The slope of the linear regression on the natural logarithm of abundance over time is not statistically significant ($p = 0.24$, Figure 2). More detailed studies of encounter rate patterns in relation to satellite-derived sea surface temperature are planned to shed light on potential oceanography-related movement patterns of harbor porpoise in this region.

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 (Barlow and Boveng 1991). This maximum theoretical rate may not be achievable for any real population. [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 northern California 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 (6,254) <u>times</u> one half the default maximum net growth rate for cetaceans (½ of 4%) <u>times</u> a recovery factor of 0.5 (for a species of unknown status; Wade and Angliss 1997), resulting in a PBR of 63.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

The incidental capture of harbor porpoise in California has largely been limited to set gillnet fisheries in Monterey Bay and to a lesser extent, Morro Bay. Coastal setnets are not allowed north of Bodega Head (to protect salmon resources there). However, two harbor porpoise strandings near Bodega Head in 1998, one inside San Francisco Bay in 1998, and one near Montara, San Mateo County in 2001 were attributed to fishery-related mortality, but the responsible fishery is unknown. Although the stranding locations fall within the range of the San Francisco-Russian River harbor porpoise stock and this is probably the source stock for the mortalities, it is possible that some of these animals were taken from the northern California/southern Oregon stock and subsequently drifted southward to the stranding location. A ban on set gillnets inshore of 60 fathoms from Point Reyes south to Point Arguello, California has been in place since September 2002.

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. Mean annual takes are based on 1998-2002 data unless noted otherwise. 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	1998-2002	stranding	n/a	3 (in 1998) 1 in 2001		n/a	$0.8 (n/a)
Minimum total annual takes							$0.8 (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. There are no known habitat issues that are of particular concern for this stock. Because the known human-caused mortality or serious injury (0.8 harbor porpoise per year) is less than the PBR (63), 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.

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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. 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.*, in press).

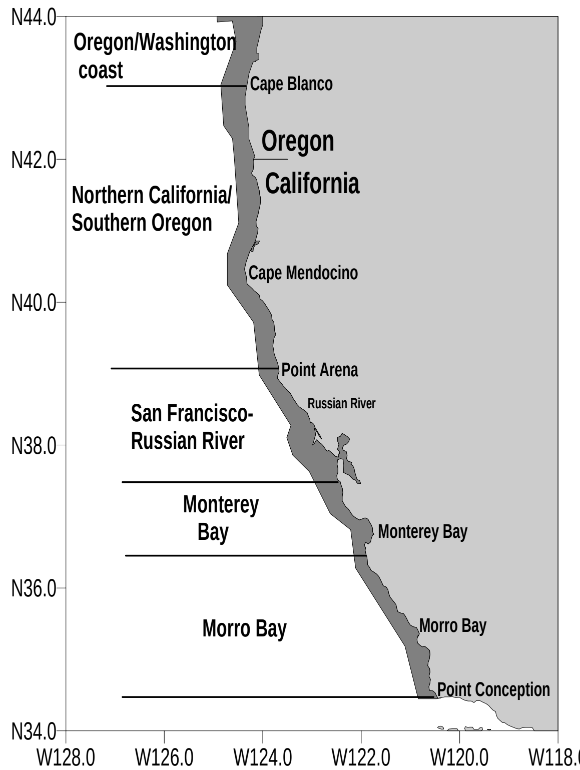

Figure 1. Stock boundaries and distributional range of harbor porpoise along the California/southern Oregon coast. Shaded area represents harbor porpoise habitat (0-200 m) along the U.S. west coast.

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 is 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 recent genetic findings (Chivers *et al*., in press), California coast stocks were re-evaluated and significant genetic differences were found among four identified sampling sites. Revised stock boundaries are presented here based on these genetic data and density discontinuities identified from aerial surveys, resulting in six west coast stocks where previously there had been four (Carretta *et al*. 2001a). These new stock boundaries 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 San Francisco-Russian River stock, 4) an 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 Morro Bay, Monterey Bay, and San Francisco-Russian River, harbor porpoise 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 1999a). 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). A recent analysis of harbor porpoise trends including oceanographic data suggests that the proportion of California harbor porpoise in deeper waters may vary between years (Forney 1999b; see Current Population Trend below). In 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. Based on pooled 1997-99 aerial survey data including data from both inshore and offshore areas, an updated estimate of abundance for the northern California/southern Oregon harbor porpoise stock is 17,763 harbor porpoise (CV=0.39). Approximately 1,572 (CV=0.86) porpoise were estimated in the northern California offshore stratum (SWFSC, unpublished data); 11,135 (CV= 0.38) in the northern California inshore stratum (SWFSC, unpublished data); 4,808 (CV = 0.49) from southern Oregon Area VI (Laake et al. 1998), and 250 (CV = 1.09) animals from southern Oregon Area VIF (Laake et al. 1998).

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 estimated from 1997-99 aerial surveys in northern California and 1997 aerial surveys in southern Oregon, or 12,940 animals. This estimate includes harbor porpoise within an area extending to the 200m isobath or 15 nmi, whichever is farther from shore.

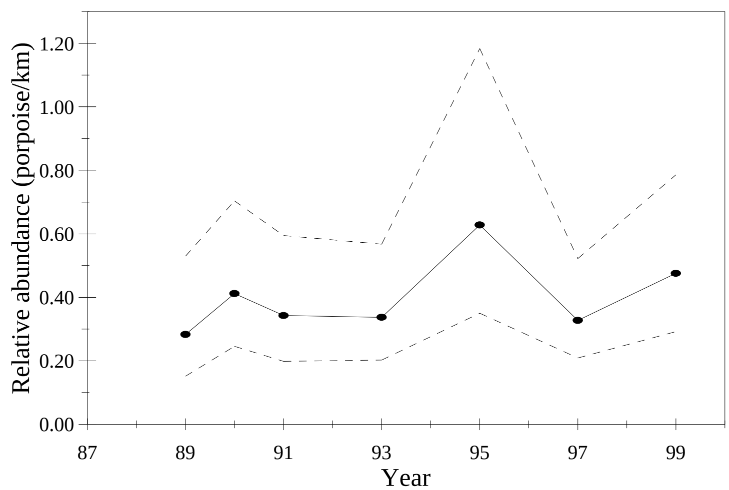

Figure 2. Relative abundance (+/- one standard error) of central California (Pt. Conception to Russian River) harbor porpoise, 1986-99, adjusted for sea state and cloud cover (following methods of Forney 1995). The trend shown includes the range of three California stocks (Morro Bay, Monterey Bay, and San-Francisco-Russian River.

Current Population Trend

Forney (1999b) examines trends in relative harbor porpoise abundance in central and northern California based on aerial surveys from 1989-95. No significant trends were evident over this time period for the Northern California Stock. The 1997-99 survey results continue to show no trend in relative abundance (Figure 2).

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 (Barlow and Boveng 1991). This maximum theoretical rate may not be achievable for any real population. [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 northern California 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 (12,940) 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 259.

HUMAN-CAUSED MORTALITY

Fishery Information

The incidental capture of harbor porpoise in California is largely limited to set gillnet fisheries in central California. Coastal setnets are not allowed in northern California (to protect salmon resources there). However, one harbor porpoise mortality was documented for the Klamath River tribal salmon gillnet fishery in 1995 (NMFS, Southwest Region, unpublished data). There have been no observed harbor porpoise mortalities or fishery-related strandings in the Klamath River tribal salmon gillnet fishery for the most recent five-year period (1996-2000) (pers. comm., Kathleen Williamson, Yurok tribe biologist).

Table 1. Summary of available information on incidental mortality and injury of harbor porpoise (northern CA stock) in fisheries that might take this species. 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)
CA Klamath River tribal salmon gillnet fishery	1996-2000	Observation	n/a	0	$0	$0
Minimum total annual takes						$0

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. There are no known habitat issues that are of particular concern for this stock. Because of the lack of recent or historical sources of human-caused mortality, the harbor porpoise stock in northern California has been concluded to be within their Optimum Sustainable Population (OSP) level (Barlow and Forney 1994). Because the known human-caused mortality or serious injury (0 harbor porpoise per year) is less than the PBR (259), 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.

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Revised 12/15/2003

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

In the eastern North Pacific Ocean, the harbor porpoise ranges from Point Barrow, along the Alaskan coast, and down the west coast of North America to Point Conception, California (Gaskin 1984). Harbor porpoise primarily frequent coastal waters. 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, suggests 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), harbor porpoise have also been conspicuously absent in offshore areas in late November (B. Taylor, pers. comm.) leaving a gap in the current understanding of their movements.

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. Investigation of pollutant loads in harbor porpoise ranging from California to the Canadian border also suggests restricted harbor porpoise movements (Calambokidis and Barlow 1991). Further genetic testing of the same data mentioned above, 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 to evolve genetic differences. 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.

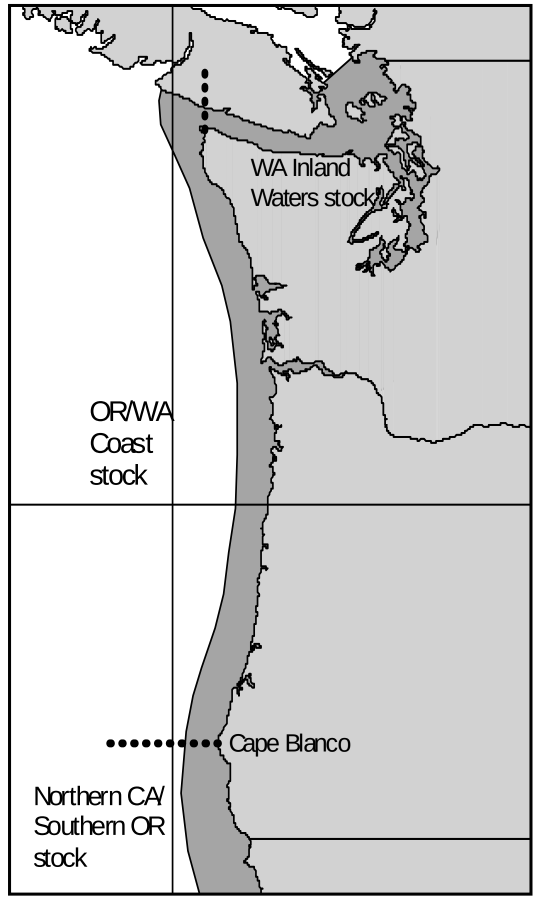

Figure 1. Approximate distribution of harbor porpoise in the U.S. Pacific Northwest (shaded area). Stock boundaries separating the stocks are shown.

Using the 1990-91 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 ($z=5.9$, $p<0.01$) between the waters of coastal Oregon/Washington and inland Washington/southern British Columbia, Canada (i.e., Strait of Juan de Fuca/San Juan Islands). Although differences in density exist between coastal Oregon/Washington and inland Washington waters, a specific stock boundary line cannot be identified based upon biological or genetic differences. However, harbor porpoise movements and rates of intermixing within the eastern North Pacific are restricted, and there has been a significant decline in harbor porpoise sightings within southern Puget Sound since the 1940s; therefore, following a risk averse management strategy, two stocks are recognized: the Oregon/Washington Coast stock (between Cape Blanco, OR, and Cape Flattery, WA) and the Washington Inland Waters stock (in waters east of Cape Flattery) (see Fig. 1). Recent genetic evidence suggests that the population of eastern North Pacific harbor porpoise is more finely structured than is currently recognized (Chivers et al. 2002). All relevant data (e.g., genetic samples, contaminant studies, and satellite tagging) will be reviewed to determine whether to adjust the stock boundaries for harbor porpoise in Oregon and Washington waters.

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), 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 (Carretta et al. 2001): 1) the Washington Inland Waters stock, 2) the 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. This report considers only the Oregon/Washington Coast stock. Stock assessment reports for the Washington Inland Waters, Northern California/Southern Oregon, San Francisco-Russian River, Monterey Bay, and Morro Bay harbor porpoise stocks appear in this volume. Three harbor porpoise stocks are also recognized in the inland and coastal waters of Alaska, including the Southeast Alaska, Gulf of Alaska, and Bering Sea stocks. The three Alaska harbor porpoise stocks 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 stock assessment report from either the Alaska Region or Pacific Northwest (Oregon/Washington).

POPULATION SIZE

In August and September 1997, an aerial survey of Oregon, Washington, and southern British Columbia coastal waters, from shore to 200 m depth, resulted in an observed abundance of 11,599 (CV=0.115) harbor porpoise in U.S. waters north of Cape Blanco, OR (Laake et al. 1998a). Using a correction factor of 3.42 (1/g(0); g(0)=0.292, CV=0.366) to adjust for groups missed by aerial observers, the corrected estimate of abundance for harbor porpoise in coastal Oregon (north of Cape Blanco) and Washington waters is 39,586 (CV=0.384). This estimate represents a substantial increase over the 1991 estimate of 26,175 (Osmek et al. 1996), even though it excludes the area south of Cape Blanco, due to: 1) the larger sampling region in the 1997 survey (out to water depths of 200 m vs. 91 m in 1991) and 2) a different estimate of g(0) (Laake et al. 1998a).

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock is calculated using Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/exp(0.842*[ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 39,586 and its associated CV(N) of 0.384, N_{MIN} for the Oregon/Washington Coast stock of harbor porpoise is 28,967.

Current Population Trend

There are no reliable data on population trends of harbor porpoise for coastal Oregon, Washington, or British Columbia waters.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently 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 Oregon/Washington Coast harbor porpoise stock.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (28,967) <u>times</u> one-half the default maximum net growth rate for cetaceans (½ of 4%) <u>times</u> a recovery factor of 0.5 (for a stock of unknown status, Wade and Angliss 1997), resulting in a PBR of 290 harbor porpoise per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Within the EEZ boundaries of coastal Oregon and Washington, human-caused (fishery) mortalities of harbor porpoise are presently known to occur only in the northern Washington marine set gillnet fishery. During 1992-1993, the WA/OR Lower Columbia River, WA Grays Harbor, and WA Willapa Bay drift gillnet fisheries were monitored at observer coverages of approximately 4% and 2%, respectively. There were no observed harbor porpoise mortalities in these fisheries.

NMFS observers monitored the northern Washington marine set gillnet fishery in 1997, 1998, and 2000. There was no observer coverage in 1999 or 2001; the total fishing effort was 4 and 46 net days, respectively, in those years and occurred only in inland waters (Gearin et al. 1994, 2000; P. Gearin, unpubl. data). For the entire area fished (coastal + inland waters), observer coverage ranged from approximately 40 to 98% during observed years. Fishing effort is conducted within the range of both harbor porpoise stocks (Oregon/Washington Coast and Washington Inland Waters stocks) occurring in Washington State waters. For the purposes of this stock assessment report, the animals taken in the inland portion of the fishery are assumed to have belonged to the Washington Inland Waters stock and the animals taken in the coastal portion of the fishery are assumed to have belonged to the Oregon/Washington Coast stock. 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. Accordingly, Table 1 includes data only from that portion of the northern Washington marine set gillnet fishery occurring within the range of the Oregon/Washington Coast stock (those waters south and west of Cape Flattery, WA, and north of Cape Blanco, OR), where observer coverage was 100% in 1997 and 2000. No fishing effort occurred in the coastal portion of the fishery in 1998, 1999, or 2001. The mean estimated mortality for this fishery is 3.2 (CV=0.79) harbor porpoise per year from this stock.

Table 1. Summary of incidental mortality of harbor porpoise (Oregon/Washington Coast stock) in commercial and tribal fisheries and calculation of the mean annual mortality rate; n/a indicates that data are not available. Mean annual takes are based on 1997-2001 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 coastal waters: areas 4 and 4A)	97 98 99 00 01	obs data	100% no fishery no fishery 100% no fishery	13 0 0 3 0	13 0 0 3 0	3.2 (0.79)
Estimated total annual takes						3.2 (0.79)

In 1995-1997, data for the northern Washington marine set gillnet fishery were collected 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 mortalities occurred in alarmed nets (Gearin et al. 1996, 2000; Laake et al. 1997). In 1997, 96% of the sets were equipped with acoustic alarms and 13 mortalities were observed (Gearin et al. 2000; P. Gearin, unpubl. data). Harbor porpoise were displaced by an acoustic buffer around the alarmed nets, but it is unclear whether the porpoise were repelled by the alarms or whether it was their prey that were repelled (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).

An additional source of information on the number of harbor porpoise killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1997 and 2001, there were no fisher self-reports of harbor porpoise mortalities from any fisheries operating within the range of the Oregon/Washington Coast stock. However, because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. Logbook data are available for part of 1989-1994, after which incidental mortality reporting requirements were modified. Under the new system, logbooks are no longer required; instead, fishers provide self-reports. Data for the 1994-1995 phase-in period is fragmentary. After 1995, the level of reporting dropped dramatically, such that the records are considered incomplete and estimates of mortality based on them represent minimums (see Appendix 7 in Angliss et al. 2001 for details).

There have been no fishery-related strandings of harbor porpoise from this stock dating back to at least 1990 (B. Norberg, pers. comm.).

Other Mortality

According to Northwest Marine Mammal Stranding Network records, maintained by the NMFS Northwest Region, no human-caused harbor porpoise mortalities or serious injuries were reported from non-fisheries sources in 1997-2001.

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 the currently available data, the level of human-caused mortality and serious injury (3.2) does not exceed the PBR (290). Therefore, the Oregon/Washington Coast stock of harbor porpoise is not classified as “strategic.” The total fishery mortality and serious injury for this stock (3.2: based on observer data) is not known to exceed 10% of the calculated PBR (29) 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*): Washington Inland Waters Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

In the eastern North Pacific Ocean, the harbor porpoise ranges from Point Barrow, along the Alaskan coast, and down the west coast of North America to Point Conception, California (Gaskin 1984). Harbor porpoise primarily frequent coastal waters. 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, suggests 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), harbor porpoise have also been conspicuously absent in offshore areas in late November (B. Taylor, pers. comm.) leaving a gap in the current understanding of their movements.

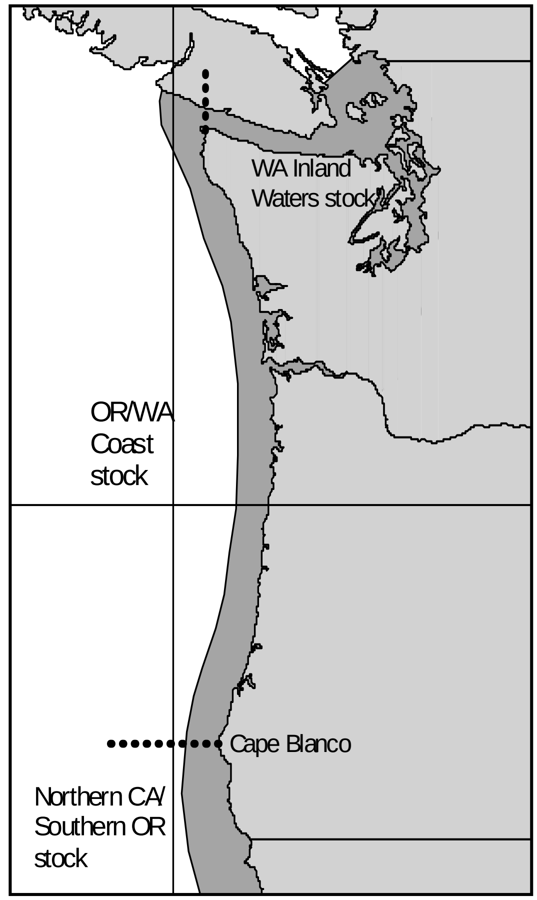

Figure 2. Approximate distribution of harbor porpoise in the U.S. Pacific Northwest (shaded area). Stock boundaries separating the stocks are shown.

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. Investigation of pollutant loads in harbor porpoise ranging from California to the Canadian border also suggests restricted harbor porpoise movements (Calambokidis and Barlow 1991). Further genetic testing of the same data mentioned above, 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 to evolve genetic differences. 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 ($z=5.9$, $p<0.01$) between the waters of coastal Oregon/Washington and inland Washington/southern British Columbia, Canada (i.e., Strait of Juan de Fuca/San Juan Islands). Although differences in density exist between coastal Oregon/Washington and inland Washington waters, a specific stock boundary line cannot be identified based upon biological or genetic differences. However, harbor porpoise movements and rates of intermixing within the eastern North Pacific are restricted, and there has been a significant decline in harbor porpoise sightings within southern Puget Sound since the 1940s; therefore, following a risk averse management strategy, two stocks are recognized: the Oregon/Washington Coast stock (between Cape Blanco, OR, and Cape Flattery, WA) and the Washington Inland Waters stock (in waters east of Cape Flattery) (see Fig. 1). Recent genetic evidence suggests that the population of eastern North Pacific harbor porpoise is more finely structured than is currently recognized (Chivers et al. 2002). All relevant data (e.g., genetic samples, contaminant studies, and satellite tagging) will be reviewed to determine whether to adjust the stock boundaries for harbor porpoise in Oregon and Washington waters.

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), 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 (Carretta et al. 2001): 1) the Washington Inland Waters stock, 2) the 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. This report considers only the Washington Inland Waters stock. Stock assessment reports for the Oregon/Washington Coast, Northern California/Southern Oregon, San Francisco-Russian River, Monterey Bay, and Morro Bay harbor porpoise stocks appear in this volume. Three harbor porpoise stocks are also recognized in the inland and coastal waters of Alaska, including the Southeast Alaska, Gulf of Alaska, and Bering Sea stocks. The three Alaska harbor porpoise stocks 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 stock assessment report from either the Alaska Region or Pacific Northwest (Oregon/Washington).

POPULATION SIZE

Aerial surveys of the inside waters of Washington and southern British Columbia were conducted during August of 1996 (Calambokidis et al. 1997). These aerial surveys included the Strait of Juan de Fuca, San Juan Islands, Gulf Islands, and Strait of Georgia, which includes waters inhabited by harbor porpoise from British Columbia, as well as the Washington Inland Waters stock. A total of 2,117 km of survey effort was completed within U.S. waters, resulting in an uncorrected abundance of 1,025 (CV=0.151) harbor porpoise in the inside waters of Washington (Calambokidis et al. 1997, Laake et al. 1997a). When corrected for availability and perception bias, using a correction factor of 3.42 (1/g(0); g(0)=0.292, CV=0.366), the estimated abundance for the Washington Inland Waters stock of harbor porpoise is 3,509 (CV=0.396) animals (Laake et al. 1997a, 1997b).

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock is calculated using Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842*[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 3,509 and its associated CV(N) of 0.396, N_{MIN} for the Washington Inland Waters stock of harbor porpoise is 2,545.

Current Population Trend

There are no reliable data on long-term population trends of harbor porpoise for most waters of Oregon, Washington, or British Columbia. For comparability to the 1996 survey, a re-analysis of the 1991 aerial survey data was conducted (Calambokidis et al. 1997). The abundance of harbor porpoise in the Washington Inland Waters stock in 1996 was not significantly different than in 1991 (Laake et al. 1997a).

A different situation exists in southern Puget Sound where harbor porpoises are now rarely observed, a sharp contrast to 1942 when they were considered common in those waters (Scheffer and Slipp 1948). Although quantitative data for this area are lacking, marine mammal survey effort (Everitt et al. 1980), stranding records since the early 1970s (Osmek et al. 1995), and the results of harbor porpoise surveys of 1991 (Calambokidis et al. 1992) and 1994 (Osmek et al. 1995) indicate that harbor porpoise abundance has 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 be related to fishery interactions, pollutants, vessel traffic, or other activities that may affect harbor porpoise occurrence and distribution in this area (Osmek et al. 1995). Research to identify trends in harbor porpoise abundance is also needed for the other areas within Washington inland waters.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is not currently available for harbor porpoise. Hence, 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) level for this stock is calculated as the minimum population size (2,545) 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 rate CV≥0.80, Wade and Angliss 1997), resulting in a PBR of 20 harbor porpoise per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

NMFS observers monitored the northern Washington marine set gillnet fishery in 1997, 1998, and 2000; there was no observer coverage in 1999 or 2001 (Gearin et al. 1994, 2000; P. Gearin, unpubl. data). For the entire area fished (coastal + inland waters), observer coverage ranged from approximately 40 to 98% during observed years. Fishing effort is conducted within the range of both harbor porpoise stocks (Oregon/Washington Coast and Washington Inland Waters stocks) occurring in Washington State waters. For the purposes of this stock assessment report, the animals taken in the inland portion of the fishery are assumed to have belonged to the Washington Inland Waters stock and the animals taken in the coastal portion of the fishery are assumed to have belonged to the Oregon/Washington Coast stock. 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. Accordingly, Table 1 includes data only from that portion of the northern Washington marine set gillnet fishery occurring within the range of the Washington Inland Waters stock (those waters east of Cape Flattery), where observer coverage ranged from 40 to 80% between 1997 and 2001 and fishing effort ranged from 4-46 net days per year (1 net day equals a 100-fathom length net set for 24 hours). There was no observer program in 1999 or 2001; the total fishing effort was 4 and 46 net days (respectively) in those years, it occurred only in inland waters, and no harbor porpoise takes were reported. No mortalities were observed in the inland portion of the fishery between 1997 and 2001, thus, the mean estimated mortality for this fishery is zero harbor porpoise per year from this stock.

In 1993, as a pilot for future observer programs, NMFS in conjunction with the Washington Department of Fish and Wildlife (WDFW) monitored all non-treaty components of the Washington Puget Sound Region salmon gillnet fishery (Pierce et al. 1994). Observer coverage was 1.3% overall, ranging from 0.9% to 7.3% for the various components of the fishery. No harbor porpoise mortalities were reported (Table 1). Pierce et al. (1994) cautioned against extrapolating these mortalities to the entire Puget Sound fishery due to the low observer coverage and potential biases inherent in the data. The area 7/7A sockeye landings represented the majority of the non-treaty salmon landings in 1993, approximately 67%. Results of this pilot study were used to design the 1994 observer programs discussed below.

In 1994, NMFS in conjunction with WDFW conducted an observer program during the Puget Sound non-treaty chum salmon gillnet fishery (areas 10/11 and 12/12B). A total of 230 sets were observed during 54 boat trips, representing approximately 11% observer coverage of the 500 fishing boat trips comprising the total effort in this fishery, as estimated from fish ticket landings (Erstad et al. 1996). No harbor porpoise were reported within 100 m of observed gillnets. The Puget Sound treaty chum salmon gillnet fishery in Hood Canal (areas 12, 12B, and 12C) and Puget Sound treaty sockeye/chum gillnet fishery in the Strait of Juan de Fuca (areas 4B, 5, and 6C) were also monitored in 1994 (NWIFC 1995). No harbor porpoise mortalities were reported in the observer programs covering these treaty salmon gillnet fisheries, where observer coverage was estimated at 2.2% (based on % of total catch observed) and approximately 7.5% (based on % of observed trips to total landings), respectively.

Also in 1994, NMFS in conjunction with WDFW and the Tribes conducted an observer program to examine seabird and marine mammal interactions with the Puget Sound treaty and non-treaty sockeye salmon gillnet fishery (areas 7 and 7A). During this fishery, observers monitored 2,205 sets, representing approximately 7% of the estimated 33,086 sets occurring in the fishery (Pierce et al. 1996). There was one observed harbor porpoise mortality (one other was entangled and released alive with no indication that it was injured), resulting in a mortality rate of 0.00045 harbor porpoise per set, which extrapolates to 15 mortalities (CV=1.0) for the entire fishery.

In 1996, Washington Sea Grant Program conducted a test fishery in the non-treaty sockeye salmon gillnet fishery (area 7) to compare entanglement rates of seabirds and marine mammals and catch rates of salmon using three experimental gears and a control (monofilament mesh net). The experimental nets incorporated highly visible mesh in the upper quarter (50 mesh gear) or upper eighth (20 mesh gear) of the net or had low-frequency sound emitters attached to the corkline (Melvin et al. 1997). In 642 sets during 17 vessel trips, 2 harbor porpoise were killed in the 50 mesh gear.

Table 1. Summary of incidental mortality of harbor porpoise (Washington Inland Waters stock) due to commercial and tribal fisheries and calculation of the mean annual mortality rate; n/a indicates that data are not available. Mean annual takes are based on 1997-2001 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: areas 4B and 5)	97 98 99 00 01	obs data	80% 40% 0% 58% 0%	0 0 n/a 0 n/a	0 0 n/a 0 n/a	0[1]
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)	93	obs data	1.3%	0	0	see text
Puget Sound non-treaty chum salmon gillnet (areas 10/11 and 12/12B)	94	obs data	11%	0	0	0
Puget Sound treaty chum salmon gillnet (areas 12, 12B, and 12C)	94	obs data	2.2%	0	0	0
Puget Sound treaty chum and sockeye salmon gillnet (areas 4B, 5, and 6C)	94	obs data	7.5%	0	0	0
Puget Sound treaty and non-treaty sockeye salmon gillnet (areas 7 and 7A)	94	obs data	7%	1	15	15 (1.0)
Unknown Puget Sound fishery	97-01	strand data		0, 0, 0, 1, 0		≥0.2 (n/a)
Minimum total annual takes						≥15.2 (1.0)

[1]1997-98 and 2000 mortality estimates are included in the average.

Combining the estimates from the 1994 observer programs (15) with the northern Washington marine set gillnet fishery (0) results in an estimated mean mortality rate in observed fisheries of 15 harbor porpoise per year from this stock. It should be noted that the 1994 observer programs did not sample all segments of the entire Washington Puget Sound Region salmon set/drift gillnet fishery and, further, the extrapolation of total kill did not include effort for the unobserved segments of this fishery. Therefore, 15 is an underestimate of the harbor porpoise mortality due to the entire fishery. Although the percentage of the overall Washington Puget Sound Region salmon set/drift gillnet fishery effort that was observed in 1994 was not quantified, the observer programs covered those segments of the fishery which had the highest salmon catches, the majority of vessel participation, and the highest likelihood of interaction with harbor porpoise (J. Scordino, pers. comm.). Since the Washington Inland Waters stock of harbor porpoise occurs primarily in the Strait of Juan de Fuca and the San Juan Islands, it is unlikely that many harbor porpoise are taken in other areas of the Washington Puget Sound Region salmon gillnet fishery (i.e., Hood Canal and southern Puget Sound). Harbor porpoise takes in the Washington Puget Sound Region salmon drift gillnet fishery are unlikely to have increased since the fishery was last observed in 1994, due to reductions in the number of participating vessels and available fishing time (see details in Appendix 1). Fishing effort and catch have declined throughout all salmon fisheries in the region due to management efforts to recover ESA-listed salmonids.

An additional source of information on the number of harbor porpoise killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1994 and 2001, there were no fisher self-reports of harbor porpoise mortalities from the Washington Puget Sound Region salmon set/drift gillnet fishery. Unlike the 1994 observer program data, the self-reported fisheries data cover the entire fishery. However, because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates of harbor porpoise mortality. Logbook data are available for part of 1989-1994, after which incidental mortality reporting requirements were modified. Under the new system, logbooks are no longer required; instead, fishers provide self-reports. Data for the 1994-1995 phase-in period is fragmentary. After 1995, the level of reporting dropped dramatically, such that the records are considered incomplete and estimates of mortality based on them represent minimums (see Appendix 7 in Angliss et al. 2001 for details).

Strandings of harbor porpoise wrapped in fishing gear or with injuries caused by interactions with gear are a final source of fishery-related mortality information. One fishery-related stranding of a harbor porpoise occurred in 2000 (B. Norberg, pers. comm.). As the stranding could not be attributed to a particular fishery, it has been included in Table 1 as occurring in an unknown Puget Sound fishery. Fishery-related strandings during 1997-2001 resulted in an estimated annual mortality of 0.2 harbor porpoise 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).

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 mortalities) 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.

The minimum estimated fishery mortality and serious injury for this stock is 15.2 harbor porpoise per year, based on observer program data (15) and stranding data (0.2) in U.S. waters.

Other Mortality

According to Northwest Marine Mammal Stranding Network records, maintained by the NMFS Northwest Region, one human-caused harbor porpoise mortality was reported from non-fisheries sources in 1997-2001. An animal was struck by a ship in 2001, resulting in an estimated mortality of 0.2 harbor porpoise per year from this stock.

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 total level of human-caused mortality and serious injury (15.2 + 0.2 = 15.4) is not known to exceed the PBR (20). Therefore, the Washington Inland Waters harbor porpoise stock is not classified as “strategic.” The minimum total fishery mortality and serious injury for this stock (15.2) exceeds 10% of the calculated PBR (2.0) 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) level and population trends is unknown, although harbor porpoise sightings in southern Puget Sound have declined since the 1940s.

This stock is not recognized as “strategic,” however, the estimated take level is close to the PBR. The mortality rate is based on observer data from a subset of the Washington Puget Sound Region salmon set/drift gillnet fishery. 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. Given that the estimated take level is from 1994, it is appropriate to consider whether the current take level is different. No new information is available about mortality per set, but 1) fishing effort has decreased in recent years and 2) preliminary analysis of data from vessel (1999, 2002) and aerial (2002) surveys indicates that abundance and range have not declined since 1996.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Dall's porpoise 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 at different times (Green et al. 1992, 1993; Mangels and Gerrodette 1994; Barlow 1995; Forney et al. 1995) 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 porpoise 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 porpoise 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.

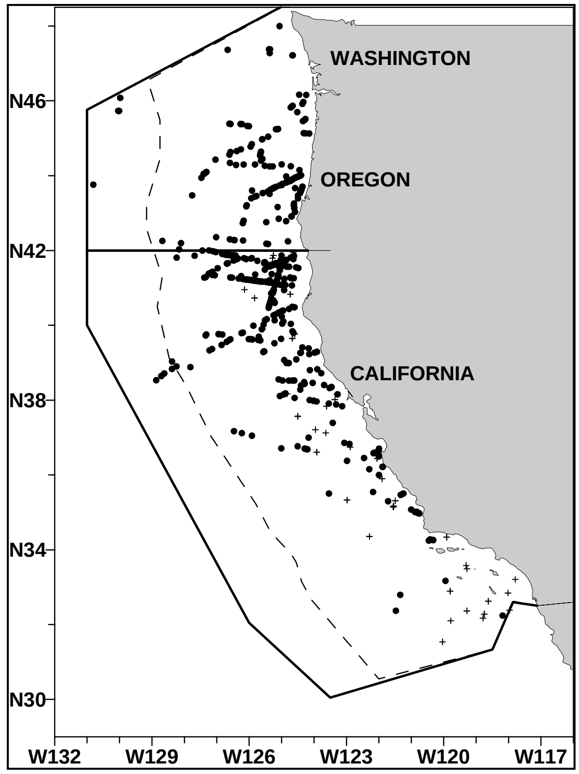

Figure 1. Dall's porpoise sightings based on aerial and shipboard surveys off California, Oregon, and Washington, 1991-2001 (see Appendix 2 for data sources and information on timing and location of survey effort). Dashed line represents the U.S. EEZ, thick line indicates the outer boundary of all surveys combined. Key: • = summer/autumn ship-based sightings and + = winter/spring aerial-based sightings.

POPULATION SIZE

Shipboard surveys are expected to be more reliable for this species than aerial surveys because of the large, unknown fraction of diving animals missed from the air (Forney 1994). Two summer/fall shipboard surveys were conducted within 300 nmi of the coasts of California Oregon and Washington in 1996 (Barlow 1997) and 2001 (Barlow 2003). The distribution of Dall's porpoise throughout this region is highly variable between years and appears to be affected by oceanographic conditions (Forney 1997; Forney and Barlow 1998). 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 1996-2001 weighted average abundance estimate for California, Oregon and Washington waters based on two ship surveys is 98,617 (CV = 0.33) Dall's porpoise (Barlow 2003). Additional aerial surveys were conducted in the inland waters of Washington in 1996, resulting in Dall's porpoise abundance estimates of 900 (CV=0.40) (Calambokidis et al. 1997). This estimate includes approximate correction factors for animals missed due to perception and availability bias. Combining the 1996 estimate for inland

Washington waters with the 1996-2001 outer coast estimate from NMFS ship surveys yields a total abundance estimate of 99,517 (CV=0.33) Dall's porpoise for the California/Oregon/Washington stock.

Minimum Population Estimate

The log-normal 20th percentile of the 1996-2001 weighted average abundance estimate for both the outer coast of California, Oregon and Washington and inland Washington waters is 75,915 Dall's porpoise.

Current Population Trend

No information is available regarding trends in abundance of Dall's porpoise in California, Oregon and Washington. Their distribution and abundance in this region varies considerably at both seasonal and interannual time scales as oceanographic conditions vary (Forney 1997; Forney and Barlow 1998).

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 (75,915) 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 a mortality rate CV>0.30 and #0.60; Wade and Angliss 1997), resulting in a PBR of 729 Dall's porpoise per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

A summary of recent fishery mortality and injury for this stock of Dall's porpoise is given in Table 1. More detailed information on these fisheries is provided in Appendix 1. Mortality estimates for the California drift gillnet fishery are included for the five most recent years of monitoring, 1997-2001 (Cameron and Forney 1999, 2000; Carretta 2001, 2002). After the 1997 implementation of a Take Reduction Plan, which included skipper education workshops and required the use of pingers and minimum 6-fathom extenders, overall cetacean entanglement rates in the drift gillnet fishery dropped considerably (Barlow and Cameron 20031999). However, because of interannual variability in entanglement rates and the relative rarity of Dall's porpoise entanglements, additional years of data will be required to fully evaluate the effectiveness of pingers for reducing mortality of this particular species. Mean annual takes in Table 1 are based on 1997-2001 data. This results in an average estimate of four (CV = 0.95) Dall's porpoise taken annually.

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).

Low levels of mortality for Dall's porpoise have also been documented in the California/Oregon/Washington domestic groundfish trawl fisheries (Perez and Loughlin 1991; Perez, in prep). Between 1997 and 2001, with 66%-96% of the fishing effort observed, six Dall's porpoise were reported killed in the at-sea processing portion of the Pacific whiting trawl fishery, and two animals were reported in unmonitored hauls. Based only on the systematically observed hauls, Dall's porpoise mortality was estimated to be ten (CV=0.69) in 1997, three (CV= 0.40) in 1998, and one (CV = n/a) in 1999 (Perez, in prep). Combining these estimates with the two reported mortalities for 1997 and 1998 that are not accounted for in the estimates, the minimum average annual mortality for 1997-2001 is 3.2 (CV=0.50) Dall's porpoise per year.

STATUS OF STOCK

The status of Dall's porpoise 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. They are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. Including driftnet mortality only for years after implementation of the Take Reduction Plan (1997-98), the average annual human-caused mortality in 1997-2001 (7 animals) is estimated to be less than the PBR (729), and therefore 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.

Table 1. Summary of available information on the incidental mortality and injury of Dall's porpoise (California/ Oregon/Washington Stock) in commercial fisheries that might take this species. All observed entanglements of Dall's porpoise 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 1997-2001 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	1997 1998 1999 2000 2001	23.0% 20.0% 20.0% 22.9% 20.4%	4 0 0 0 0	20 (0.95) 0 0 0 0	4 (0.95)
WA/OR/CA domestic groundfish trawl fisheries (At-sea processing Pacific whiting fishery only).	observer data	1997 1998 1999 2000 2001	65.7% 77.3% 68.6% 80.6% 96.2%	3 2 1 0 0	10 (0.69) 3 (0.40) 1 (n/a) 0 0	2.8 (0.50)
Minimum total annual takes						7 (0.58)

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Revised 12/15/2003

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 are common both on the high seas and along the continental margins. Off the U.S. west coast, Pacific white-sided dolphins have been seen primarily in shelf and slope waters (Figure 1). Sighting patterns from recent aerial and shipboard surveys conducted in California, Oregon and Washington at different times of the year (Green et al. 1992; 1993; Barlow 1995; Forney et al. 1995) 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 (Green et al. 1992; Forney 1994).

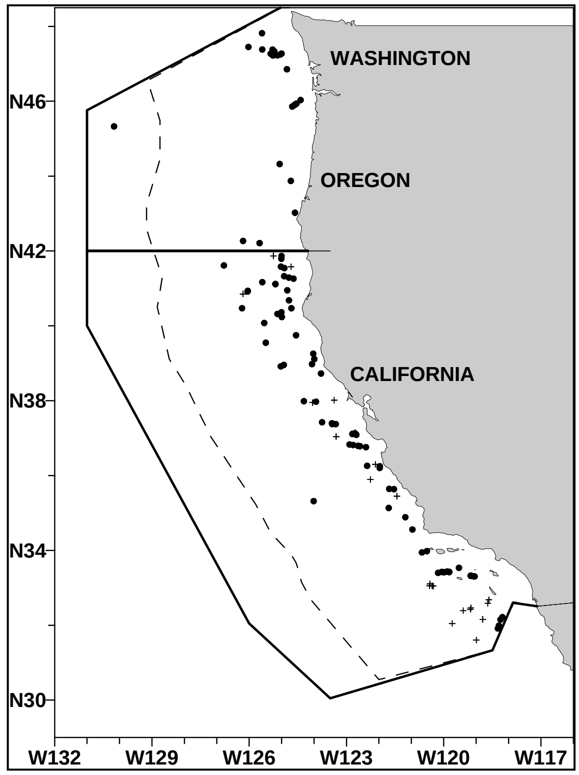

Figure 1. Pacific white-sided dolphin sightings based on aerial and shipboard surveys off California, Oregon, and Washington, 1991-2001 (see Appendix 2 for data sources and information on timing and location of survey effort). Dashed line represents the U.S. EEZ, thick line indicates the outer boundary of all surveys combined. Key: • = summer/autumn ship-based sightings; + = winter/spring aerial-based sightings.

Stock structure throughout the North Pacific is poorly understood, but based on morphological evidence, two forms are known to occur off the California coast (Walker et al. 1986; Chivers et al. 1993). Specimens belonging to the northern form were collected from north of about 33^{o}N, (Southern California to Alaska), and southern specimens were obtained from about 36^{o}N 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). Recent 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 in 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).

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 animals without genetic or morphometric analyses. 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 must be managed as a single unit; however, this is an undesirable management situation. Furthermore, Pacific white-sided dolphins are not restricted to U.S. territorial 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). Additional means of differentiating the two types must be found, and cooperative management with Mexico is particularly important for this species, given the apparently dynamic nature of geographical stock boundaries. Until these goals are accomplished, the management stock includes animals of both forms. 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 previous best estimates of abundance for Pacific white-sided dolphins were based on three summer/autumn shipboard surveys conducted within 300 nmi of the coasts California in 1991 and 1993 (Barlow and Gerrodette 1996) and California, Oregon, and Washington in 1996 (Barlow 1997). More recently, a shipboard survey within 300 nmi of the coasts of California, Oregon, and Washington was conducted in summer/autumn of 2001 (Barlow 2003). 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). 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 1996-2001 weighted average abundance estimate for California, Oregon and Washington waters based on the two most recent ship surveys is 59,274 (CV =0.50) Pacific white-sided dolphins (Barlow 2003).

Minimum Population Estimate

The log-normal 20th percentile of the 1996-2001 weighted average abundance estimate is 39,822 Pacific white-sided dolphins.

Current Population Trend

No long-term trends in the abundance of Pacific white-sided dolphins in California, Oregon and Washington are suggested based on historical and recent surveys (Dohl et al. 1980; 1983; Green et al. 1992; 1993; Barlow 1995; Forney et al. 1995, Barlow 2003).

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 (39,822) 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 $0.30 and #0.60; Wade and Angliss 1997), resulting in a PBR of 382 Pacific white-sided dolphins per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

A summary of recent fishery mortality and injury for this stock of Pacific white-sided dolphin is shown in Table 1. More detailed information on these fisheries is provided in Appendix 1. Mortality estimates for the California drift gillnet fishery are included for the five most recent years of monitoring, 1997-2001 (Cameron and Forney 1999, 2000; Carretta 2001, 2002). After the 1997 implementation of a Take Reduction Plan, which included skipper education workshops and required the use of pingers and minimum 6-fathom extenders, overall cetacean entanglement rates in the drift gillnet fishery dropped considerably (Barlow and Cameron 2003). However, because of interannual variability in entanglement rates and the relative rarity of Pacific white-sided dolphin entanglements, additional years of data will be required to fully evaluate the effectiveness of pingers for reducing mortality of this particular species. Mean annual takes in Table 1 are based on 1997-2001 data. This results in an average estimate of 5.9 (CV = 0.42) Pacific white-sided dolphins taken annually.

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).

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. 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 1997-2001 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	1997 1998 1999 2000 2001	23.0% 20.0% 20.0% 22.9% 20.4%	3 0 0 2 2	12 (0.68) 0 0 5 (1.02) 9 (0.69)	5.2 (0.44)
WA/OR/CA domestic groundfish trawl fisheries (At-sea processing Pacific whiting fishery only).	observer data	1997 1998 1999 2000 2001	65.7% 77.3% 68.6% 80.6% 96.2%	0 1 0 0 0	0 1 (0.48) 0 0 0	0.2 (0.48)
Minimum total annual takes						5.4 (0.42)

Low levels of mortality for Pacific white-sided dolphins have also been documented in the California/Oregon/ Washington domestic groundfish trawl fisheries (Perez and Loughlin 1991; Perez, in prep;). Between 1997 and 2001, with 66%-96% of the fishing effort observed, one Pacific white-sided dolphin was reported killed in the at-sea processing portion of the Pacific whiting trawl fishery, and three additional animals were reported in unmonitored hauls. Based only on the systematically observed hauls, mortality was estimated to be one Pacific white-sided dolphin (CV=0.48, Perez, in prep) in 1998. Combining this estimate with the three additional reported mortalities for 1996 that are not accounted for in the estimate, the minimum average annual mortality for 1997-2001 is 0.8 (CV=0.48) Pacific white-sided dolphins.

Other removals

Additional removals of Pacific white-sided dolphins from the wild have occurred in live-capture fisheries off California. Brownell et al. (1999) estimate a minimum total live capture of 128 Pacific white-sided dolphins between the late 1950s and 1993. The most recent capture was in November 1993, when three animals were taken for public display (Forney 1994). No MMPA permits are currently active for live-captures of Pacific white-sided dolphins.

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. Including driftnet mortality only for years after implementation of the Take Reduction Plan (1997-98), the average annual human-caused mortality in 1997-2001 (5.4 animals) is estimated to be less than the PBR (382), and therefore 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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RISSO'S DOLPHIN (*Grampus griseus*): California/Oregon/Washington Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Risso's dolphins are distributed world-wide 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). The southern end of this population's range is not well-documented, but on a recent joint U.S./Mexican ship survey, Risso's dolphins were sighted off northern Baja California, and a conspicuous 500 nmi gap was present 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.

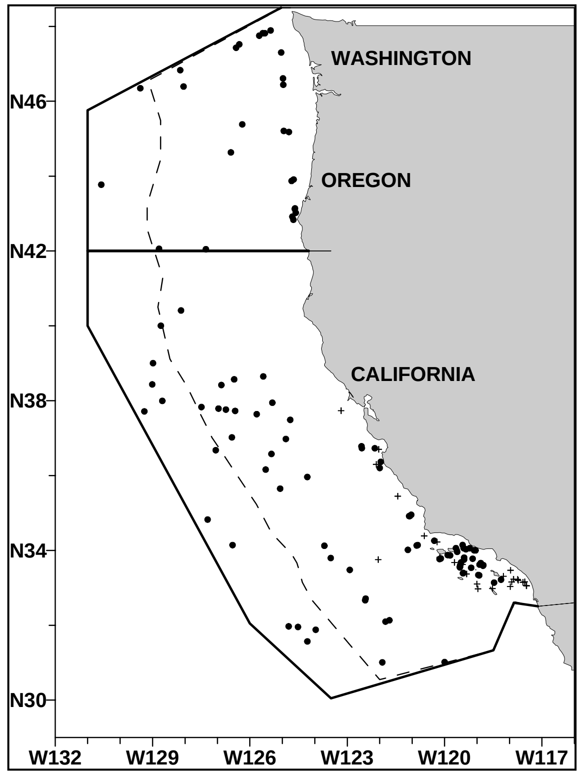

Figure 1. Risso's dolphin sightings based on aerial and shipboard surveys off California, Oregon, and Washington, 1991-2001 (see Appendix 2 for data sources and information on timing and location of survey effort). Dashed line represents the U.S. EEZ, thick line indicates the outer boundary of all surveys combined. Key: • = summer/autumn ship-based sightings; + = winter/spring aerial-based sightings.

POPULATION SIZE

The previous best estimates of abundance for Risso's dolphins were based on three summer/autumn shipboard surveys conducted within 300 nmi of the coasts California in 1991 and 1993 (Barlow and Gerrodette 1996) and California, Oregon, and Washington in 1996 (Barlow 1997). More recently, a shipboard survey within 300 nmi of the coasts of California, Oregon, and Washington was conducted in summer/autumn of 2001 (Barlow, 2003). 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 1996-2001 weighted average abundance estimate for California, Oregon and Washington waters based on the two most recent ship surveys is 16,066 (CV = 0.28) Risso's dolphins (Barlow 2003).

Minimum Population Estimate

The log-normal 20th percentile of the 1996-2001 weighted average abundance estimate is 12,748 Risso's dolphins.

Current Population Trend

The pooled abundance estimate from the most recent two surveys of California, Oregon, and Washington waters is 16,066 (CV = 0..28) (Barlow 2003), which is relatively unchanged from the estimate of 16,483 (CV = 0.28) from pooled 1991-1996 surveys (Barlow 1997). Currently, there is no evidence of a trend in abundance for this stock.

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 (12,748) <u>times</u> one half the default maximum net growth rate for cetaceans (½ of 4%) <u>times</u> a recovery factor of 0.45 (for a species of unknown status with a mortality rate CV #0.60 and $0.80; Wade and Angliss 1997), resulting in a PBR of 115 Risso's dolphins per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

A summary of recent fishery mortality and injury for this stock of Risso's dolphin is shown in Table 1. More detailed information on these fisheries is provided in Appendix 1. Mortality estimates for the California drift gillnet fishery are included for the five most recent years of monitoring, 1997-2001 (Julian 1997; Cameron and Forney 1999, 2000; Carretta 2001, 2002). After the 1997 implementation of a Take Reduction Plan, which included skipper education workshops and required the use of pingers and minimum 6-fathom extenders, overall cetacean entanglement rates in the drift gillnet fishery dropped considerably (Barlow and Cameron 2003). However, because of interannual variability in entanglement rates and the relative rarity of Risso's dolphin entanglements, additional years of data will be required to fully evaluate the effectiveness of pingers for reducing mortality of this particular species. Mean annual takes in Table 1 are based on 1997-2001 data. This results in an average estimate of 3.6 (CV = 0.63) Risso's dolphins taken annually.

Table 1. Summary of available information on the incidental mortality and injury of Risso's dolphin (California/ Oregon/Washington Stock) in commercial fisheries that might take this species. All observed entanglements of Risso's 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 1997-2001 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	1997 1998 1999 2000 2001	23.0% 20.0% 20.0% 22.9% 20.4%	3 0 0 2 0	11 (0.96) 0 0 7 (0.58) 0	3.6 (0.63)
Minimum total annual takes						3.6 (0.63)

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).

Additional mortality of unknown extent has been documented for Risso's dolphins 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). In 2002, two Risso's dolphin stranded in close proximity in southern California on the same day; bullets were retrieved from one animal, the other showed evidence of gunshot wounds. The timing and location of the strandings suggests that the squid purse seine fishery may have been responsible for the mortalities.

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 (1997-2001), the average annual human-caused mortality 3.6 animals) is estimated to be less than the PBR (115), and therefore 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 12/15/2003

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). California coastal bottlenose dolphins are found within about one kilometer of shore (Figure 1; Hansen, 1990; Carretta et al. 1998; Defran and Weller 1999) primarily from Point Conception south into Mexican waters, at least as far south as Ensenada. 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 probably moving into and out of this area. 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 (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 three stocks: 1) California coastal stock (this report), 2) California, Oregon and Washington offshore stock, and 3) Hawaiian stock.

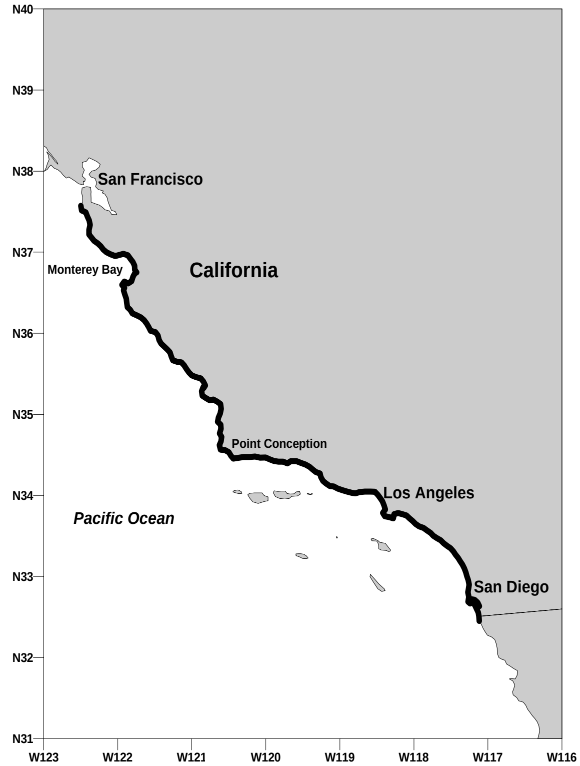

Figure 1. Approximate range (in bold) of California coastal bottlenose dolphins based on aerial surveys along the coast of California from 1990-2000. This population of bottlenose dolphins is found within about 1 km of shore.

POPULATION SIZE

Photo-identification studies along the coasts of southern California and northern Mexico identified 404 unique individuals in this population between 1981 and 1989 based on dorsal fin characteristics, with an estimated 35% of animals lacking identifiable characters at any particular time (Defran and Weller 1999). This cannot be considered a minimum population estimate, however, because an unknown number of animals died during this period and rates of acquisition of dorsal fin characters are not known. Mark-recapture estimates based on photo-identification studies in 1985-89 range from 234 (95% CI 205-263) to 285 (95% CI 265-306) animals for the entire California-Mexico population (Defran and Weller 1999). A recent re-analysis of mark-recapture estimates from the 1980s resulted in revised abundance estimates of 289 (95% CI 230-298) for the period 1984-86 and 354 (95% CI 330-390) for 1987-89 (Dudzik 1999). The most recent photographic mark-recapture abundance estimate is 356 (95% CI 306 - 437) for the period 1996-98 (Dudzik 1999). Because coastal bottlenose dolphins spend an unknown amount of time in

Mexican waters, where they are subject to mortality in Mexican fisheries, an average abundance estimate for California only is the most appropriate for U.S. management of this stock. Tandem aerial surveys were conducted in 1990-94 and 1999-2000 to estimate the abundance of coastal bottlenose dolphins throughout the southern and central California portion of their range and to correct for the fraction of animals missed by a single observer team. (Carretta et al. 1998, NMFS, SWFSC, unpublished data). Aerial survey correction factors have been improved using recent information on California coastal bottlenose dolphin swim speeds (Ward 1999). Using the same methods as Carretta et al. (1998), the weighted average abundance estimate for the 1999-2000 surveys is 206 (CV=0.12) coastal bottlenose dolphins (NMFS, SWFSC, unpublished data). This presently is the best estimate of the average number of coastal bottlenose dolphins in U.S. waters.

Minimum Population Estimate

The log-normal 20th percentile of the above average abundance estimate for U.S. waters based on the 1999-2000 surveys is 186 coastal bottlenose dolphins.

Current Population Trend

Based on a comparison of mark-recapture abundance estimates for the periods 1987-89 ($\hat{N}$= 354) and 1996-98 ($\hat{N}$= 356), Dudzik (1999) stated that the population size had remained stable over an 11-year period.

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 (186) 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 1.9 coastal bottlenose 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 set net fisheries. A summary of information on fishery mortality and injury for this stock of bottlenose dolphin is shown in Table 1.

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.

Fishery Name	Data Type	Year(s)	Percent Observer Coverage	Observed Mortality	Estimated Annual Mortality	Mean Annual Takes
CA angel shark/ halibut and other species large mesh (>3.5in) set gillnet fishery	observer data	1997 1998 1999 2000 2001	0 % 0% 4.0 %[1] 1.8%[1] 0%	0	0	0
Minimum total annual takes						0

[1] The CA set gillnets were not observed during 1997-98 and in 2001; mortality was extrapolated from effort estimates and previous (1991-94) entanglement rates. In 1999 and 2000, approximately 25% of Monterey portion of the set gillnet fishery was observed, representing <5% of the overall fishery.

More detailed information on the set gillnet fishery is provided in Appendix 1. From 1991-94, no bottlenose dolphins were observed taken in this fishery with 10-15% observer coverage (Julian and Beeson 1998). The observer program was discontinued at the end of 1994, when coastal set gillnet fishing was banned within 3 nmi of the southern California coast. In central California, gillnets have been restricted to waters deeper than 30 fathoms (56m) since 1991 in all areas except between Point Sal and Point Arguello. In 2002, a ban on set gill and trammel nets inshore of 60 fathoms from Point Reyes to Point Arguello became effective. Because of these closures, the potential for mortality of coastal bottlenose dolphins in the California set gillnet fishery has been greatly reduced. Fisher self-report data and 36 stranding records for 1997-2001 do not include any evidence of fishery interactions for this stock. Coastal gillnet fisheries exist in Mexico and probably take animals from this population, but no details are available.

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.

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. Because no recent fishery takes have been documented, coastal bottlenose 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.

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 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 12/15/2003

BOTTLENOSE DOLPHIN (*Tursiops 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). 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 41°N (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. Based on aerial surveys conducted during winter/spring 1991-92 (Forney et al. 1995) and shipboard surveys conducted in summer/fall 1991 (Barlow 1995), no seasonality in distribution is apparent (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 three stocks: 1) California coastal stock, 2) California, Oregon and Washington offshore stock (this report), and 3) Hawaiian stock.

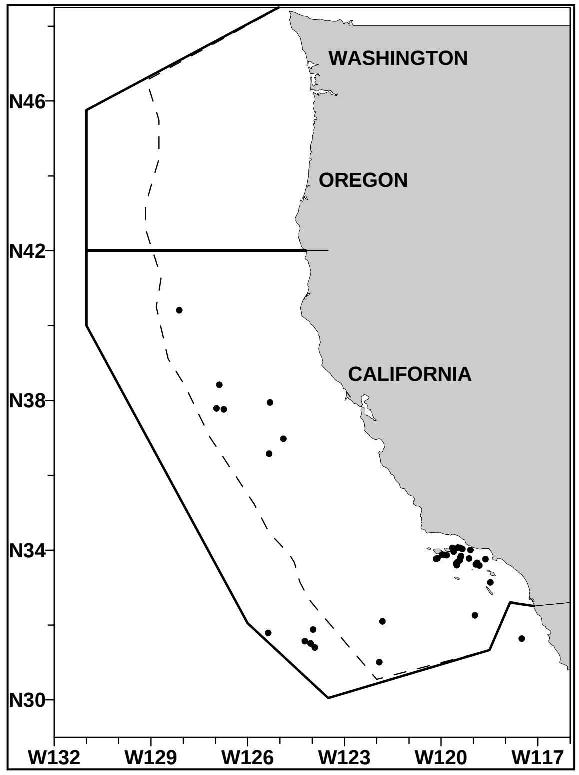

Figure 1. Offshore bottlenose dolphin sightings based on shipboard surveys off California, Oregon, and Washington, 1991-2001 (see Appendix 2 for data sources and information on timing and location of survey effort). Dashed line represents the U.S. EEZ, thick line indicates the outer boundary of all surveys combined.

POPULATION SIZE

The most recent shipboard surveys conducted within 300 nmi of the coasts of California, Oregon, and Washington were in 1996 (Barlow 1997) and 2001 (Barlow 2003). Because the distribution of bottlenose dolphins appears to vary interannually and they may 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. The most comprehensive multi-year average abundance is the weighted average abundance estimate for California, Oregon and Washington waters based on the 1996-2001 ship surveys, 5,065 (CV = 0.66) offshore bottlenose dolphins (Barlow 2003).

Minimum Population Estimate

The log-normal 20th percentile of the 1996-2001 weighted average abundance estimate is 3,053 offshore bottlenose dolphins.

Current Population Trend

No information on trends in abundance of offshore bottlenose dolphins is available.

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 (3,053) 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 31 offshore bottlenose dolphins per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

A summary of known fishery mortality and injury for this stock of bottlenose dolphin is shown in Table 1. More detailed information on these fisheries is provided in Appendix 1. Mortality estimates for the California drift gillnet fishery are included for the five most recent years of monitoring, 1997-2001 (Cameron and Forney 1999, 2000; Carretta 2001; 2002). After the 1997 implementation of a Take Reduction Plan, which included skipper education workshops and required the use of pingers and minimum 6-fathom extenders, overall cetacean entanglement rates in the drift gillnet fishery dropped considerably (Barlow and Cameron 2003). However, because of interannual variability in entanglement rates and the rarity of bottlenose dolphin entanglements, additional years of data will be required to fully evaluate the effectiveness of pingers for reducing mortality of this particular species. Mean annual takes in Table 1 are based on 1997-2001 data. This results in an average estimate of zero offshore bottlenose dolphins taken annually.

Table 1. Summary of available information on the incidental mortality and injury of bottlenose dolphins (California/ Oregon/Washington Offshore Stock) in commercial fisheries that might take this species. Mean annual takes are based on 1997-2001 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	1997 1998 1999 2000 2001	23.0% 20.0% 20.0% 22.9% 20.4%	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).

Offshore bottlenose dolphins are often associated with Risso's dolphins and pilot whales, for which mortality has been documented in the squid purse seine fishery off Southern California (Heyning et al. 1994). Based on this association, offshore bottlenose dolphins may also have experienced some mortality in this fishery. However these would probably represent animals killed intentionally to protect catch or gear, rather than incidental kills, and such intentional takes are now illegal under the 1994 Amendment to the MMPA.

Other removals

Twenty-seven bottlenose dolphins were captured off California between 1966 and 1982 (Walker 1975; Reeves and Leatherwood 1984). Based on the locations of capture activities, these animals probably were offshore bottlenose dolphins (Walker 1975). No additional captures of bottlenose dolphins off California have been documented since 1982, and no MMPA live-capture permits are currently active for this species.

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 no recent fishery takes have been documented, offshore bottlenose 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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Revised 12/15/2003

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. On recent shipboard surveys extending about 300 nmi offshore of California, they were sighted within about 100-300 nmi from the coast (Figure 1). No sightings have been reported for Oregon and Washington waters, but striped dolphins have stranded in both states (Oregon Department of Fish and Wildlife, unpublished data; Washington Department of Fish and Wildlife, unpublished data). 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.

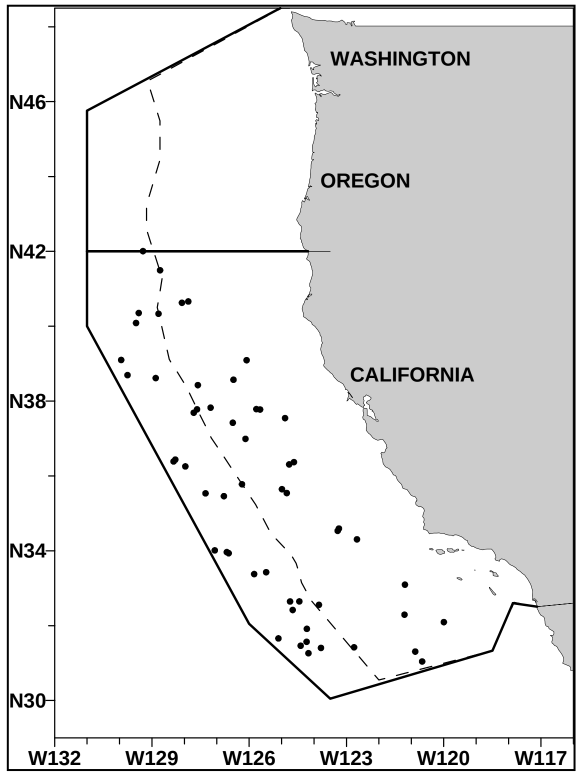

Figure 1. Striped dolphin sightings based on aerial and shipboard surveys off California, Oregon, and Washington, 1991-2001 (see Appendix 2 for data sources and information on timing and location of survey effort). Dashed line represents the U.S. EEZ, thick line indicates the outer boundary of all surveys combined.

POPULATION SIZE

Two summer/fall shipboard surveys were conducted within 300 nmi of the coasts of California, Oregon and Washington in 1996 (Barlow 1997) and 2001 (Barlow 2003). 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, Forney and Barlow 1998). 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 1996-2001 weighted average abundance estimate for California, Oregon and Washington waters based on the above two ship surveys is 13,934 (CV = 0.53) striped dolphins (Barlow 2003).

Minimum Population Estimate

The log-normal 20th percentile of the 1996-2001 weighted average abundance estimate is 9,165 striped dolphins.

Current Population Trend

Prior to a 1991 shipboard survey (Barlow 1995), striped dolphins were not thought to be common off California (Leatherwood et al. 1982), and two surveys extending approximately 200 nmi offshore of California and Baja California in 1979 and 1980 resulted in only one sighting of three striped dolphins (Smith et al. 1986). Thus it is possible that striped dolphin abundance off California has increased over the last decade (consistent with the observed warming trend for these waters; Roemmich 1992); however, no definitive statement can be made, because statistical estimates of abundance were not obtained for the earlier surveys. Estimates of abundance from surveys conducted in 1991/93, 1996, and 2001 in California waters were 28,396 (CV = 0.31); 5,489 (0.48); and 22,316 (0.65) striped dolphin, respectively (Barlow 2003). Currently, there is no evidence of a trend in abundance for this stock.

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 (9,165) 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 92 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. Mortality estimates for the California drift gillnet fishery are included for the five most recent years of monitoring, 1997-2001 (Cameron and Forney 1999, 2000, Carretta 2001; 2002). No striped dolphin were observed killed in the most recent five-year period. One striped dolphin was observed killed in the drift gillnet fishery in 1994. After the 1997 implementation of a Take Reduction Plan, which included skipper education workshops and required the use of pingers and minimum 6-fathom extenders, overall cetacean entanglement rates in the drift gillnet fishery dropped considerably (Barlow and Cameron 2003). However, because of interannual variability in entanglement rates and the rarity of striped dolphin entanglements, additional years of data will be required to fully evaluate the effectiveness of pingers for reducing mortality of this particular species. Mean annual takes in Table 1 are based on 1997-2001 data. This results in an average estimate of zero striped dolphins taken annually.

Table 1. Summary of available information on the incidental mortality and injury of striped dolphins (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 1997-2001 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	1997 1998 1999 2000 2001	23.0% 20.0% 20.0% 22.9% 20.4%	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 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. Including driftnet information only for years after implementation of the Take Reduction Plan (1997-98), the average annual human-caused mortality in 1997-2001 is zero. Because recent mortality is zero, 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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Revised 12/15/2003

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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. The abundance of this species off California has been shown to change on both seasonal and inter-annual time scales (Dohl et al. 1986; Barlow 1995; Forney et al. 1995). Historically, they were reported primarily south of Pt. Conception (Dohl et al. 1986), but on recent (1991/93/96) summer/fall surveys, they were commonly sighted as far north as 42°N (Figure 1). Four strandings of common dolphins (*Delphinus sp*.) have been reported in Oregon and Washington since 1942 (B. Norberg, pers. comm.), but three of these could not be identified to species. One animal, which stranded in 1983, was identified as a short-beaked common dolphin (J. Hodder, pers. comm.). 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). Their distribution is continuous southward into Mexican waters to about 13°N (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). The less abundant long-beaked common dolphin has only recently been recognized as a different species (Heyning and Perrin 1994; Rosel et al. 1994), and much of the available information has not differentiated between the two types of common dolphin. 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 (e.g. gillnet fisheries). 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.

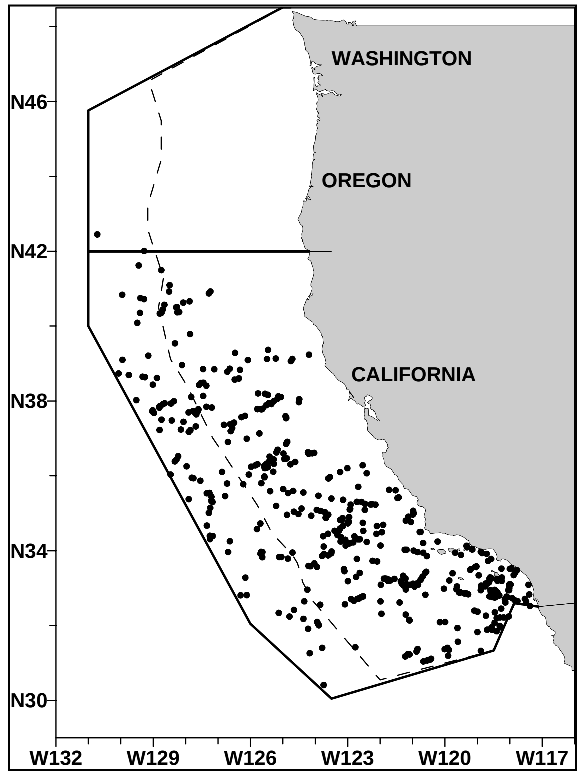

Figure 1. Short-beaked common dolphin sightings based on shipboard surveys off California, Oregon, and Washington, 1991-2001 (see Appendix 2, for data sources and information on timing and location of survey effort). No *Delphinus* sightings have been made off Washington. Dashed line represents the U.S. EEZ, thick line indicates the outer boundary of all surveys combined.

POPULATION SIZE

Aerial line transect surveys conducted in winter/spring of 1991-92 resulted only in a combined abundance estimate of 305,694 (CV=0.34) animals for short-beaked and long-beaked common dolphins, because species-level identification was not possible from the air (Forney et al. 1995). Based on sighting locations, the majority of these were probably short-beaked common dolphins. More recent, species-specific abundance estimates are available based on two summer/fall shipboard surveys that were conducted within 300 nmi of the coasts of California, Oregon and Washington in 1996 (Barlow 1997) and 2001 (Barlow 2003). 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 1996-2001 weighted average abundance estimate for California, Oregon and Washington waters based on the two ship surveys is 449,846 (CV= 0.25) short-beaked common dolphins (Barlow 2003).

Minimum Population Estimate

The log-normal 20th percentile of the 1996-2001 weighted average abundance estimate is 365,617 short-beaked common dolphins.

Current Population Trend

In the past, common dolphin abundance has been shown to increase off California during the warm-water months (Dohl et al. 1986). Surveys conducted during both cold-water and warm-water conditions in 1991 and 1992 (Barlow 1995, Forney et al. 1995) resulted in overall abundance estimates (for both types of common dolphins combined) which were considerably greater than historical estimates (Dohl et al. 1986). The recent combined abundance estimate for the 1996-2001 summer/fall surveys (Barlow 2003) is the highest and most precise to date. Environmental models (Forney 1997) and seasonal comparisons (Forney and Barlow 1998) have shown that the abundance of short-beaked common dolphins off California varies with seasonal and interannual changes in oceanographic conditions. An ongoing decline in the abundance of 'northern common dolphins' (including both long-beaked and short-beaked common dolphins) in the eastern tropical Pacific and along the Pacific coast of Mexico suggests a possible northward shift in the distribution of common dolphins (IATTC 1997) during this period of gradual warming of the waters off California (Roemmich 1992). The majority of this shift would likely be reflected in an increase in short-beaked common dolphin abundance. Heyning and Perrin (1994) have detected changes in the proportion of short-beaked to long-beaked common dolphins stranding along the California coast, with short-beaked common dolphin stranding more frequently prior to the 1982-83 El Niño (which increased water temperatures off California), and the long-beaked common dolphin more commonly observed for several years afterwards. Thus, it appears that both relative and absolute abundances of these species off California may change with varying oceanographic conditions.

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 (365,617) <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 a mortality rate CV< 0.30; Wade and Angliss 1997), resulting in a PBR of 3,656 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. More detailed information on these fisheries is provided in Appendix 1. Mortality estimates for the California drift gillnet fishery are included for the five most recent years of monitoring, 1997-2001 (Cameron and Forney 1999, 2000; Carretta 2001, 2002). Because of the difficulty in distinguishing short-beaked and long-beaked common dolphins in the field, tissue samples have been collected for most of the animals observed killed. These tissue samples have enabled positive identification using genetic techniques for all except two of the common dolphins killed (NMFS, unpublished data). Based on past patterns (Barlow et al. 1997), these two animals are likely to have been a short-beaked common dolphin, and they are included below for this species. After the 1997 implementation of a Take Reduction Plan, which included skipper education workshops and required the use of pingers and minimum 6-fathom extenders, common dolphin entanglement rates in the drift gillnet fishery dropped considerably (Barlow and Cameron 2003 1999), but entanglement rates increased again in 1999 and 2000 (Figure 2) and have since returned to low levels. Because of interannual variability in entanglement rates, additional years of data will be required to fully evaluate the effectiveness of pingers for reducing mortality of this species in the long term. Mean annual takes in Table 1 are based on 1997-2001 data. This results in an average estimate of 93(CV=0.23) short-beaked common dolphins taken annually.

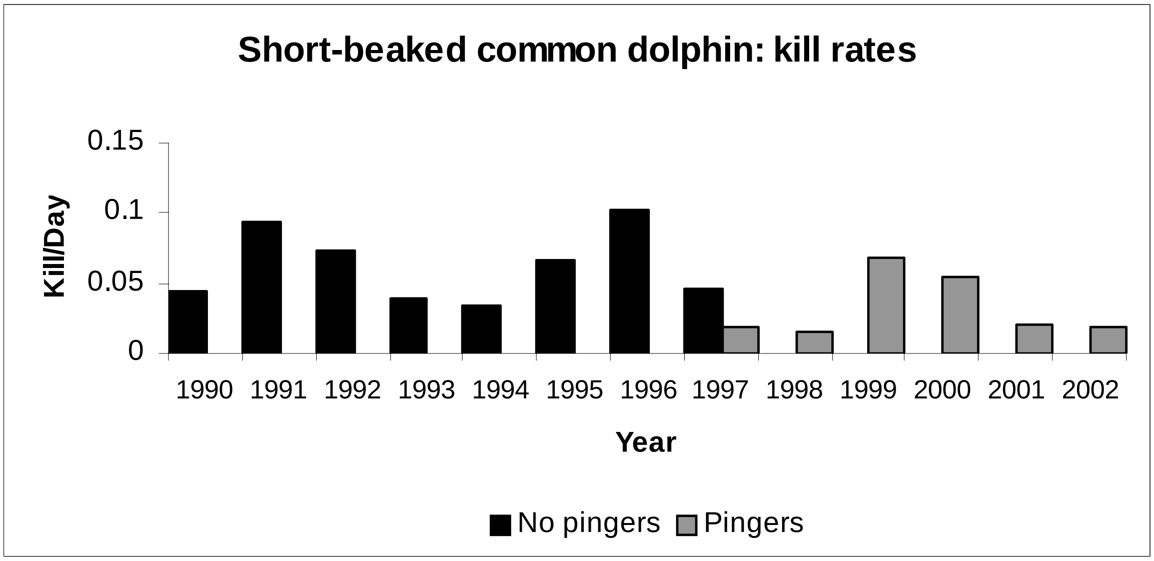

Figure 2. Kill rates of short-beaked common dolphin per day fished in the California drift gillnet fishery for swordfish and thresher shark, 1990-2002. Kill rates include observations from pingered and unpingered sets. Pingers were not used from 1990-95 and were used experimentally in 1996 and 1997. In 1996, no short-beaked common dolphin were observed killed in 146 pingered sets. For the period 1998-2002, over 99% of all observed sets utilized pingers.

Additional common dolphin mortality has been reported for set gillnets in California (Julian and Beeson 1998); however, because of a 1994 ban on gillnets in nearshore areas of Southern California, the size of this fishery decreased by about a factor of two (see Appendix 1), and the observer program was discontinued. Approximately 4% and 1.8% of the entire fishery was observed in Monterey Bay in 1999 and 2000, respectively, and no common dolphin were observed taken. Marine Mammal Authorization Permit (MMAP) fisher self-reports for 1994-98 indicate that at least four common dolphins (type not specified) were killed between 1995 and 1998. Although these reports are considered unreliable (see Appendix 4 of Hill and DeMaster 1998) they represent a minimum mortality for this fishery.

Nine common dolphins (type not specified) stranded with evidence of fishery interaction (NMFS, Southwest Region, unpublished data) between 1997-2001. It is not known which fisheries were responsible for these deaths.

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).

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. All entanglements resulted in the death of the animal. The observer program for the set gillnet fishery was discontinued during 1994 and later resumed in Monterey Bay from 1999-2000. Coefficients of variation for mortality estimates are provided in parentheses; n/a = not available. Mean annual takes are based on 1997-2001 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 data	1997 1998 1999 2000 2001	23.0% 20.0% 20.0% 22.9% 20.4%	21 9 34 23 7	105 (0.30) 51 (0.33) 191 (0.31) 75 (0.32) 26 (0.41)	(includes prorated) 90 (0.17)
CA angel shark/ halibut and other species large mesh (>3.5in) set gillnet fishery		Common dolphins, species not determined				
	extrapolated estimates	1997-2001	0 - 4%	0	3[1]	$0.6[1]
	MMAP self-reporting	1997 1998 1999 2000 2001	- - - - -	0 2 0 0 0	0 2 0 0 0	$0.4 (n/a)
Undetermined	strandings	1997-2001	9 common dolphins (species not determined) stranded with evidence of fishery interactions			$1.8 (n/a)
Minimum total annual takes						93 (0.23)

[1]The set gillnet fishery was observed from 1991-94 and then only in Monterey Bay during 1999-2000, where 20-25% of the local fishery was observed. Recent mortality estimates for common dolphin in this fishery are based on kill rates observed from 1991-94 and current levels of fishing effort.

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. Cooperative international management programs have dramatically reduced overall dolphin mortality in these fisheries during the last decade (Joseph 1994). Between 1997 and 2001, annual fishing mortality of northern common dolphins (potentially including both short-beaked and long-beaked common dolphins) ranged between 9 and 261 animals, with an average of 101 (IATTC, in prep). Although it is unclear whether these animals are part of the same population as short-beaked common dolphins found off California, they are managed separately under a section of the MMPA written specifically for the management of dolphins involved in eastern tropical Pacific tuna fisheries.

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 (Anganuzzi et al. 1993; Barlow 1995; Forney et al. 1995; Forney and Barlow 1998), 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. Including driftnet mortality only for years after implementation of the Take Reduction Plan (1997-98), the average annual human-caused mortality in 1997-2001 (93 animals) is estimated to be less than the PBR (3,656), 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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LONG-BEAKED COMMON DOLPHIN (*Delphinus capensis*): California Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Long-beaked common dolphins have only recently been recognized as a distinct species (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, and much historical information has not distinguished between these two species. 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). Stranding data and sighting records indicate that the relative abundance of this species off California changes both seasonally and inter-annually, with highest densities observed during warm-water events (Heyning and Perrin 1994). 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). Under the Marine Mammal Protection Act (MMPA), long-beaked ("Baja neritic") common dolphins involved in eastern tropical Pacific tuna fisheries are managed separately as part of the 'northern common dolphin' stock (Perrin et al. 1985), and these animals 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.

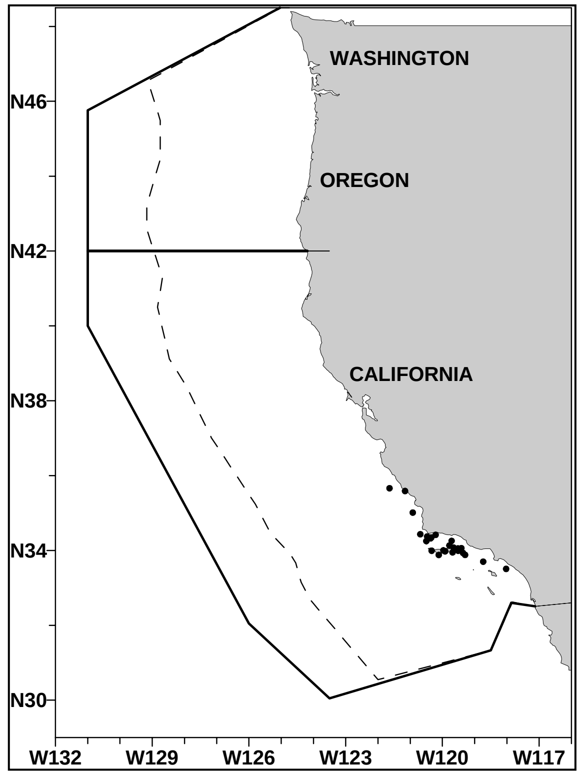

Figure 1. Long-beaked common dolphin sightings based on shipboard surveys off California, Oregon, and Washington, 1991-2001 (see Appendix 2 for data sources and information on timing and location of survey effort). No *Delphinus* sightings have been made off Washington. Dashed line represents the U.S. EEZ, thick line indicates the outer boundary of all surveys combined.

POPULATION SIZE

Aerial line transect surveys conducted in winter and spring of 1991 and 1992 resulted only in a combined abundance estimate of 305,694 (CV=0.34) long-beaked and short-beaked common dolphins, because species-level identification was not possible from the air (Forney et al. 1995). Based on sighting locations, the majority of these animals were probably short-beaked common dolphins. More recent, species-specific abundance estimates are available based on two summer/fall shipboard surveys that were conducted within 300 nmi of the coasts of California, Oregon and Washington in 1996 (Barlow 1997) and 2001 (NMFS, unpublished data). The distribution and abundance of long-beaked common dolphins off California appears to be variable on interannual and seasonal time scales (Heyning and Perrin 1994). As oceanographic conditions change, long-beaked common dolphins may spend time in Mexican waters, and therefore a multi-year average abundance estimate is the most appropriate for management within the U.S. waters. The 1991-96 weighted average abundance estimate for California, Oregon and Washington waters based on the three ship surveys is 43,360 (CV=0.72) long-beaked common dolphins (Barlow 2003).

Minimum Population Estimate

The log-normal 20th percentile of the weighted average abundance estimate is 25,163 long-beaked common dolphins.

Current Population Trend

Due to the historical lack of distinction between the two species of common dolphins, it is difficult to establish trends in abundance for this species. In the past, common dolphins have been shown to increase in abundance off California during the warm-water months (Dohl et al. 1986). Surveys conducted during both cold-water and warm-water conditions in 1991 and 1992 (Barlow 1995, Forney et al. 1995) resulted in overall abundance estimates (for both types of common dolphins combined) which were considerably greater than historical estimates (Dohl et al. 1986). The combined abundance estimate for the 1991-96 summer/fall surveys (Barlow 1997) is the highest and most precise to date. An ongoing decline in the abundance of 'northern common dolphins' (including both long-beaked and short-beaked common dolphins) in the eastern tropical Pacific and along the Pacific coast of Mexico (IATTC 1997) suggests a possible northward shift in the distribution of common dolphins during this period of gradual warming of the waters off California (Roemmich 1992). However, it is unclear how much of this increase reflects an increase in the abundance of the long-beaked common dolphin. Heyning and Perrin (1994) have detected changes in the proportion of short-beaked to long-beaked common dolphins stranding along the California coast, with the short-beaked common dolphin stranding more frequently prior to the 1982-83 El Niño (which increased water temperatures off California), and the long-beaked common dolphin more commonly observed for several years afterwards. Thus, it appears that both relative and absolute abundance of these species off California may change with varying oceanographic conditions.

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 (25,163) 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 $0.30 and #0.60; Wade and Angliss 1997), resulting in a PBR of 242 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. Mortality estimates for the California drift gillnet fishery are included for the five most recent years of monitoring, 1997-2001 (Cameron and Forney 1999, 2000; Carretta 2001, 2002). Because of the difficulty in distinguishing short-beaked and long-beaked common dolphins in the field, tissue samples have been collected for most of the animals observed killed. These tissue samples have enabled positive identification using genetic techniques for all except two of the common dolphins killed (NMFS, unpublished data). Based on past patterns (Barlow et al. 1997), these two animals are likely to have been a short-beaked common dolphin, and they have not been included in the mortality calculations below for long-beaked common dolphins. After the 1997 implementation of a Take Reduction Plan, which included skipper education workshops and required the use of pingers and minimum 6-fathom extenders, common dolphin entanglement rates in the drift gillnet fishery dropped considerably (Barlow and Cameron 2003). However, because of interannual variability in entanglement rates additional years of data will be required to fully evaluate the effectiveness of pingers for reducing mortality of this species in the long term. Mean annual takes in Table 1 are based on 1997-2001 data. This results in an average estimate of 11 (CV= 0.50) long-beaked common dolphins taken annually.

Additional common dolphin mortality has been reported for set gillnets in California (Julian and Beeson 1998); however, because of a 1994 ban on gillnets in nearshore areas of Southern California, the size of this fishery decreased by about a factor of two (see Appendix 1), and the observer program was discontinued. Approximately 4% and 1.8% of the entire fishery was observed in Monterey Bay in 1999 and 2000, respectively, and no common dolphin were observed taken. Marine Mammal Authorization Permit (MMAP) fisher self-reports for 1997-2001 indicate that at least two common dolphins (type not specified) were killed between 1997 and 2001. Although these reports are considered unreliable (see Appendix 4 of Hill and DeMaster 1998) they represent a minimum mortality for this fishery.

Table 1. Summary of available information on the incidental mortality and injury of long-beaked common dolphins (California Stock) and prorated unidentified common dolphins in commercial fisheries that might take this species. All observed entanglements resulted in the death of the animal. The observer program for the set gillnet fishery was discontinued during 1994 and later resumed in Monterey Bay from 1999-2000. Coefficients of variation for mortality estimates are provided in parentheses, when available. Mean annual takes are based on 1997-2001 data unless noted otherwise.

Fishery Name	Data Type	Year(s)	Percent Observer Coverage	Observed	Estimated Annual Mortality	Mean Annual Takes (CV in parentheses)
CA/OR thresher shark/swordfish drift gillnet fishery	observer data	1997 1998 1999 2000 2001	23.0% 20.0% 20.0% 22.9% 20.4%	4 0 1 1 0	25 (0.74) 0 8 (0.93) 9 (0.76) 0	8.4 (0.50)
CA angel shark/ halibut and other species large mesh (>3.5in) set gillnet fishery		Common dolphins, species not determined				
	observer data	1997-2001	0 - 4%	0	3[1]	0.6 (n/a)
	MMAP self-reporting	1997 1998 1999 2000 2001	- - - - -	0 2 0 0 0	0 $2 0 0 0	$0.4 (n/a)
Undetermined	strandings	1997-2001	9 common dolphins (species not determined) stranded with evidence of fishery interactions			$1.8 (n/a)
Minimum total annual takes						11 (0.50)

[1]The set gillnet fishery was observed from 1991-94 and then only in Monterey Bay during 1999-2000, where 20-25% of the local fishery was observed. Recent mortality estimates for common dolphin in this fishery are based on kill rates observed from 1991-94 and current levels of fishing effort.

Nine common dolphins (type not specified) stranded with evidence of fishery interaction (NMFS, Southwest Region, unpublished data) between 1997-2001. It is not known which fisheries were responsible for these deaths.

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).

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. Cooperative international management programs have dramatically reduced overall dolphin mortality in these fisheries during the last decade (Joseph 1994). Between 1997 and 2001, annual mortality of northern common dolphins (potentially including both short-beaked and long-beaked common dolphins) ranged between 9 and 261 animals, with an average of 101 (IATTC, in prep). Although it is unclear whether these animals are part of the same population as short-beaked common dolphins found off California, they are managed separately under a section of the MMPA written specifically for the management of dolphins involved in eastern tropical Pacific tuna fisheries.

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 of this species of common dolphin. 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. Including driftnet mortality only for years after implementation of the Take Reduction Plan (1997-98), the average annual human-caused mortality in 1997-2001 (14 animals) is estimated to be less than the PBR (226), 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 is less than 10% of the PBR and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate.

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Revised 12/15/2003

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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; NMFS, unpublished data). Sighting patterns from recent aerial and shipboard surveys conducted in California, Oregon and Washington during different seasons (Green et al. 1992; 1993; Forney et al. 1995; Barlow 1995) 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 (Green et al. 1992; Forney 1994; Forney and Barlow 1998). 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.

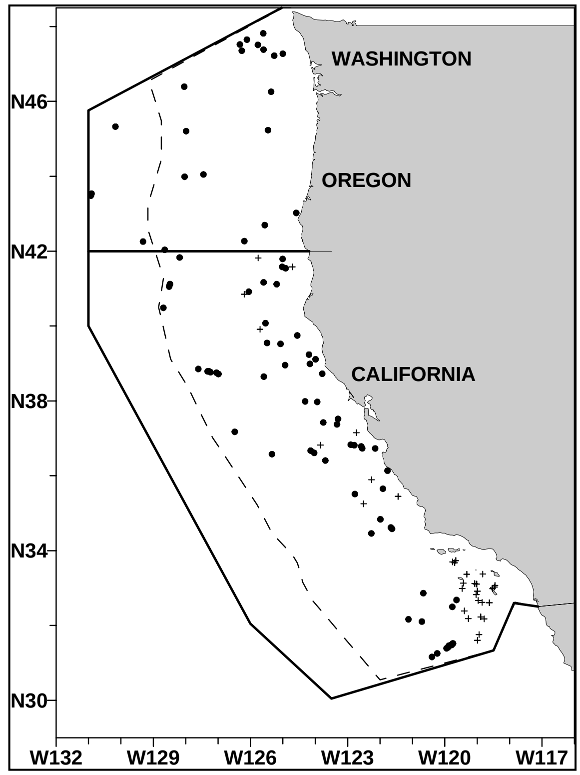

Figure 1. Northern right whale dolphin sightings based on aerial and shipboard surveys off California, Oregon, and Washington, 1991-2001 (see Appendix 2 for data sources and information on timing and location of survey effort). Dashed line represents the U.S. EEZ, thick line indicates the outer boundary of all surveys combined. Key: • = summer/autumn ship-based sightings; + = winter/spring aerial-based sightings.

POPULATION SIZE

The previous best estimates of abundance for northern right-whale dolphins (Barlow et al. 1997) were based on winter/spring 1991-92 aerial surveys (Forney et al. 1995) off California, which were presumed to include northern right-whale dolphins that are found off Oregon and Washington during summer and fall. Two summer/fall shipboard surveys were conducted within 300 nmi of the coasts of California, Oregon and Washington in 1996 (Barlow 1997) and 2001 (Barlow 2003). 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). 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 1996-2001 weighted average abundance estimate for California, Oregon and Washington waters based on the two ship surveys is 20,362 (CV=0.26) northern right-whale dolphins (Barlow 2003).

Minimum Population Estimate

The log-normal 20th percentile of the 1996-2001 weighted average abundance estimate is 16,417 northern right-whale dolphins.

Current Population Trend

Estimates of northern right whale dolphin abundance from surveys conducted in 1991/93, 1996, and 2001 in California waters were 9,929 (CV = 0.49); 14,593 (0.55); and 10,915 (0.41), respectively (Barlow 2003). Abundance estimates for all California, Oregon, and Washington waters from 1996 and 2001 surveys were 19,619 (0.43) and 21,104 (0.30), respectively (Barlow 1993). Currently, there is no evidence of a trend in abundance for this stock.

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 (16,417) 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 164 northern right-whale dolphins per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

A summary of recent fishery mortality and injury for this stock of northern right-whale dolphin is shown in Table 1. More detailed information on these fisheries is provided in Appendix 1. Mortality estimates for the California drift gillnet fishery are included for the five most recent years of monitoring, 1997-2001 (Cameron and Forney 1999, 2000; Carretta 2001, 2002). After the 1997 implementation of a Take Reduction Plan, which included skipper education workshops and required the use of pingers and minimum 6-fathom extenders, overall cetacean entanglement rates in the drift gillnet fishery dropped considerably (Barlow and Cameron 2003). However, because of interannual variability in entanglement rates and the relative rarity of northern right-whale dolphin entanglements, additional years of data will be required to fully evaluate the effectiveness of pingers for reducing mortality of this particular species. Entanglement rates for this species may be related to oceanographic conditions, as lower entanglement rates have been observed during warm-water periods, such as El Niño (Figure 2). Mean annual takes in Table 1 are based on 1997-2001 data. This results in an average estimate of 23 (CV= 0.27) northern right-whale dolphins taken annually.

Table 1. Summary of available information on the incidental mortality and injury of northern right-whale dolphins (California/Oregon/Washington Stock) in commercial fisheries that might take this species. 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. Mean annual takes are based on 1997-2001 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	1997 1998 1999 2000 2001	23.0% 20.0% 20.0% 22.9% 20.4%	5 0 3 11 5	29 (0.42) 0 17 (0.66) 47 (0.51) 22 (0.54)	23 (0.27)
Minimum total annual takes						23 (0.27)

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).

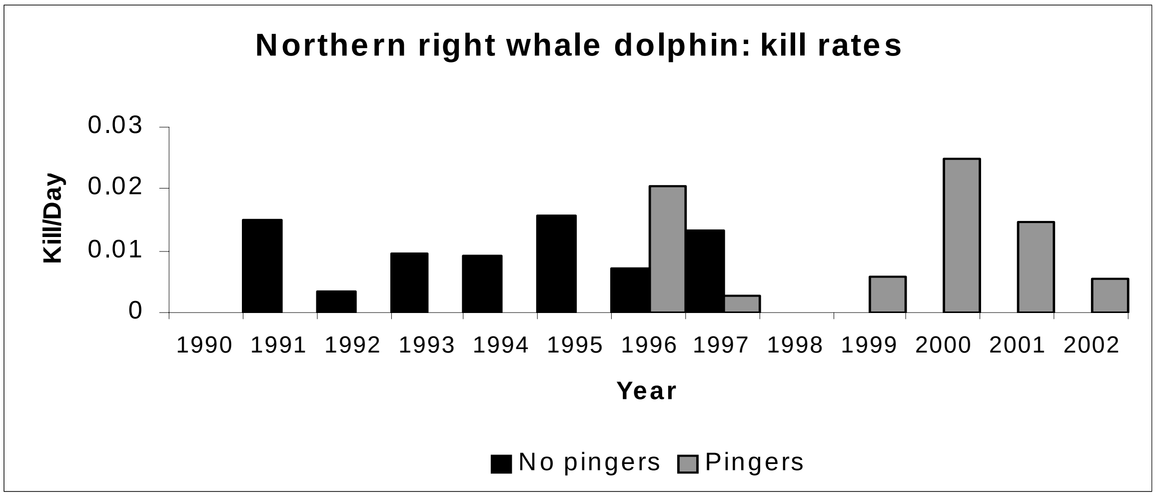

Figure 2. Kill rates of northern right whale dolphin per day fished in the California drift gillnet fishery for swordfish and thresher shark, 1990-2002. Kill rates include observations from pingered and unpingered sets. Pingers were not used from 1990-95 and were used experimentally in 1996 and 1997. For the period 1998-2002, over 99% of all observed sets utilized pingers.

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. Including driftnet mortality only for years after implementation of the Take Reduction Plan (1997-98), the average annual human-caused mortality in 1997-2001 (23 animals) is estimated to be less than the PBR (158), 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 is greater than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate.

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Revised 12/15/2003

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). 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).

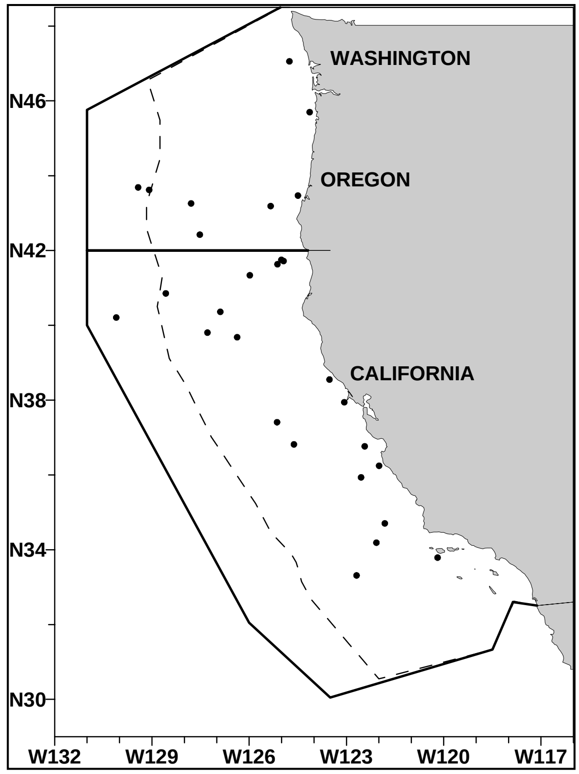

Figure 1. Killer whale sightings based on aerial and shipboard surveys off California, Oregon and Washington, 1991- 2001 (see Appendix 2 for data sources and information on timing and location of survey effort). Sightings include killer whales from all stocks found in this region. Dashed line represents the U.S. EEZ, thick line indicates the outer boundary of all surveys

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, five killer whale stocks are recognized within the Pacific U.S. EEZ 1) the Eastern North Pacific Northern Resident stock - occurring from British Columbia through Alaska, 2) the Eastern North Pacific Southern Resident stock - occurring within the inland waters of Washington and southern British Columbia, 3) the Eastern North Pacific Transient stock - occurring from Alaska through California, 4) the Eastern North Pacific Offshore stock - occurring from Southeast Alaska through California (this report), and 5) the Hawaiian stock. 'Offshore' whales in Canadian waters are considered part of the Eastern North Pacific Offshore stock. The Stock Assessment Reports for the

Alaska Region contain assessments of the Eastern North Pacific Northern Resident and transient stocks, and the most recent assessment for the Hawaii Stock is included in this volume.

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 1996 (Barlow 1997) and 2001 (Barlow 2003), the total number of killer whales within 300 nmi of the coasts of California, Oregon and Washington was recently estimated to be 1,340 animals (CV=0.31). 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 * 1,340 = 466 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 1996-2001 line-transect surveys as the 20^{th} percentile of the abundance estimate, or 1,038 killer whales. Using the same prorating as above, a minimum of 56/161 * 1,038= 361 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 (361) <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 known fishery mortality; Wade and Angliss 1997), resulting in a PBR of 3.6 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. 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 2001, 2002), 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 monitored 5-15% of all sets in the large mesh (>3.5") set gillnet fishery for halibut and angel sharks, 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 1997-2001 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	1997 1998 1999 2000 2001	23.0% 20.0% 20.0% 22.9% 20.4%	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).

Historical mortality

California coastal whaling operations killed five killer whales between 1962 and 1967 (Rice 1974). An additional killer whale was taken by whalers in British Columbian waters (Hoyt 1981). It is unknown whether any of these animals belonged to the Eastern North Pacific Offshore stock.

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 species. 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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Revised 11/01/2005

KILLER WHALE (*Orcinus orca*): Eastern North Pacific Southern Resident 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). Seasonal and year-round occurrence has been noted for killer whales throughout Alaska (Braham and Dahlheim 1982) and in the intracoastal 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 geographical areas have been documented. For example, whales identified in Prince William Sound have been observed near Kodiak Island (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).

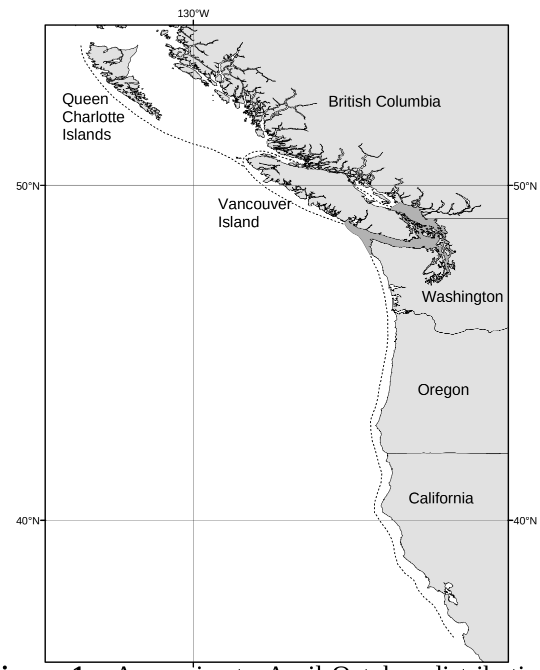

Figure 1. Approximate April-October distribution of the Eastern North Pacific Southern Resident killer whale stock (shaded area) and range of sightings (dotted line).

Studies on mtDNA restriction patterns provide evidence that the 'resident' and 'transient' types are genetically distinct (Stevens et al. 1989, Hoelzel 1991, Hoelzel and Dover 1991, Hoelzel et al. 1998). Analysis of 73 samples collected from eastern North Pacific killer whales from California to Alaska has demonstrated significant genetic differences among 'transient' whales from California through Alaska, 'resident' whales from the inland waters of Washington, and 'resident' whales ranging from British Columbia to the Aleutian Islands and Bering Sea (Hoelzel et al. 1998). However, low genetic diversity throughout this specie's world-wide distribution has hampered efforts to clarify its taxonomy. At an international symposium in cetacean systematics in May 2004, a workshop was held to review the taxonomy of killer whales. A majority of invited experts felt that the Resident- and Transient-type whales in the eastern North Pacific probably merited species or subspecies status (Reeves 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). 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). Pods K1 and L1 are often seen entering the inland waters of Vancouver Island from the north–through Johnstone Strait–in the spring (Ford et al. 2000), suggesting that they may spend time along the entire outer coast of Vancouver Island during the winter. In May 2003, these pods were sighted off the northern end of the Queen Charlotte Islands, the furthest north they had ever previously been documented (J. Ford, pers. comm.). Off the Washington coast, Southern Resident killer whales have been sighted as far south as Grays Harbor (season unknown) (Bigg et al. 1990), and members of pods K1 and L1 were observed in Monterey Bay, California, in January 2000 and March 2003 (N. Black, pers. comm.).

Based on data regarding association patterns, acoustics, movements, genetic differences and potential fishery interactions, five killer whale stocks are recognized within the Pacific U.S. EEZ: 1) the Eastern North Pacific Northern Resident stock - occurring from British Columbia through Alaska, 2) the Eastern North Pacific Southern Resident stock - occurring mainly within the inland waters of Washington State and southern British Columbia (see Fig. 1), 3) the Eastern North Pacific Transient stock - occurring from Alaska through California, 4) the Eastern North Pacific Offshore stock - occurring from Southeast Alaska through California, and 5) the Hawaiian stock. The Stock Assessment Reports for the Alaska Region contain information concerning the Eastern North Pacific Northern Resident 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 resulted in a substantial understanding 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 before increasing slightly to 84 whales in 2004 (Fig. 2; Ford et al. 2000; Center for Whale Research, unpubl. data). The 2001-2004 counts include 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 (J. Ford, pers. comm.). As of October 2004, L-98 has remained separate from L pod and it remains unclear whether it will rejoin L pod in the future, either on its own or through a proposed reintroduction effort. For now, it will be included in the current population size. However, two new calves observed in the fall of 2004 will not be a part of the official census until seen in May/June 2005 (Center for Whale Research, unpubl. data).

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 84 animals.

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). The first complete census of this stock occurred in 1974. Between 1974 and 1993 the Southern Resident stock increased approximately 35%, from 71 to 96 individuals (Ford et al. 1994). This represents a net annual growth rate of 1.8% during those years. Since 1995, the population declined to 79 whales before increasing from 2002-2004 to a total of 84 whales (Ford et al. 2000; Center for Whale Research, unpubl. data).

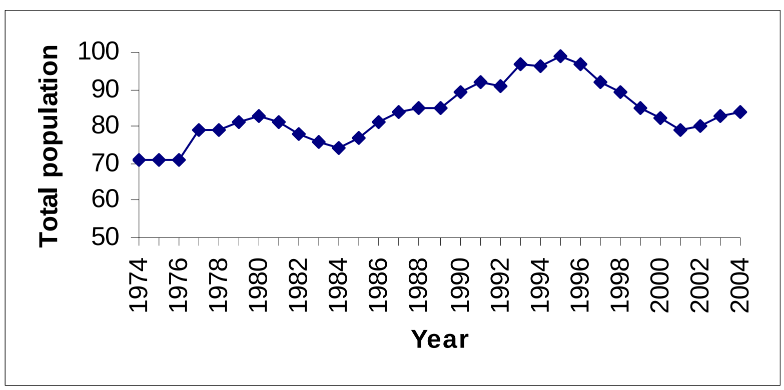

Figure 2. Population of Eastern North Pacific Southern Resident stock of killer whales, 1974-2004. Each year's count includes animals first seen and first missed; a whale is considered first missed the year after it was last seen alive (Ford et al. 2000; Center for Whale Research, unpubl. data).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for this stock of killer whales. Studies of 'resident' killer whale pods in British Columbia and Washington waters resulted in estimated population growth rates of 2.92% and 2.54% over the period from 1973 to 1987 (Olesiuk et al. 1990, Brault and Caswell 1993). For southern resident killer whales, estimates of the population growth rate have been made during the three periods when the population has been documented increasing since monitoring began in 1974. From 1974 to 1980 the population increased at a rate of 2.6%/year, 2.3%/year from 1985 to 1996, and 2.5%/year from 2002 to 2003 (Krahn et al. 2004). However, a population increases at the maximum growth rate (R_{MAX}) only when the population is at extremely low levels; thus, any of these estimates may be an underestimate of R_{MAX}. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate (R_{MAX}) of 4% be employed for this stock (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (84) times one-half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.5 (for a depleted stock, Wade and Angliss 1997), resulting in a PBR of 0.8 whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

NMFS observers have monitored the northern Washington marine set gillnet fishery since 1988 (Gearin et al. 1994, 2000; P. Gearin, unpubl. data). Observer coverage ranged from approximately 40 to 83% in the entire fishery (coastal + inland waters) between 1998 and 2002. There was no observer coverage in this fishery from 1999-2003. However, the total fishing effort was 4, 46, 4.5 and 7 net days (respectively) in those years, it occurred only in inland waters, and no killer whale takes were reported. No killer whale mortalities have been recorded in this fishery since the inception of the observer program.

In 1993, as a pilot for future observer programs, NMFS in conjunction with the Washington Department of Fish and Wildlife (WDFW) monitored all non-treaty components of the Washington Puget Sound Region salmon gillnet fishery (Pierce et al. 1994). Observer coverage was 1.3% overall, ranging from 0.9% to 7.3% for the various components of the fishery. Encounters (whales within 10 m of a net) with killer whales were reported, but not quantified, though no entanglements occurred.

In 1994, NMFS and WDFW conducted an observer program during the Puget Sound non-treaty chum salmon gillnet fishery (areas 10/11 and 12/12B). A total of 230 sets were observed during 54 boat trips, representing approximately 11% observer coverage of the 500 fishing boat trips comprising the total effort in this fishery, as estimated from fish ticket landings (Erstad et al. 1996). No interactions with killer whales were observed during this fishery. The Puget Sound treaty chum salmon gillnet fishery in Hood Canal (areas 12, 12B, and 12C) and the Puget Sound treaty sockeye/chum gillnet fishery in the Strait of Juan de Fuca (areas 4B, 5, and 6C) were also monitored in 1994 at 2.2% (based on % of total catch observed) and approximately 7.5% (based on % of observed trips to total landings) observer coverage, respectively (NWIFC 1995). No interactions resulting in killer whale mortalities were reported in either treaty salmon gillnet fishery.

Also in 1994, NMFS, WDFW, and the Tribes conducted an observer program to examine seabird and marine mammal interactions with the Puget Sound treaty and non-treaty sockeye salmon gillnet fishery (areas 7 and 7A). During this fishery, observers monitored 2,205 sets, representing approximately 7% of the estimated number of sets in the fishery (Pierce et al. 1996). Killer whales were observed within 10 m of the gear during 10 observed sets (32 animals in all), though none were observed to have been entangled.

Killer whale takes in the Washington Puget Sound Region salmon drift gillnet fishery are unlikely to have increased since the fishery was last observed in 1994, due to reductions in the number of participating vessels and available fishing time (see details in Appendix 1). Fishing effort and catch have declined throughout all salmon fisheries in the region due to management efforts to recover ESA-listed salmonids.

An additional source of information on the number of killer whales killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1994 and 2003, there were no fisher self-reports of killer whale mortalities from any fisheries operating within the range of this stock. However, because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. Logbook data are available for part of 1989-1994, after which incidental mortality reporting requirements were modified. Under the new system, logbooks are no longer required; instead, fishers provide self-reports. Data for the 1994-1995 phase-in period is fragmentary. After 1995, the level of reporting dropped dramatically, such that the records are considered incomplete and estimates of mortality based on them represent minimums (see Appendix 7 in Angliss and Lodge 2002 for details).

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, though the mortality level is thought to be minimal.

During this decade there have been no reported takes from this stock incidental to commercial fishing operations (D. Ellifrit, pers. comm.), no reports of interactions between killer whales and longline operations (as occurs in Alaskan waters; see Yano and Dahlheim 1995), no reports of stranded animals with net marks, and no photographs of individual whales carrying fishing gear. The total fishery mortality and serious injury for this stock is zero.

Other Mortality

According to Northwest Marine Mammal Stranding Network records, maintained by the NMFS Northwest Region, no human-caused killer whale mortalities or serious injuries were reported from non-fisheries sources in 1998-2003.

STATUS OF STOCK

NMFS received a petition from the Center for Biological Diversity and 10 co-petitioners on 2 May 2001 (an 11th co-petitioner was added on 16 July 2001) to list the Eastern North Pacific Southern Resident stock of killer whales as an "endangered" or "threatened" species under the Endangered Species Act (ESA) and to designate critical habitat for this stock under that Act. NMFS determined that the petition presented substantial scientific information indicating that a listing may be warranted thus was required to conduct an ESA status review of the stock (66 FR 42499, 13 August 2001). NMFS established a Biological Review Team (BRT) for this purpose and, in accordance with the BRT report (Krahn et al. 2002), determined that Southern Resident killer whales are not a "species" under the ESA and that a listing of "threatened" or "endangered" was not warranted (67 FR 44133, 1 July 2002). The BRT report (Krahn et al. 2002) identified potential risk factors that could influence this killer whale population, including: changes in prey availability, caused by fluctuations in environmental conditions (e.g., El Niño events); high levels of contaminants (Ross et al. 2000, Ylitalo et al. 2001); noise generated by whale-watching vessels; diseases and parasites; declines in stocks of salmon which are important prey; and catastrophes, such as oil spills and blooms of harmful algae. However, few quantitative data are available to determine which, if any, of these factors are likely to place the population in imminent danger of extinction. NMFS will continue to seek new information on the taxonomy, biology, and ecology of these whales, as well as potential threats to their continued existence, and will reassess their status under the ESA within 4 years (67 FR 44133, 1 July 2002). NMFS reviewed the status of the stock under the MMPA, determined that the stock is below its Optimum Sustainable Population (OSP), classified the stock as "depleted" under the MMPA, and announced its intention to prepare a Conservation Plan to reverse the decline and to promote recovery of the stock to OSP (68 FR 31980, 29 May 2003). In December 2003, the U.S. District Court set aside NMFS's not warranted finding relative to the 2001 ESA petition. Because the finding concluded that NMFS had erred by using "inaccurate" global species of Orcinus orca when considering whether southern residents were a distinct population segment (DPS), NMFS reconvened the southern resident killer whale Biological Review Team to review taxonomy and other new information that had become available since its 2002 Status Review. The BRT concluded that based on the new information southern resident killer whales were a DPS of the North Pacific resident taxon (Krahn et al. 2004). On December 16, 2004 NMFS announced its proposal to list southern resident killer whales as threatened under the ESA (69 FR 76673, 22 December 2004).

Based on currently available data, the total fishery mortality and serious injury for this stock (0) is not known to exceed 10% of the calculated PBR (0.08) 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 is not known to exceed the PBR (0.8). However, because the Eastern North Pacific Southern Resident killer whale stock has been designated as "depleted" under the MMPA, it is classified as a "strategic" stock.

In April 1999, Canada's Committee on the Status of Endangered Wildlife in Canada (COSEWIC) listed resident killer whales in British Columbia as "threatened," i.e., likely to become "endangered" if limiting factors are not reversed (Baird 1999). In November 2001, COSEWIC split the original listing for resident killer whales into two populations. The northern resident population was designated as "threatened" and the southern resident population was designated as "endangered," i.e., facing imminent extirpation or extinction (COSEWIC 2003). In June 2000, the Washington Department of Fish and Wildlife (WDFW) designated killer whales in Washington State as a "state candidate species" (a species that the Department will review for possible listing as "state endangered, threatened, or sensitive"). In October 2003, WDFW released a draft status review which proposes that Southern Resident killer whales be added to the state's endangered species list (WDFW 2003). In April 2004, the

Washington State Fish and Wildlife Commission approved the addition of killer whales to the State's endangered species list.

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Revised 11/01/2005

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Short-finned pilot whales were once commonly seen 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, few sightings were made from 1984-1992 (Jones and Szczepaniak 1992; Barlow 1997; Carretta and Forney 1993; Shane 1994; Green et al. 1992, 1993). In 1993, six groups of short-finned pilot whales were again seen off California (Carretta et al. 1995; Barlow and Gerrodette 1996), and mortality in drift gillnets increased (Julian and Beeson 1998) but sightings remain rare (Barlow 1997). Figure 1 summarizes the sighting history of short-finned pilot whales off the U.S. west coast. Although the full geographic range of the California/Oregon/Washington population is not known, it may be continuous with animals found off Baja California, and its individuals are morphologically distinct from short-finned pilot whales found farther south in the eastern tropical Pacific (Polisini 1981). Separate southern and northern forms of short-finned pilot whales have also been documented for the western North Pacific (Kasuya et al. 1988; Wada 1988; Miyazaki and Amano 1994). 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.

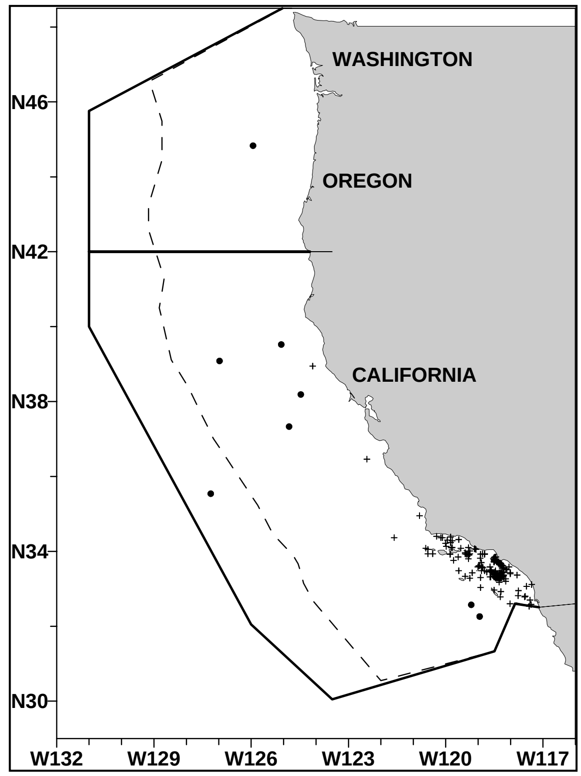

Figure 1. Short-finned pilot whale sightings made during aerial and shipboard surveys conducted off California in 1975-83 (+) and off California, Oregon, and Washington, 1991- 2001 (●). See Appendix 2 for data sources and information on timing and location of survey effort. Dashed line represents the U.S. EEZ, thick line indicates the outer boundary of all surveys combined.

POPULATION SIZE

Only two groups of pilot whales (numbering approximately 80 animals) were seen during the two most recent ship surveys conducted off California, Oregon, and Washington in 1996 and 2001 (Barlow 1997; Barlow 2003). All animals were seen during the 1996 survey. The abundance of short-finned pilot whales in this region appears to be variable and may relate to oceanographic conditions, as with other odontocete species (Forney 1997, Forney and Barlow 1998). 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 1996-2001 weighted average abundance estimate for California, Oregon and Washington waters based on the two ship surveys is 304 (CV= 1.02) short-finned pilot whales (Barlow 2003).

Minimum Population Estimate

The log-normal 20th percentile of the 1996-2001 weighted average abundance estimate is 149 short-finned pilot whales.

Current Population Trend

Approximately nine years after the virtual disappearance of short-finned pilot whales following the 1982-83 El Niño, they appear to have returned to California waters, as indicated by an increase in sighting records as well as incidental fishery mortality (Barlow and Gerrodette 1996; Carretta et al. 1995; Julian and Beeson 1998). However, this cannot be considered a true growth in the population, because it merely reflects large-scale, long-term movements of this species in response to changing oceanographic conditions. It is not known where the animals went after the 82-83 El Niño, nor where the recently observed animals came from. Until the range of this population and the movements of animals in relation to environmental conditions are better documented, 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 (149) <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 species of unknown status with a mortality rate CV>0.80; Wade and Angliss 1997), resulting in a PBR of 1.2 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. Mortality estimates for the California drift gillnet fishery are included for the five most recent years of monitoring, 1999-2003 (Cameron and Forney 1999, 2000; Carretta 2001, 2002; Carretta and Chivers 2003, 2004). After the 1997 implementation of a Take Reduction Plan, which included skipper education workshops and required the use of pingers and minimum 6-fathom extenders, overall cetacean entanglement rates in the drift gillnet fishery dropped considerably (Barlow and Cameron 2003). However, because of interannual variability in entanglement rates and the relative rarity of short-finned pilot whale entanglements, additional years of data will be required to fully evaluate the effectiveness of pingers for reducing mortality of this particular species. There have been 11 pilot whale mortalities observed in this fishery since 1990. In 1993, there were 8 mortalities observed, and one each in 1990, 1992, 1997 (in an unpingered net) and 2003. Mean annual takes in Table 1 are based on 1999-2003 data. This results in an average estimate of 1.0 (CV=1.00) short-finned pilot whales taken annually.

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).

Historically, short-finned pilot whales were also killed in squid purse seine operations off Southern California (Miller et al. 1983; Heyning et al. 1994). No recent mortality has been reported, presumably because short-finned pilot whales are no longer common in the areas of squid purse seine fishing activity; however, there have been recent anecdotal reports of pilot whales seen near squid fishing operations off Southern California during the October 1997- April 98 fishing season. This fishery is not currently monitored, and has expanded markedly since 1992 (Vojkovich 1998).

Table 1. Summary of available information on the incidental mortality and injury of short-finned pilot whales (California/ Oregon/Washington Stock) in commercial fisheries that might take this species. All observed entanglements of pilot whales 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 1999-2003 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	1999	20.0%	0	0	1.0 (1.00)
		2000	22.9%	0	0	
		2001	20.4%	0	0	
		2002	22.0%	0	0	
		2003	20.0%	1	5 (1.00)	
Undetermined (probably squid purse seine fishery)	strandings	1975-90	14 short-finned pilot whales stranded in Southern California with evidence of fishery interactions, probably with the squid purse seine fishery			n/a
Minimum total annual takes						1.0 (1.00)

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, likely a result of a change in their distribution 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 from 1999-2003 is 1.0 animals., which is less than the PBR (1.2), and therefore they are not classified as a "strategic" stock under the MMPA.

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Revised 12/15/2003

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). 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.

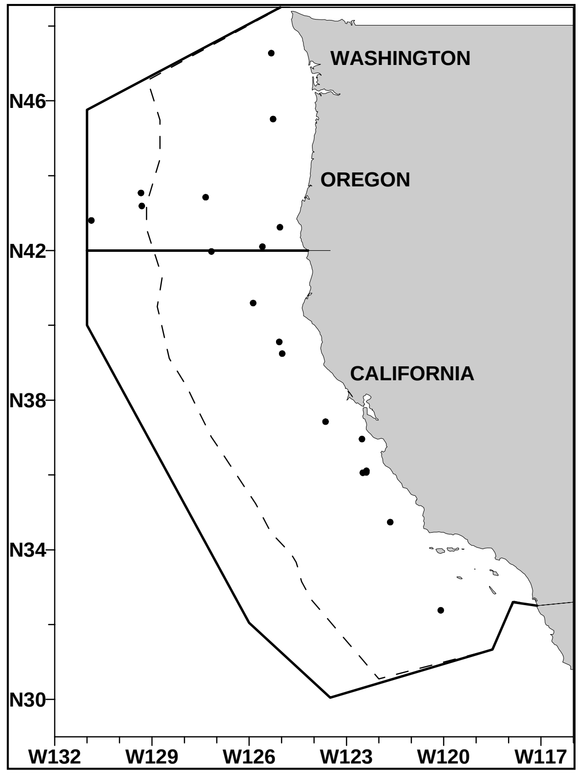

Figure 1. Baird's beaked whale sightings based on aerial and shipboard surveys off California, Oregon and Washington, 1991-2001 (see Appendix 2 for data sources and information on timing and location of survey effort). Dashed line represents the U.S. EEZ, thick line indicates the outer boundary of all surveys combined.

POPULATION SIZE

Two summer/fall shipboard surveys were conducted within 300 nmi of the coasts of California, Oregon and Washington in 1996 (Barlow 1997) and 2001 (Barlow 2003), resulting in a combined total of 11 Baird's beaked whale sightings. Because their distribution 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. The 1996-2001 weighted average abundance estimate for California, Oregon and Washington waters based on the above two ship surveys is 228 (CV=0.51) Baird's beaked whales (Barlow 1997). This abundance estimate includes correction factors for the proportion of animals missed (g(0) = 0.90 for groups of 1-3 animals, g(0)=1.0 for larger groups), which are similar to the estimate of g(0)=0.96 calculated more recently (Barlow 1999) based on dive-interval studies.

Minimum Population Estimate

The log-normal 20th percentile of the 1996-2001 weighted average abundance estimate is 152 Baird's beaked whales.

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. Future studies of trends must take the apparent seasonality of the distribution of Baird's beaked whales into account.

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 (152) 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 1.5 Baird's beaked whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

A summary of recent fishery mortality and injury for Baird's beaked whales in this region is shown in Table 1. More detailed information on these fisheries is provided in Appendix 1. Mortality estimates for the California drift gillnet fishery are included for the five most recent years of monitoring, 1997-2001 (Julian 1997; Cameron and Forney 1999, 2000; Carretta 2001; 2002). After the 1997 implementation of a Take Reduction Plan, which included skipper education workshops and required the use of pingers and minimum 6-fathom extenders, overall cetacean entanglement rates in the drift gillnet fishery dropped considerably (Barlow and Cameron 2003). However, because of interannual variability in entanglement rates and the relative rarity of Baird's beaked whale entanglements, additional years of data will be required to fully evaluate the effectiveness of pingers for reducing mortality of this particular species. Mean annual takes in Table 1 are based on 1997-2001 data. This results in an average estimated annual mortality of zero Baird's beaked whales. One Baird's beaked whale was taken in the drift gillnet fishery in 1994.

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 1997-2001 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	1997 1998 1999 2000 2001	23.0% 20.0% 20.0% 22.9% 20.4%	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).

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).

Additional, unknown levels of injuries and mortalities of Baird's beaked whales may occur as a result of anthropogenic noise, such as military sonars (U.S. Dept. of Commerce and Secretary of the Navy 2001) or other commercial and scientific activities involving the use of air guns. Such injuries or mortalities would rarely be documented, due to the remote nature of many of these activities and the low probability that an injured or dead beaked whale would strand.

STATUS OF STOCK

The status of Baird's beaked whales in California, Oregon and Washington waters 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, but in recent years questions have been raised regarding potential effects of human-made sounds on deep-diving cetacean species, such as Baird's beaked whales (Richardson et al. 1995). In particular, active sonar has been implicated in the mass stranding of beaked whales in the Mediterranean Sea (Frantzis 1998) and more recently in the Caribbean (U.S. Dept. of Commerce and Secretary of the Navy 2001). They are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. Including driftnet mortality only for years after implementation of the Take Reduction Plan (1997-98), the average annual human-caused mortality in 1997-2001 is zero. Because recent mortality is zero, Baird's beaked whales 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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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. At least 5 species in this genus have been recorded off the U.S. west coast, but due to the rarity of records and the difficulty in identifying these animals in the field, virtually no species-specific information is available (Mead 1989). 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*). 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 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.

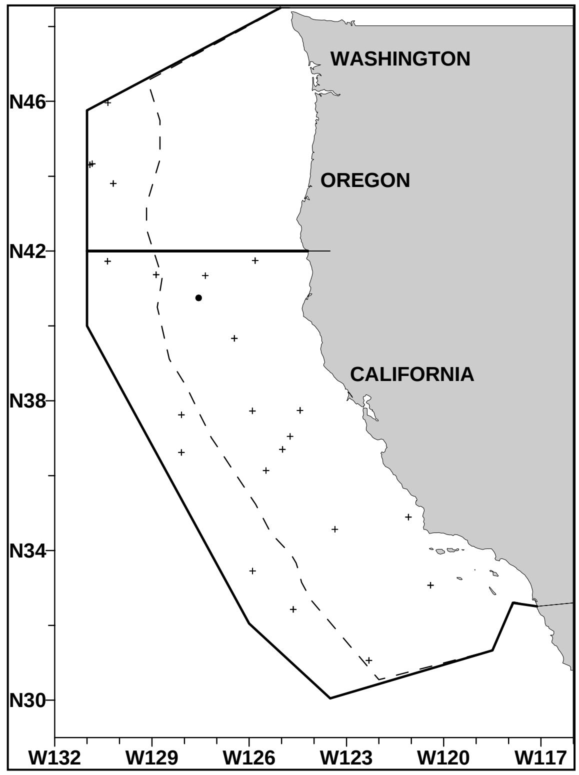

Figure 1. *Mesoplodon* beaked whale sightings based on aerial and shipboard surveys off California, Oregon and Washington, 1991-2001 (see Appendix 2 for data sources and information on timing and location of survey effort). Key: • = *Mesoplodon densirostris*, + = *Mesoplodon* spp. Dashed line represents the U.S. EEZ, thick line indicates the outer boundary 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, sightings have generally been too rare to produce reliable population estimates, and species identification has been problematic. Previous abundance estimates have been imprecise and biased downward by an unknown amount because of the large proportion of time mesoplodont beaked whales spend submerged, and because the surveys on which they were based covered only California waters, and thus could not include animals off Oregon/Washington. Furthermore, there were a large number of unidentified beaked whale sightings, which were either *Mesoplodon* sp. or Cuvier's beaked whales (*Ziphius cavirostris*). Updated analyses are based on 1) combining data from two surveys conducted within 300 nmi of the coasts of California, Oregon and Washington in 1996; (Barlow 1997) and 2001 (Barlow 2003), 2) whenever possible, assigning unidentified beaked whale sightings to *Mesoplodon* spp. or *Ziphius cavirostris* based on written descriptions, size estimates, and 'most probable identifications' made by the observers at the time of the sightings, and 3) estimating a correction factor for animals missed because they are submerged, based on dive-interval data collected for mesoplodont whales in 1993-95 (about 26% of all trackline groups are estimated to be seen). Of the 12 sightings of *Mesoplodon* made during the 1996 and 2001 surveys, none could be identified to the species level. Thus, an updated estimate of Blainville's beaked whale abundance is unavailable. An updated estimate of abundance for unidentified mesoplodont beaked whales is presented, based on 1996-2001 sightings. Because their distribution 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. The 1996-2001 weighted average abundance estimates for California, Oregon and Washington waters based on the above analyses are 1,247(CV=0.92) mesoplodont beaked whales of unknown species.

Minimum Population Estimate

Based on the abundance estimate of 1,247 (CV=0.92), 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 645 animals.

Current Population Trend

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

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 (645) 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 recent fishery mortality; Wade and Angliss 1997), resulting in a PBR of 6.5 mesoplodont beaked whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

A summary of recent fishery mortality and injury for mesoplodont beaked whales in this region is shown in Table 1. More detailed information on these fisheries is provided in Appendix 1. Mortality estimates for the California drift gillnet fishery are included for the five most recent years of monitoring, 1997-2001 (Cameron and Forney 1999, 2000; Carretta 2001, 2002). After the 1997 implementation of a Take Reduction Plan, which included skipper education workshops and required the use of pingers and minimum 6-fathom extenders, overall cetacean entanglement rates in the drift gillnet fishery dropped considerably (Barlow and Cameron 2003). However, because of interannual variability in entanglement rates and the relative rarity of mesoplodont beaked whale entanglements, additional years of data will be required to fully evaluate the effectiveness of pingers for reducing mortality of this group of species. Mean annual takes in Table 1 are based on 1997-2001 data. This results in an average estimated annual mortality of zero mesoplodont beaked whales. Prior to the most recent 5-year period, there were a total of eight mesoplodont beaked whales entangled in the drift gillnet fishery: 1990 (one animal), 1992 (four), and 1994 (three).

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).

Other mortality

Additional, unknown levels of injuries and mortalities of mesoplodont beaked whales may occur as a result of anthropogenic noise, such as military sonars (U.S. Dept. of Commerce and Secretary of the Navy 2001) or other commercial and scientific activities involving the use of air guns. Such injuries or mortalities would rarely be documented, due to the remote nature of many of these activities and the low probability that an injured or dead beaked whale would strand.

STATUS OF STOCKS

The status of mesoplodont beaked whales in California, Oregon and Washington waters 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, but in recent years questions have been raised regarding potential effects of human-made sounds on deep-diving cetacean species, such as mesoplodont beaked whales (Richardson et al. 1995). In particular, active sonar has been implicated in the mass stranding of beaked whales in the Mediterranean Sea (Frantzis 1998) and more recently in the Bahamas (U.S. Dept. of Commerce and Secretary of the Navy 2001).

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. All observed entanglements of *Mesoplodon* beaked whales resulted in the death of the animal. Coefficients of variation for mortality estimates are provided in parentheses. Mean annual takes are based on 1997-2001 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	Hubbs' beaked whale, *Mesoplodon carlhubbsi*					
	observer data	1997 1998 1999 2000 2001	23.0% 20.0% 20.0% 22.9% 20.4%	0 0 0 0 0	0 0 0 0 0	0
	Stejneger's beaked whale, *Mesoplodon stejnegeri*					
	observer data	1997 1998 1999 2000 2001	23.0% 20.0% 20.0% 22.9% 20.4%	0 0 0 0 0	0 0 0 0 0	0
	Unidentified beaked whale (probably *Mesoplodon*)					
	observer data	1997 1998 1999 2000 2001	23.0% 20.0% 20.0% 22.9% 20.4%	0 0 0 0 0	0 0 0 0 0	0
Minimum total annual takes of *Mesoplodon* beaked whales						0

None of the six species is listed as "threatened" or "endangered" under the Endangered Species Act nor considered "depleted" under the MMPA. Including driftnet mortality only for years after implementation of the Take Reduction Plan (1997-98), the average annual human-caused mortality in 1997-2001 is zero. Because recent mortality is zero, mesoplodont beaked whales 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. 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.

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Revised 12/15/2003

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 (Heyning 1989). 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). However, there are currently no international agreements for cooperative management of this species. 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.

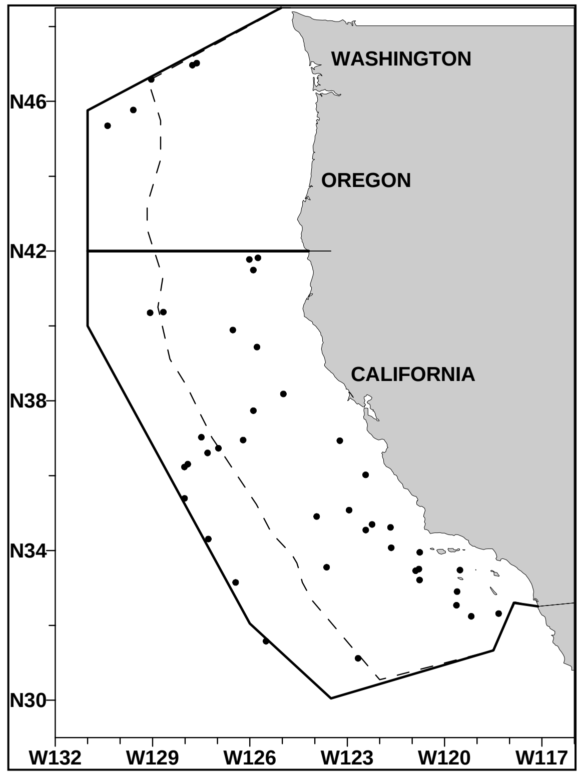

Figure 1. Cuvier's beaked whale sightings based on aerial and shipboard surveys off California, Oregon and Washington, 1991-2001 (see Appendix 2, for data sources and information on timing and location of survey effort). Dashed line represents the U.S. EEZ, thick line indicates the outer boundary of 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, sightings have been too rare to produce reliable population estimates. Previous abundance estimates have been imprecise and biased downward by an unknown amount because of the large proportion of time this species spends submerged, and because the ship surveys on which they were based covered only California waters, and thus could not observe animals off Oregon/Washington. Furthermore, there were a large number of unidentified beaked whale sightings, which were probably either *Mesoplodon* sp. or Cuvier's beaked whales (*Ziphius cavirostris*). Updated analyses are based on 1) combining data from two surveys conducted within 300 nmi of the coasts of California, Oregon and Washington in 1996 (Barlow 1997) and 2001 (Barlow 2003), 2) whenever possible, assigning unidentified beaked whale sightings to *Mesoplodon* spp. or *Ziphius cavirostris* based on written descriptions, size estimates, and 'most probable identifications' made by the observers at the time of the sightings, and 3) estimating a correction factor for animals missed because they are submerged, based on dive-interval data collected for Cuvier's beaked whales in 1993-95 (an estimated 13% of all groups are estimated to be seen). Because 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. The 1996-2001 weighted average abundance estimate for California, Oregon and Washington waters based on the above analyses is 1,884 (CV=0.68) Cuvier's beaked whales.

Minimum Population Estimate

Based on the above abundance estimate and CV, 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 1,121 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 (1,121) 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 recent fishery mortality; Wade and Angliss 1997), resulting in a PBR of 11 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. More detailed information on these fisheries is provided in Appendix 1. Mortality estimates for the California drift gillnet fishery are included for the five most recent years of monitoring, 1997-2001 (Cameron and Forney 1999, 2000; Carretta 2001, 2002). After the 1997 implementation of a Take Reduction Plan, which included skipper education workshops and required the use of pingers and minimum 6-fathom extenders, overall cetacean entanglement rates in the drift gillnet fishery dropped considerably (Barlow and Cameron 2003). However, because of interannual variability in entanglement rates and the relative rarity of Cuvier's beaked whale entanglements, additional years of data will be required to fully evaluate the effectiveness of pingers for reducing mortality of this particular species. Mean annual takes in Table 1 are based only on 1997-2001 data. This results in an average estimated annual mortality of zero Cuvier's beaked whales. There have been no Cuvier's beaked whales observed entangled in the drift gillnet fishery since 1995. Prior to the most recent 5-year period, there were a total of 21 Cuvier's beaked whales entangled in the drift gillnet fishery: 1992 (six animals), 1993 (three), 1994 (six) and 1995 (six).

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 1997-2001 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	1997 1998 1999 2000 2001	23.0% 20.0% 20.0% 22.9% 20.4%	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).

Other mortality

Additional, unknown levels of injuries and mortalities of Cuvier's beaked whales may occur as a result of anthropogenic noise, such as military sonars (U.S. Dept. of Commerce and Secretary of the Navy 2001) or other commercial and scientific activities involving the use of air guns. Such injuries or mortalities would rarely be documented, due to the remote nature of many of these activities and the low probability that an injured or dead beaked whale would strand.

STATUS OF STOCK

The status of Cuvier's beaked whales in California, Oregon and Washington waters 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, but in recent years questions have been raised regarding potential effects of human-made sounds on deep-diving cetacean species, such as Cuvier's beaked whales (Richardson et al. 1995). In particular, active sonar has been implicated in the mass stranding of beaked whales in the Mediterranean Sea (Frantzis 1998) and more recently in the Caribbean (U.S. Dept. of Commerce and Secretary of the Navy 2001). 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 1997-2001 is zero. Because recent mortality is zero, Cuvier's beaked whales 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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Revised 12/15/2003

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 very rare (Figure 1). However, this is probably a reflection of their pelagic distribution, small body size and cryptic behavior, rather than an indication of true rareness. 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.

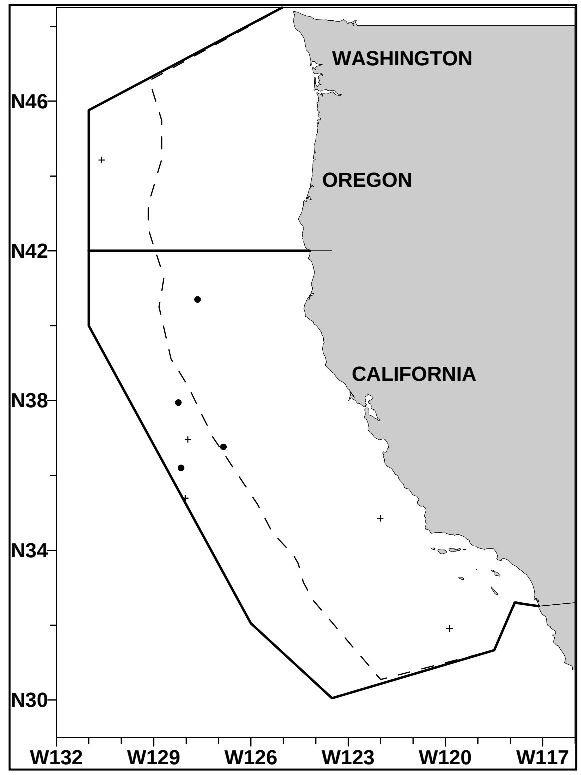

Figure 1. *Kogia* sightings based on aerial and shipboard surveys off California, Oregon and Washington, 1991- 2001 (see Appendix 2 for data sources and information on timing and location of survey effort). Key: • = *Kogia breviceps*, + = *Kogia* spp. Dashed line represents the U.S. EEZ, thick line indicates the outer boundary of all surveys combined.

POPULATION SIZE

Although pygmy sperm whales have been sighted along the U.S. west coast on several line transect surveys utilizing both aerial and shipboard platforms, sightings have been too rare to produce reliable population estimates. Previous abundance estimates have been imprecise and biased downward by an unknown amount because pygmy sperm whales spend a large proportion of time submerged and are very difficult to detect at the surface unless seas are calm. Furthermore, the ship survey covered only California waters, and thus could not observe animals off Oregon/Washington. Updated analyses are based on 1) combining data from two surveys conducted within 300 nmi of the coasts of California, Oregon and Washington in 1996 (Barlow 1997), and 2001 (Barlow 2003), 2) estimating a correction factor for animals missed because they are submerged, based on dive-interval data collected for *Kogia sima* in 1993-95 (about 19% of all groups are estimated to be seen). Because 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. The 1996-2001 weighted average abundance estimate for California, Oregon and Washington waters based on the above analyses is 247 (CV=1.06) pygmy sperm whales, based on two sightings that could only be identified to the genus *Kogia*. 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

Based on the above abundance estimate and CV, the minimum population estimate (defined as the log-normal 20th percentile of the total *Kogia* abundance estimate) for pygmy sperm whales in California, Oregon, and Washington is 119 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 (119) 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 recent fishery mortality; Wade and Angliss 1997), resulting in a PBR of one pygmy sperm whale 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. More detailed information on the drift gillnet fishery is provided in Appendix 1. In the California drift gillnet fishery, no mortality of pygmy sperm whales or unidentified *Kogia* was observed during the most recent five years of monitoring, 1997-2001 (Cameron and Forney 1999, 2000; Carretta 2001, 2002). One pygmy sperm whale was observed killed in the drift gillnet fishery in 1992 and another in 1993. After the 1997 implementation of a Take Reduction Plan, which included skipper education workshops and required the use of pingers and minimum 6-fathom extenders, overall cetacean entanglement rates in the drift gillnet fishery dropped considerably (Barlow and Cameron 2003). However, because of interannual variability in entanglement rates and the rarity of *Kogia* entanglements, additional years of data will be required to fully evaluate the effectiveness of pingers for reducing mortality of pygmy sperm whales. Mean annual takes in Table 1 are based on 1997-2001 data. This results in an average estimated annual mortality of zero pygmy sperm whales.

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).

Other mortality

Additional, unknown levels of injuries and mortalities of pygmy sperm whales may occur as a result of anthropogenic noise, such as military sonars (U.S. Dept. of Commerce and Secretary of the Navy 2001) or other commercial and scientific activities involving the use of air guns. Such injuries or mortalities 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. No habitat issues are known to be of concern for this species, but in recent years questions have been raised regarding potential effects of human-made sounds on deep-diving cetacean species, such as pygmy sperm whales (Richardson et al. 1995). In particular, active sonar has been implicated in the mass stranding of beaked whales in the Mediterranean Sea (Frantzis 1998) and more recently in the Caribbean (U.S. Dept. of Commerce and Secretary of the Navy 2001). They are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. Including driftnet mortality only for years after implementation of the Take Reduction Plan (1997-98), the average annual human-caused mortality in 1997-2001 is zero. Because recent mortality is zero, pygmy sperm whales 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.

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 1997-2001 data unless noted otherwise.

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	1997 1998 1999 2000 2001	23.0% 20.0% 20.0% 22.9% 20.4%	0 / 0 0 / 0 0 / 0 0 / 0 0 / 0	0 / 0 0 / 0 0 / 0 0 / 0 0 / 0	0
Minimum total annual takes						0

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Revised 12/15/2003

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.

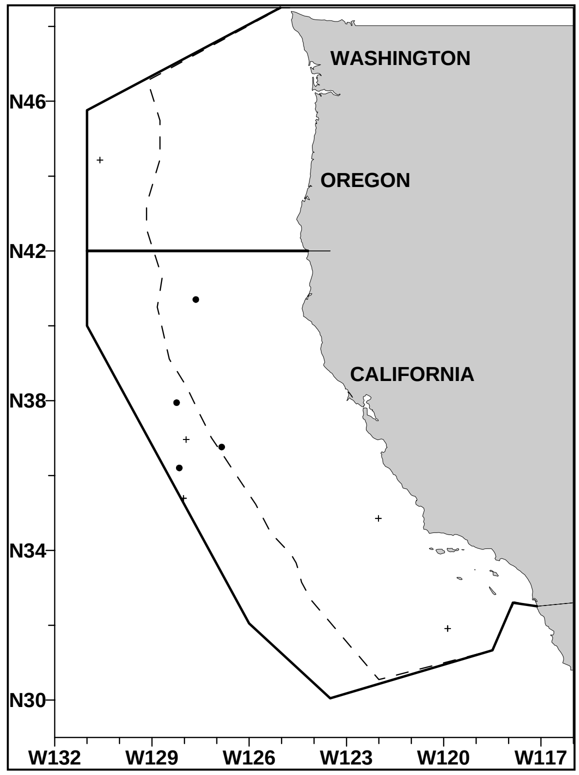

Figure 1. *Kogia* sightings based on aerial and shipboard surveys off California, Oregon and Washington, 1991- 2001 (see Appendix 2 for data sources and information on timing and location of survey effort). Key: • = *Kogia breviceps*, + = *Kogia* spp. Dashed line represents the U.S. EEZ, thick line indicates the outer boundary 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. 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

In the California drift gillnet fishery, no mortality of dwarf sperm whales or unidentified *Kogia* was observed during the most recent five years of monitoring, 1997-2001 (Cameron and Forney 1999, 2000; Carretta 2001, 2002). After the 1997 implementation of a Take Reduction Plan, which included skipper education workshops and required the use of pingers and minimum 6-fathom extenders, overall cetacean entanglement rates in the drift gillnet fishery dropped considerably (Barlow and Cameron 2003). However, because of interannual variability in entanglement rates and the rarity of *Kogia* entanglements, additional years of data will be required to fully evaluate the effectiveness of pingers for reducing mortality of dwarf sperm whales. Mean annual takes in Table 1 are based on 1997-2001 data. This results in an average estimated annual mortality of zero dwarf sperm whales.

Similar 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 has increased from two vessels in 1986 to 29 vessels in 1992 (Sosa-Nishizaki et al. 1993). 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).

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 1997-2001 data unless noted otherwise.

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	1997 1998 1999 2000 2001	23.0% 20.0% 20.0% 22.9% 20.4%	0 / 0 0 / 0 0 / 0 0 / 0 0 / 0	0 / 0 0 / 0 0 / 0 0 / 0 0 / 0	0
Minimum total annual takes						0

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. No habitat issues are known to be of concern for this species, but in recent years questions have been raised regarding potential effects of human-made sounds on deep-diving cetacean species, such as dwarf sperm whales (Richardson et al. 1995). In particular, active sonar has been implicated in the mass stranding of beaked whales in the Mediterranean Sea (Frantzis 1998) and more recently in the Caribbean (U.S. Dept. of Commerce and Secretary of the Navy 2001). 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 current fishery mortality is zero, dwarf sperm whales off California, Oregon and Washington are not classified as a "strategic" stock under the MMPA.

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Revised 12/15/2003

SPERM WHALE (*Physeter macrocephalus*): California/Oregon/Washington 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°N in winter (Rice 1974; 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°W at the equator, is 160°W between 40-50°N, and ends up at 180°W north of 50°N; however, the IWC has not reviewed this stock boundary in many years (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). They were seen in every season except winter (Dec.-Feb.) in Washington and Oregon (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 tapers off markedly westward towards the middle of the tropical Pacific (near the IWC stock boundary at 150°W) and tapers off northward towards the tip of Baja California. The structure of sperm whale populations in the eastern tropical Pacific is not known, 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), suggesting that the eastern tropical animals constitute a distinct stock. A recent 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 1998). Recent analyses of genetic relationships of animals in the eastern Pacific found that mtDNA and microsatellite DNA of animals sampled in the California Current is significantly different from animals sampled further offshore and that genetic differences appeared larger in an east-west direction than in a north-south direction (Mesnick et al. 1999).

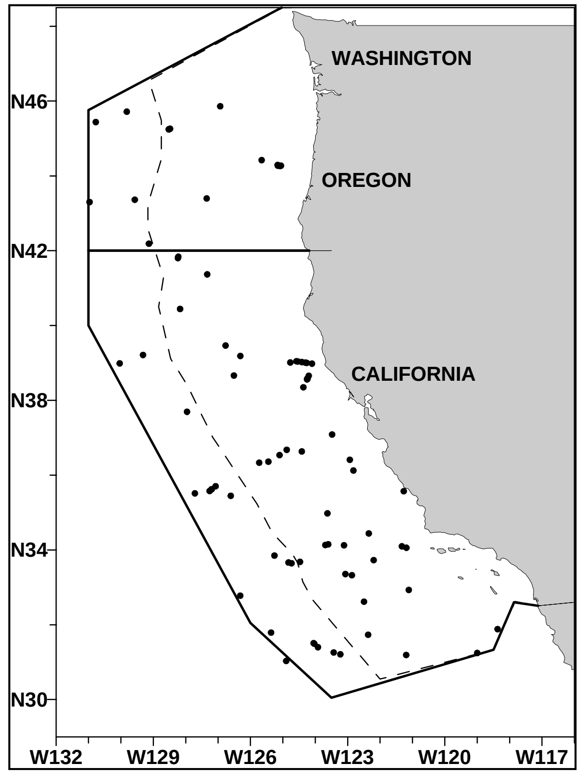

Figure 1. Sperm whale sighting locations based on aerial and shipboard surveys off California, Oregon, and Washington, 1991-2001. Dashed line represents the U.S. EEZ, thick line indicates the outer boundary of all surveys combined. Greater effort was conducted off California (south of 42°N) and in the inshore half of the U.S. EEZ. See Appendix 2 for data sources and information on timing and location of survey effort.

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

Barlow and Taylor (2001) estimated 1,407 (CV=0.39) sperm whales along the coasts of California, Oregon, and Washington during summer/fall based on ship line transect surveys in 1993 and 1996. Forney et al. (1995) estimated 892 (CV=0.99) sperm whales off California during winter/spring based on aerial line-transect surveys in 1991-92, but this estimate does not correct for diving whales that were missed and is now more than eight years out of date. The most recent abundance estimate is based on summer/autumn shipboard surveys conducted within 300 nmi of the coasts of California, Oregon, and Washington in 1996 (Barlow 1997) and 2001 (Barlow 2003). The combined weighted estimate for the 1996 and 2001 surveys is 1,233 (CV = 0.41) sperm whales (Barlow 2003). Green et al. (1992) report that sperm whales were the third most abundant large whale (after gray and humpback whales) in aerial surveys off Oregon and Washington, but they did not estimate population size for that area. 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. Recently, a combined visual and acoustic line-transect survey conducted in the eastern temperate North Pacific in spring 1997 resulted in estimates of 24,000 (CV=0.46) sperm whales based on visual sightings, and 39,200 (CV=0.60) based acoustic detections and visual group size estimates (Barlow and Taylor 1998). However, it is not known whether any or all of these animals routinely enter the U.S. EEZ. 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), but this area does not include areas where sperm whales are taken by drift gillnet fisheries in the U.S. EEZ and there is no evidence of sperm whale movements from the eastern tropical Pacific to the U.S. EEZ. Barlow and Taylor (2001) also estimated 1,640 (CV=0.33) sperm whales off the west coast of Baja California, but again there is no evidence for interchange between these animals and those off California, Oregon and Washington.

Clearly, large populations of sperm whales exist in waters that are within several thousand miles west and south of the California, Oregon, and Washington region that is covered by this report; however, there is no evidence of sperm whale movements into this region from either the west or south and genetic data suggest that mixing to the west is extremely unlikely. There **is** limited evidence of sperm whale movement from California to northern areas off British Columbia, but there are no abundance estimates for this area. The most precise and recent estimate of sperm whale abundance for this stock is therefore from the ship surveys conducted in 1996 and 2001 (Barlow 2003).

Minimum Population Estimate

The minimum population estimate for sperm whales is taken as the lower 20th percentile of the log-normal distribution of abundance estimated from the 1996-2001 summer/fall ship surveys off California, Oregon and Washington (Barlow 2003) or approximately 885. More sophisticated methods of estimating minimum population size would be available if a correction factor (and associated variance) were available to correct the aerial survey estimates for missed animals.

Current Population Trend

Sperm whale abundance appears to have been rather variable off California between 1979/80 and 1996 (Barlow 1994; Barlow 1997) but does not show any obvious trends. Although the population in the eastern North Pacific is expected to have grown since large-scale pelagic whaling stopped in 1980, the possible effects of large unreported catches are unknown (Yablokov 1994) and the ongoing incidental ship strikes and gillnet mortality make this uncertain.

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 the California portion of this stock is calculated as the minimum population size (885) <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 (the default value for an endangered species), resulting in a PBR of 1.8.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Historic Whaling

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.). 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) estimate that about 89,000 whales were additionally taken by the Soviet pelagic whaling fleet between 1949 and 1979. The 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.

Fishery Information

The offshore drift gillnet fishery is the only fishery that is likely to take sperm whales from this stock. Detailed information on this fishery is provided in Appendix 1. A 1997-2001 summary of known fishery mortality and injury for this stock of sperm whales is given in Table 1. After the 1997 implementation of a Take Reduction Plan, which included skipper education workshops and required the use of pingers and minimum 6-fathom extenders, overall cetacean entanglement rates in the drift gillnet fishery dropped considerably (Barlow and Cameron 2003). However, two sperm whales have been observed taken in nets with pingers (1996 and 1998). Because sperm whale entanglement is rare and because those nets which took sperm whales did not use the full mandated complement of pingers, it is difficult to evaluate whether pingers have any effect on sperm whale entanglement in drift gillnets. Mean annual takes for this fishery (Table 1) are based on 1997-2001 data. This results in an average estimate of 1.0 (CV = 0.89) sperm whale mortalities per year.

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 (Cameron and Forney 1999; 2000; Carretta 2001; 2002). Injury includes any entanglement that does not result in immediate death and may include serious injury resulting in death. n/a indicates that data are not available. Mean annual takes are based on 1997-2001 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	1997 1998 1999 2000 2001	Observer data	23.0% 20.0% 20.0% 22.9% 20.4%	0 1 0 0 0	0 5 (0.89) 0 0 0	1 (0.89)
Total annual takes						1 (0.89)

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).

Ship Strikes

No sperm whale mortalities have been attributed to ship strikes during the period 1997-2001.

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. 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 annual rate of kill and serious injury (1.0 per year) is less than the calculated PBR for this stock (1.8). Total fishery takes may not be approaching zero mortality and serious injury rate. The increasing levels of anthropogenic noise 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 oceans "sound channel".

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Revised 11/01/2005

HUMPBACK WHALE (*Megaptera novaeangliae*): Eastern North Pacific Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Although the International Whaling Commission (IWC) only considered one stock (Donovan 1991), there is now good evidence for multiple populations of humpback whales in the North Pacific (Johnson and Wolman 1984; Baker et al. 1990). Aerial, vessel, and photo-identification surveys, and genetic analyses indicate that within the U.S. EEZ, there are at least three relatively separate populations that migrate between their respective summer/fall feeding areas and winter/spring calving and mating areas (Calambokidis et al. 2001, Baker et al. 1998): 1) winter/spring populations in coastal Central America and Mexico which migrate to the coast of California to southern British Columbia in summer/fall (Steiger et al. 1991, Calambokidis et al. 1996) - referred to as the eastern North Pacific stock (Figure 1); 2) winter/spring populations of the Hawaiian Islands which migrate to northern British Columbia/Southeast Alaska and Prince William Sound west to Kodiak (Baker et al. 1990, Perry et al. 1990, Calambokidis et al. 2001) - referred to as the central North Pacific stock; and 3) winter/spring populations of Japan which, based on Discovery Tag information, probably migrate to waters west of the Kodiak Archipelago (the Bering Sea and Aleutian Islands) in summer/fall (Berzin and Rovnin 1966, Nishiwaki 1966, Darling 1991) - referred to as the western North Pacific stock. Winter/spring populations of humpback whales also occur in Mexico's offshore islands; the migratory destination of these whales is not well known (Calambokidis et al. 2001), but Norris et al. (1999) speculate that they may travel to the Bering Sea or Aleutian Islands. This stock structure represents the predominant migration patterns, but there is not a perfect correspondence between the breeding and feeding areas that are paired above. For example, some individuals migrate from Mexico to the Gulf of Alaska and others migrate from Japan to British Columbia. In general, interchange occurs (at low levels) between breeding areas, but fidelity is extremely high among the feeding areas (Calambokidis et al. 2001).

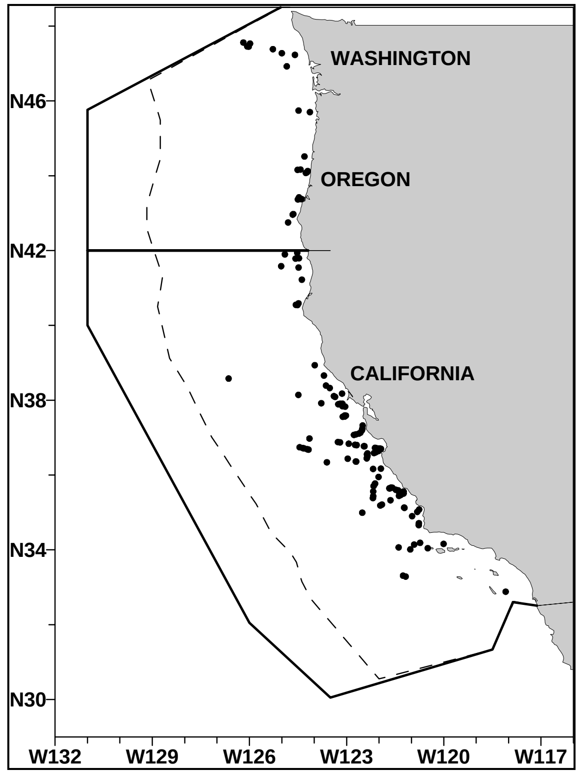

Figure 1. Humpback whale sightings based on shipboard surveys off California, Oregon, and Washington, 1991-2001. Dashed line represents the U.S. EEZ, thick line indicates the outer boundary of all surveys combined. See Appendix 2 for data sources and information on timing and location of survey effort.

Significant levels of genetic differences were found between the California and Alaska feeding groups based on analyses of mitochondrial DNA (Baker et al. 1990) and nuclear DNA (Baker et al. 1993). The genetic exchange rate between California and Alaska is estimated to be less than 1 female per generation (Baker 1992). Two breeding areas (Hawaii and coastal Mexico) showed fewer genetic differences than did the two feeding areas (Baker 1992). This is substantiated by the observed movement of individually identified whales between Hawaii and Mexico (Baker et al. 1990). There have been no individual matches between 597 humpbacks photographed in California and 617 humpbacks photographed in Alaska (Calambokidis et al. 1996). Only two of the 81 whales photographed in British Columbia have matched with a California catalog (Calambokidis et al. 1996), indicating that the U.S./Canada border is an approximate geographic boundary between feeding populations.

Until further information becomes available, three management units of humpback whales (as described above) are recognized within the U.S. EEZ of the North Pacific: the eastern North Pacific stock (this report), the central North Pacific stock, and the western North Pacific stock. The central and western North Pacific stocks are reported separately in the Stock Assessment Reports for the Alaska Region.

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). The North Pacific total now almost certainly exceeds 6,000 humpback whales (Calambokidis et al. 1997). Estimates of the abundance of the eastern Pacific stock of humpback whales were made by aerial survey (Dohl 1983; Forney et al. 1995) and ship surveys (Barlow 1995), but those estimates are now over 9 years old and the aerial estimates did not include correction factors for diving whales that would be missed. More recent estimates are available from ship surveys and mark-recapture studies. Barlow (2003) estimated 1,314 (CV=0.30) humpbacks in California, Oregon, and Washington waters based on summer/fall ship line-transect surveys in 1996 and 2001. Calambokidis et al. (2004) estimated humpback whale abundance in these feeding areas from 1991 to 2003 using Petersen mark-recapture estimates based on photo-identification collections in adjacent pairs of years (Figure 2). These data show a general upward trend in abundance followed by a large (but not statistically significant) drop in the 1999/2000 and 2000/2001 estimates. The 2002/2003 population estimate (1,391, CV=0.22) is higher than any previous estimates and may indicate that the apparent decline in the previous two estimates exaggerates any real decline that might have occurred (Calambokidis et al. 2003) or that a real decline was followed by an influx of new whales from another area (Calambokidis et al. 2004). This latter view is substantiated by the greater fraction of new whales seen for the first time in 2003 (Calambokidis et al. 2004). In general, mark-recapture estimates are negatively biased due to heterogeneity in sighting probabilities (Hammond 1986); however, this bias is likely to be minimal because the above mark-recapture estimate is based on data from nearly half of the entire population (the 2002/2003 data contained 542 known individuals). The recent ship line transect estimate from 1996-2001 surveys is less precise than the mark-recapture estimates and is negatively biased because it does not include some humpback whales which could not be identified in the field and which were recorded as "unidentified large whale".

Minimum Population Estimate

The minimum population estimate for humpback whales in the California/Mexico stock is taken as the lower 20th percentile of the log-normal distribution of 2002/2003 abundance estimated from mark-recapture methods (Calambokidis et al. 2004) or approximately 1,158.

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 1996 (Barlow 1997); however estimates declined between 1996 and 2001 (Barlow 2003). Mark-recapture population estimates increased steadily from 1988/90 to 1997-98 at about 8% per year (Calambokidis et al. 1999). The apparent dip in the 1999/2000 and 2000/2001 estimates may indicate that population growth is slowing, but the subsequent increases in 2001/2002 and 2002/2003 casts some doubt on this explanation. Population estimates for the entire North Pacific have also increased substantially from 1,200 in 1966 to 6,000-8,000 circa 1992. 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 the recently observed growth rate of the eastern North Pacific stock.

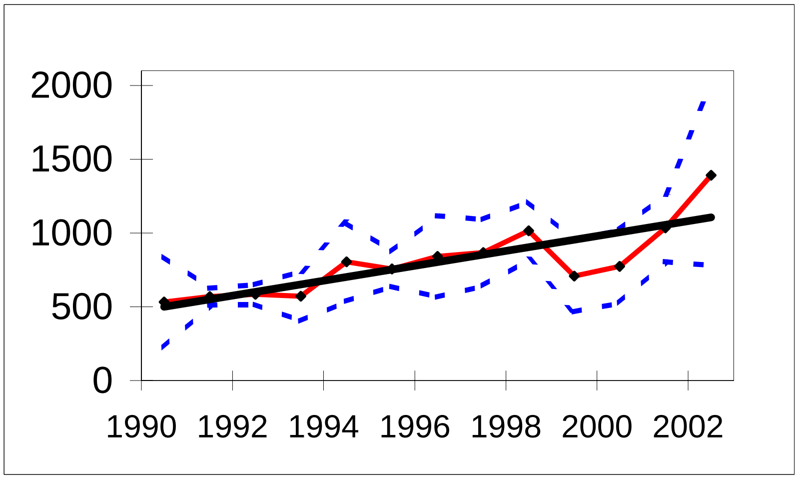

Figure 2. Mark-recapture estimates of the abundance of humpback whales feeding off California, Oregon, and Washington based on photo-identification studies (Calambokidis et al. 2004). Dotted lines indicate +/- 2 standard errors for each estimate. Straight, bold line indicates linear regression.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The proportion of calves in the California/Mexico 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 (1,158) times one half the estimated population growth rate for this stock of humpback whales (½ of 8%) 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 4.6. Because this stock spends approximately half its time outside the U.S. EEZ, the PBR allocation for U.S. waters is 2.3 whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Historic Whaling

The reported take of North Pacific humpback whales by commercial whalers totaled approximately 7,700 between 1947 and 1987 (C. Allison, IWC unpubl. data). In addition, approximately 7,300 were taken along the west coast of North America from 1919 to 1929 (Tonnessen and Johnsen 1982). Total 1910-1965 catches from the California-Washington stock includes at least the 2,000 taken in Oregon and Washington, the 3,400 taken in California, and the 2,800 taken in Baja California (Rice 1978). 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.

Fishery Information

A 1999-2003 summary of known fishery mortality and injury for this stock of humpback whales is given in Table 1. Detailed information on these fisheries is provided in Appendix 1. After the 1997 implementation of a Take Reduction Plan, which included skipper education workshops and required the use of pingers and minimum 6-fathom extenders, overall cetacean entanglement rates in the drift gillnet fishery dropped considerably (Barlow and Cameron 2003). Mean annual takes for this fishery (Table 1) are based on 1999-2003 data. This results in an average estimate of zero humpback whales taken annually. Some gillnet mortality of large whales may go unobserved because whales swim away with a portion of the net. The deaths of two humpback whales that stranded in the Southern California Bight have been attributed to entanglement in fishing gear (Heyning and Lewis 1990), and a humpback whale was observed off Ventura, CA in 1993 with a 20 ft section of netting wrapped around and trailing behind. During the period 1999-2003, a humpback cow-calf pair was seen entangled in a net off Big Sur, California (1999) and another lone humpback was seen entangled in line and fishing buoys off Grover City (2000), but the fate of these animals is not known (J. Cordero, NMFS unpubl. data). One humpback whale was entangled and released alive in the swordfish/thresher shark drift gillnet fishery in November of 1999 at N33°17' W120° 49' (set DN-SD-0949). Other unobserved fisheries may also result in injuries or deaths of humpback whales. In 2001, a humpback whale with "pot gear" wrapped around its flukes was seen free-swimming 8 miles offshore of Point Bonita, California (NMFS, Southwest Region, unpublished data). In 2003, there were five separate reports of humpback whales entangled in crab pot and/or polypropylene lines (J. Cordero, NMFS, unpubl. data). In March 2003, an adult female with a calf was seen off Monterey with crab pot line wrapped around its flukes. An adult humpback was seen in May 2003 in the Santa Barbara Channel with 100 feet of yellow polypropylene line wrapped around it pectoral fins and caudal peduncle. Another adult female with a calf was seen in August 2003 west of the Farallon Islands with crab pot line with floats wrapped around its caudal peduncle and fluke lobe; the adult was reported to be 'diving awkwardly'. In November 2003, there were two reports within four days near Crescent City and south of Humboldt Bay of single humpback whales with crab pot line wrapped around their 'torso'. These two reports may represent the same whale. The final status of all these whales is unknown.

Drift gillnet fisheries for swordfish and sharks exist along the entire Pacific coast of Baja California, Mexico and may take animals from the same 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).

Table 1. Summary of available information on the incidental mortality and injury of humpback whales (eastern North Pacific stock) for commercial fisheries that might take this species (Cameron and Forney 2000; Carretta 2001, 2002; Carretta and Chivers 2003, 2004). Injury includes any entanglement that does not result in immediate death and may include serious injury resulting in death. n/a indicates that data are not available. Mean annual takes are based on 1999-2003 data unless noted otherwise.

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	1999	Observer data	20.0%	0	Mortality	Mortality
	2000		22.9%	0	0,0,0,0,0	0
	2001		20.4%	0		
	2002		20.0%	0	Injury	Injury
	2003		20.3%	0	0,0,0,0,0	0
CA angel shark/halibut and other species large mesh (>3.5") set gillnet fishery	1990-94		10-15%	0,0,0,0,0	0,0,0,0,0	
	1999	Observer data	23.1%[2]	0[2]	0[2]	
	2000		26.9%[2]	0[2]	0[2]	0[1]
	2001		0%	0[1]	0[1]	
	2002		0%	0[1]	0[1]	
	2003		0%	0[1]	0[1]	
Unidentified fisheries	1999-2003	Stranding& sightings	n/a	0 (6)	n/a	> 1.2
Total Annual Takes						> 1.2

[1] The CA set gillnets were not observed in 1995-98, and observations in 1999-2000 only included Monterey Bay; mortality for unobserved areas and times was extrapolated from effort estimates and 1991-94 entanglement rates. The fishery was not observed in 2001-2002, owing to area closures that reduced fishing effort to negligible levels.
[2] Observer coverage and observed mortality in 1999-2000 only includes the observed portion of the fishery in Monterey Bay. Observer coverage throughout the entire fishery was only 4.0% and 1.8%, respectively.

Ship Strikes

Ship strikes were implicated in the deaths of at least two humpback whales in 1993, one in 1995, and one in 2000 (J. Cordaro, NMFS unpubl. data). During 1999-2003, there were an additional 5 injuries and 2 mortalities 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 have obvious signs of trauma. Several humpback whales have been photographed in California with large gashes in their dorsal surface that appear to be from ship strikes (J. Calambokidis, pers. comm.). The average number of humpback whale deaths by ship strikes for 1999-2003 is at least 0.2 per year.

Other human-caused mortality

A humpback whale died and stranded near Moss Landing in 2000 with synthetic (possibly nylon) line wrapped around its flukes. The origin of this line (fishery or other anthropogenic source) is unknown. The average number of humpback deaths from unknown anthropogenic sources is 0.2 per year from 1999-2003.

STATUS OF STOCK

Humpback whales in the North Pacific were estimated to have been reduced to 13% of carrying capacity (K) by commercial whaling (Braham 1991). Clearly the North Pacific population was severely depleted. The initial abundance has never been estimated separately for the eastern North Pacific stock, but this stock was also depleted (probably twice) by whaling (Rice 1974; Clapham et al. 1997). Humpback whales are formally listed as "endangered" under the Endangered Species Act (ESA), and consequently the California/Mexico stock is automatically considered as a "depleted" and "strategic" stock under the MMPA. The estimated annual mortality and injury due to entanglement (1.2/yr), other anthropogenic sources (0.2/yr), plus ship strikes (0.2/yr) in California is less than the PBR allocation of 2.3 for U.S. waters. The three humpbacks that were entangled at sea may have been seriously injured. Based on strandings and gillnet observations, annual humpback whale mortality and serious injury in California's drift gillnet fishery is probably greater than 10% of the PBR; therefore, total fishery mortality may not be approaching zero mortality and serious injury rate. The eastern North Pacific stock appears to be increasing in abundance. The increasing levels of anthropogenic noise in the world's oceans, such as those produced by ATOC (Acoustic Thermometry of Ocean Climate) or LFA (Low Frequency Active) Sonar, have 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 03/15/2005

BLUE WHALE (*Balaenoptera musculus*): Eastern 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 now this ocean is thought to include more than one population (Ohsumi and Wada 1972; Braham 1991), possibly as many as five (Reeves et al. 1998). This report covers one population that feeds in California waters in summer/fall (from June to November) and migrates south to productive areas off Mexico (Calambokidis et al. 1990) and as far south as the Costa Rica Dome (10^{o} N) (Mate et al. 1999; Calambokidis, pers. comm.) in winter/spring. Blue whales are occasionally seen or heard off Oregon (McDonald et al. 1994, Stafford et al. 1998; VonSaunder and Barlow 1999), but sightings there are rare. Reilly and Thayer (1990) speculate that blue whales found near the Costa Rica Dome from June to November are likely to be part of a southern hemisphere population or an isolated resident population; however, based on acoustic call similarities, Stafford et al. (1999) linked these animals to the population that feeds off California at the same time of year. Rice (1974) hypothesized that blue whales from Baja California migrated far offshore to fed in the eastern Aleutians or Gulf of Alaska and returned to feed in California waters; however, he has more recently concluded that the California population is separate from the Gulf of Alaska population (Rice 1992). Recently, 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). One other stock of North Pacific blue whales (in Hawaiian waters) is recognized in the Marine Mammal Protection Act (MMPA) Stock Assessment Reports.

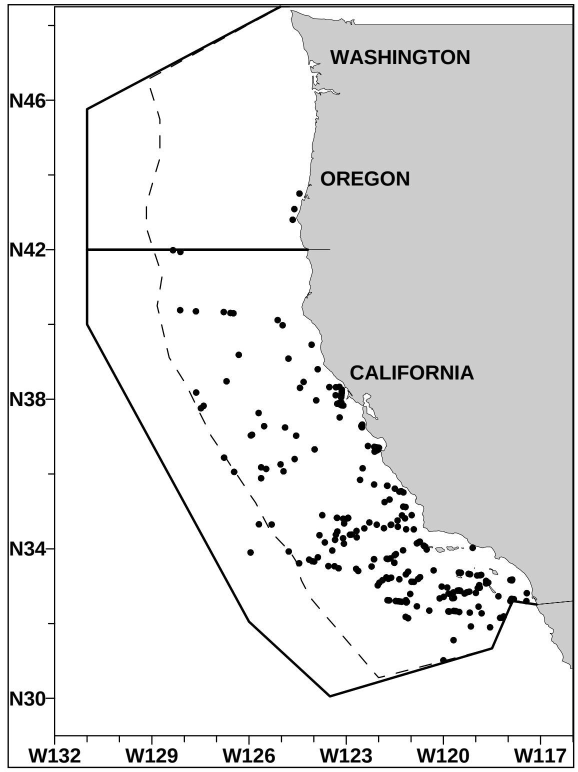

Figure 1. Blue whale sighting locations based on aerial and summer/autumn shipboard surveys off California, Oregon, and Washington, 1991-2001 (see Appendix 2 for data sources and information on timing and location of surveys). Dashed line represents the U.S. EEZ; bold line indicates the outer boundary of all surveys combined.

POPULATION SIZE

The size of the feeding stock of blue whales in California was estimated recently by both line-transect and mark-recapture methods. Barlow (2003) estimated 1,736 (CV=0.23) blue whales off California, Oregon, and Washington based on ship line-transect surveys in 1996 and 2002. Calambokidis et al. (2003) used photographic mark-recapture and estimated population sizes of 1,567 (CV=0.32) based on 2000-2002 photographs of left sides and 1,953 (CV=0.33) based on right sides. The average of the mark-recapture estimates (1,760 CV=0.32) is is very close to the line-transect estimate. Mark-recapture estimates are often negatively biased by individual heterogeneity in sighting probabilities (Hammond 1986); however, Calambokidis et al. 2003 minimize such effects by selecting one sample that was taken randomly with respect to distance from the coast. Similarly, the line-transect estimates may also be negatively biased because some blue whales in this stock are probably along Baja California and, therefore, out of the study area at the time of survey (Wade and Gerrodette 1993). The best estimate of blue whale abundance is the average of the line-transect and mark-recapture estimates, weighted by the inverse of their variances, or 1,744 (0.28).

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 combined mark-recapture and line-transect estimates, or approximately 1,384.

Current Population Trend

There is some indication that blue whales have increased in abundance in California coastal waters between 1979/80 and 1991 (regression $p<0.05$, Barlow 1994) and between 1991 and 1996 (not significant, Barlow 1997). Although this may be due to an increase in the stock as a whole, it could also be the result of an increased use of California as a feeding area. The size of the apparent increase abundance seen by Barlow (1994) is too large to be accounted for by population growth alone. Also, Larkman and Veit (1998) did not detect any increase along consistently surveyed tracklines in the Southern California Bight from 1987 to 1995. Although the population in the North Pacific is expected to have grown since being given protected status in 1966, the possibility of continued unauthorized takes after blue whales were protected (Yablokov 1994) and the existence of incidental ship strikes and gillnet mortality makes this uncertain. Estimates made by Calambokidis et al. (2003) and Barlow (2003) declined in 2000-2002 compared to previous years (Figure 2), but sample sizes were small and this apparent decline may not be real.

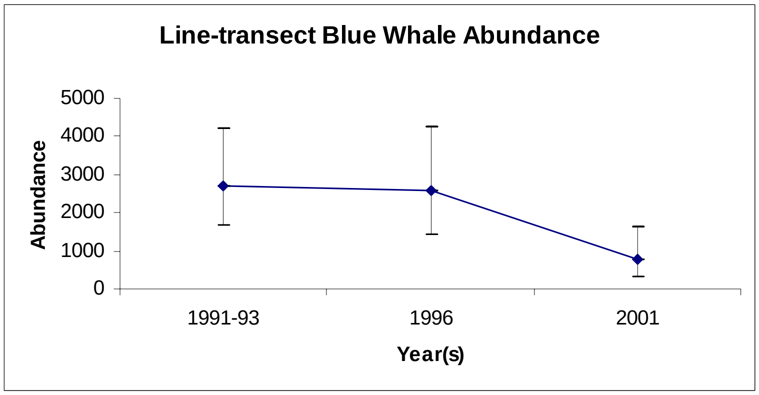

Figure 2. Estimates of abundance from vessel-based line transect surveys conducted in California waters, 1991-2001 (Barlow 2003).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No information exists on the rate of growth of blue whale populations in the Pacific (Best 1993).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (1,384) <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 an endangered species which has a minimum abundance less than 1,500), resulting in a PBR of 2.8. Because this stock spends approximately half its time outside the U.S. EEZ, the PBR allocation for U.S. waters is half this total, or 1.4 whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Historic Whaling

The reported take of North Pacific blue whales by commercial whalers totaled 9,500 between 1910 and 1965 (Ohsumi and Wada 1972). Approximately 2,000 were taken off the west coast of North America between 1919 and 1929 (Tonnessen and Johnsen 1982). Partially overlapping with this is Rice's (1992) report of at least 1,378 taken by factory ships off California and Baja California between 1913 and 1937. Between 1947 and 1987, reported takes of blue whales in the North Pacific were approximately 2,400. Shore-based whaling stations in central California took 3 blue whales between 1919 and 1926 (Clapham et al. 1997) and 48 blue whales between 1958 and 1965 (Rice 1974). Blue whales in the North Pacific were given protected status by the IWC in 1966.

Fisheries Information

The offshore drift gillnet fishery is the only fishery that is likely to take blue whales from this stock, but no fishery mortalities or serious injuries have been observed (Table 1). Detailed information on this fishery is provided in Appendix 1. After the 1997 implementation of a Take Reduction Plan, which included skipper education workshops and required the use of pingers and minimum 6-fathom extenders, overall cetacean entanglement rates in the drift gillnet fishery dropped considerably (Barlow and Cameron 1999). Mean annual takes for this fishery (Table 1) are based only on 1998-2002 data. This results in an average estimate of zero blue whales taken annually.

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 (blue and fin whales) usually swim through nets without entangling and with very little damage to the nets.

Drift gillnet fisheries for swordfish and sharks exist along the entire Pacific coast of Baja California, Mexico and may take animals from the same 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).

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 (Cameron and Forney 1999, 2000; Carretta 2001, 2002; Carretta and Chivers 2003). Mean annual takes are based on 1998-2002 data unless noted otherwise.

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	1998	Observer data	20.0%	0	0	0
	1999		20.0%	0	0	
	2000		22.9%	0	0	
	2001		20.4%	0	0	
	2002		20.0%	0	0	
Total Annual Takes						0

Ship Strikes

Ship strikes were implicated in the deaths of blue whales in 1980, 1986, 1987, 1993, and 2002 (J. Cordaro, Southwest Region, NMFS and J. Heyning, pers. comm.). During 1998-2002, there were an additional 5 injuries and 2 mortalities 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. Several blue whales have been photographed in California with large gashes in their dorsal surface that appear to be from ship strikes (J. Calambokidis, pers. comm.). The average number of blue whale mortalities in California attributed to ship strikes was 0.2 per year for 1998-2002.

STATUS OF STOCK

Previously, blue whales in the entire North Pacific were estimated to be at 33% (1,600 out of 4,900) of historic carrying capacity (Mizroch et al. 1984). The initial abundance has never been estimated separately for the "eastern" stock, but this stock was almost certainly depleted by whaling. Blue 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 MMPA. The annual incidental mortality from ship strikes is apparently less than the calculated PBR for this stock. 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. The population appears to be growing. The 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).

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Revised 12/15/2003

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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) cites evidence for additional fin whale subpopulations in the North Pacific. From whaling records, fin whales that were marked in winter 1962-70 off southern California were later taken in commercial whaling operations between central California and the Gulf of Alaska in summer (Mizroch et al. 1984). More recent observations show aggregations of fin whales year-round in southern/central California (Dohl et al. 1983; Barlow 1997; Forney et al. 1995), year-round in the Gulf of California (Tershy et al. 1993), in summer in Oregon (Green et al. 1992; McDonald 1994), and in summer/autumn in the Shelikof Strait/Gulf of Alaska (Brueggeman et al. 1990). Acoustic signals from fin whale are detected year-round off northern California, Oregon and Washington, with a concentration of vocal activity between September and February (Moore et al. 1998). Fin whales appear very scarce in the eastern tropical Pacific in summer (Wade and Gerrodette 1993) and winter (Lee 1993).

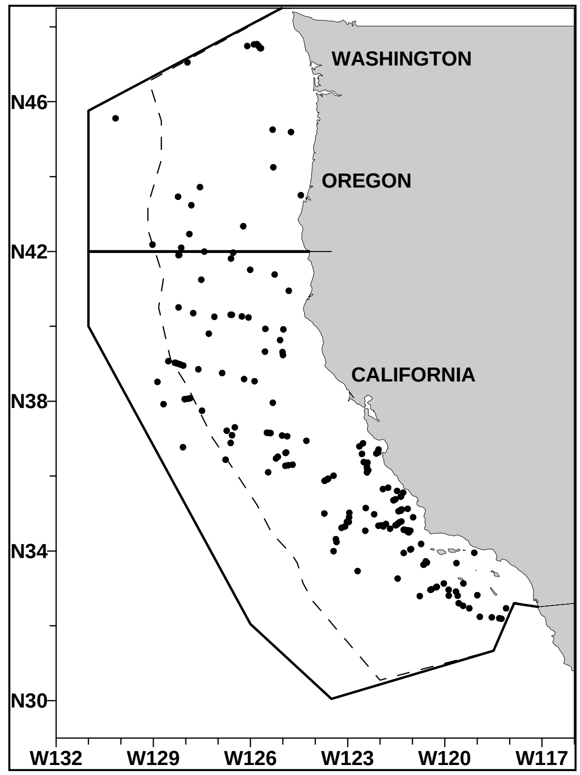

Figure 1. Fin whale sighting locations based on aerial and shipboard surveys off California, Oregon, and Washington, 1991-2001 (see Appendix 2 for data sources and information on timing and location of surveys). Dashed line represents the U.S. EEZ; bold line indicates the outer boundary of all surveys combined.

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. This assessment will cover the stock of fin whales which is 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. Genetic studies of the fin whales have shown that the population in the Gulf of California is isolated from fin whales in the rest of the eastern North Pacific and is an evolutionary unique population (Bérubé et al. 2002). 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 Alaska stock.

POPULATION SIZE

The initial 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. A minimum of 148 individually-identified fin whales are found in the Gulf of California (Tershy et al. 1990). Recently 3,279 (CV = 0.31) fin whales were estimated to be off California, Oregon and Washington based on ship surveys in summer/autumn of 1996 (Barlow and Taylor 2001) and

2001 (Barlow 2003). This is probably a slight underestimate because it almost certainly excludes some fin whales which could not be identified in the field and which 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 log-normal distribution of abundance estimated from 1996 and 2001 summer/fall ship surveys (Barlow and Taylor 2001; Barlow 2003) or approximately 2,541.

Current Population Trend

There is some indication that fin whales have increased in abundance in California coastal waters between 1979/80 and 1991 (Barlow 1994) and between 1991 and 1996 (Barlow 1997), but these trends are not significant. Although the population in the North Pacific is expected to have grown since receiving protected status in 1976, the possible effects of continued unauthorized take (Yablokov 1994) and incidental ship strikes and gillnet mortality make this uncertain.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

There are no estimates of the growth rate of fin 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 (2,541) 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, with $N_{min} > 1,500$ and $CV_{Nmin} < 0.50$), resulting in a PBR of 15.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Historic Whaling

Approximately 46,000 fin whales were taken from the North Pacific by commercial whalers between 1947 and 1987 (C. Allison, IWC, pers. comm.), including 1,060 fin whales taken by coastal whalers in central California between 1958 and 1965 (Rice 1974). In addition, approximately 3,800 were taken off the west coast of North America between 1919 and 1929 (Tonnessen and Johnsen 1982), and 177 were taken by coastal whalers off California between 1919 and 1926 (Clapham et al. 1997). Fin whales in the North Pacific were given protected status by the IWC in 1976.

Fisheries Information

The offshore drift gillnet fishery is the only fishery that is likely to take fin whales from this stock, and one fin whale death has been observed (Table 1). Detailed information on this fishery is provided in Appendix 1. After the 1997 implementation of a Take Reduction Plan, which included skipper education workshops and required the use of pingers and minimum 6-fathom extenders, overall cetacean entanglement rates in the drift gillnet fishery dropped considerably (Barlow and Cameron 2003). Mean annual takes for this fishery (Table 1) are based on 1997-2001 data. This results in an average estimate of 1.0 fin whales taken annually. 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 (blue and fin whales) usually swim through nets without entangling and with very little damage to the nets.

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).

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 (Cameron and Forney 1999, 2000; Carretta 2001, 2002).

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	1997 1998 1999 2000 2001	Observer data	23.0% 20.0% 20.0% 22.9% 20.4%	0 0 1 0 0	0 0 5 (09.4) 0 0	1 (0.94)
Total annual takes						1 (0.94)

Ship Strikes

Ship strikes were implicated in the deaths of one fin whale in 1997 and 2001 (J. Heyning and J. Cordaro, Southwest Region, NMFS, pers. comm.). During 1997-2001, there were an additional 4 injuries and 2 mortalities 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 0.4 fin whales per year for the period 1997-2001.

STATUS OF STOCK

Fin whales in the entire North Pacific were estimated to be at less than 38% (16,625 out of 43,500) of historic carrying capacity (Mizroch et al. 1984). The initial abundance has never been estimated separately for the "west coast" stock, but this stock was also probably depleted by whaling. Fin 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 total incidental mortality due to fisheries (1.0/yr) and ship strikes (0.4/yr) appears to be less than the calculated PBR (15). Total fishery mortality is less than 10% of PBR and, therefore, may be approaching zero mortality and serious injury rate. There is some indication that the population may be growing. The increasing levels of anthropogenic noise 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).

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Revised 12/15/2000

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 real justification for splitting stocks between the northern and southern hemispheres (Donovan 1991). Recent surveys (Lee 1993; Wade and Gerrodette 1993) have shown them to be common and distributed throughout the eastern tropical Pacific with a concentration around the equator east of 110°W (corresponding approximately to the IWC's "Peruvian stock") and a reduction west of 140°W. They are also the most common baleen whale in the central Gulf of California (Tershy et al. 1990). Only one was positively identified in surveys of California coastal waters (Barlow 1997). Bryde's whales in California are likely to belong to a larger population inhabiting at least the eastern part of the tropical Pacific. 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 150°W and including the Gulf of California and waters off California; this report), and 2) Hawaiian waters.

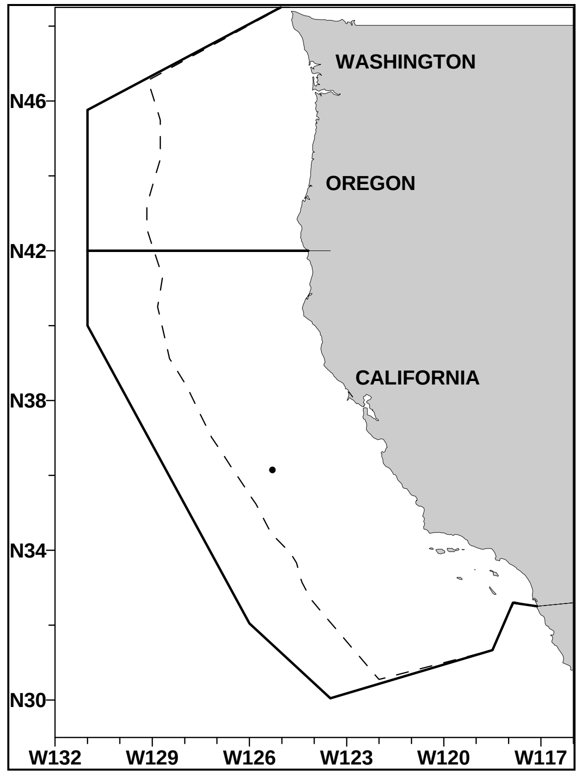

Figure 1. Sighting locations of Bryde's whales based on aerial and shipboard surveys off California, Oregon, and Washington, 1991-96 (see Appendix 2, Figures 1-5 for data sources and information on timing and location of surveys). Dashed line represents the U.S. EEZ; bold line indicates the outer boundary of all surveys combined.

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 recently as 13,000 (CV=0.20; 95% C.I.=8,900-19,900) (Wade and Gerrodette 1993), and the minimum number in the Gulf of California is 160 based on individually-identified whales (Tershy et al. 1990). Only one confirmed sighting of Bryde's whales and five possible sightings (identified as sei or Bryde's whales) were made in California waters during extensive ship and aerial surveys in 1991, 1992, 1993, and 1996 (Hill and Barlow 1992; Carretta and Forney 1993; Mangels and Gerrodette 1994; VonSaunder and Barlow 1999). Green et al. (1992) did not report any sightings of Bryde's whales in aerial surveys off Oregon and Washington. The estimated abundance of Bryde's whales in California, Oregon, and Washington coastal waters is 12 (CV=2.0) (Barlow 1997).

Minimum Population Estimate

The minimum population estimate for Bryde's whales is taken as the lower 20th percentile of the log-normal distribution of abundance estimated from the summer/fall ship surveys in 1986-90 (Wade and Gerrodette 1993) plus the minimum of 160 whales counted in the Gulf of California (Tershy et al. 1990), or 11,163.

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 the only relevant abundance estimate (Wade and Gerrodette 1993) is more than 8 years old. Additional data on the abundance of Bryde's whales in the eastern Pacific was gathered in 1998-99, but their abundance has not yet been estimated from those data.

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 (Julian 1997; Julian and Beeson 1998; Cameron and Forney 1999). n/a indicates that data are not available. Mean annual takes are based on 1994-98 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	1994-98	Observer data	12-23%	0,0,0,0,0	0,0,0,0,0	0[1]
Mexico thresher shark/swordfish drift gillnet fishery	1991-95	Observer data	n/a	n/a	n/a	n/a
Total annual takes						0

[1] Only 1997-98 mortality estimates are included in the average because of gear modifications implemented within the fishery as part of a 1997 Take Reduction Plan. Gear modifications included the use of net extenders and acoustic warning devices (pingers).

Fishery Information

The offshore drift gillnet fishery is the only fishery that is likely to take Bryde's whales from this stock, but no fishery mortalities or serious injuries have been observed (Table 1). Detailed information on this fishery is provided in Appendix 1. After the 1997 implementation of a Take Reduction Plan, which included skipper education workshops and required the use of pingers and minimum 6-fathom extenders, overall cetacean entanglement rates in the drift gillnet fishery dropped considerably (Barlow and Cameron 2003). Because of the changes in this fishery after implementation of the Take Reduction Plan, mean annual takes for this fishery (Table 1) are based only on 1997-98 data. This results in an average estimate of zero Bryde's whales taken annually. However, some gillnet mortality of large whales may go unobserved because whales swim away with a portion of the net.

Drift gillnet fisheries for swordfish and sharks exist along the entire Pacific coast of Baja California 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 2,700, 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. There are currently efforts underway to convert the Mexican swordfish driftnet fishery to a longline fishery (D. Holts, pers. comm.).

Ship Strikes

Ship strikes may occasionally kill Bryde's whales as they are known to kill their larger relatives: blue and fin whales. No ship strikes have been reported for this species in this area.

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 estimated to be zero; therefore, under the MMPA, total fishery mortality is approaching zero mortality and serious injury rate. The increasing levels of anthropogenic noise 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 12/15/2003

SEI WHALE (*Balaenoptera 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 45-55°N (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 now rare in California waters (Dohl et al. 1983; Barlow 1997; Forney et al. 1995; Mangels and Gerrodette 1994), 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 180°) will be considered as a separate stock.

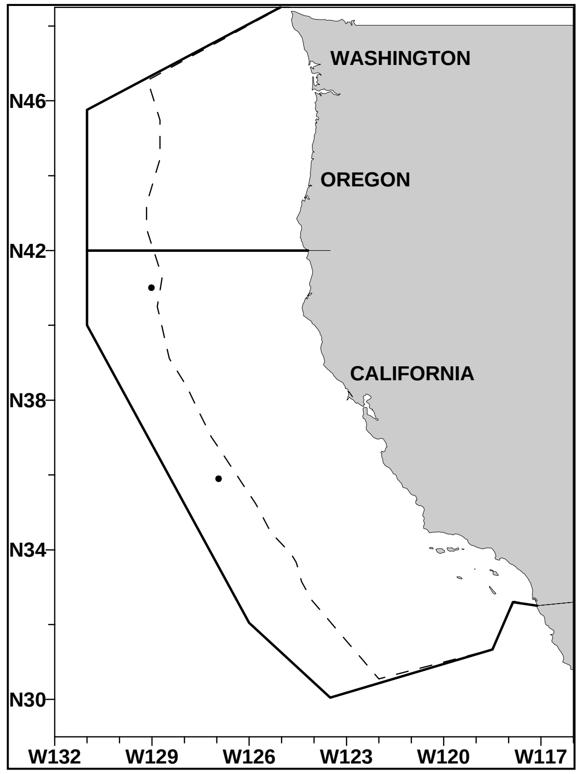

Figure 1. Sei whale sighting locations based on aerial and shipboard surveys off California, Oregon, and Washington, 1991-2001 (see Appendix 2 for data sources and information on timing and location of surveys). Dashed line represents the U.S. EEZ; bold line indicates the outer boundary of all surveys 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. Only two confirmed sightings of sei whales and 5 possible sightings (identified as sei or Bryde's whales) were made in California, Oregon, and Washington waters during extensive ship and aerial surveys in 1991, 1992, 1993, 1996, and 2001 (Hill and Barlow 1992; Carretta and Forney 1993; Mangels and Gerrodette 1994; VonSaunder and Barlow 1999; Barlow 2003). Green et al. (1992) did not report any sightings of sei whales in aerial surveys of Oregon and Washington. The abundance estimate for California, Oregon, and Washington waters out to 300 nmi, based on 1996 and 2001 shipboard surveys, is 56 (CV = 0.61) whales (Barlow 2003).

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 1996 and 2001 shipboard line-transect survey, or approximately 35.

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.

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 (35) 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 0.1

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Historic Whaling

The reported take of North Pacific sei whales by commercial whalers totaled 61,500 between 1947 and 1987 (C. Allison, IWC, pers. comm.). Of these, 384 were taken by-shore-based whaling stations in central California between 1958 and 1965 (Rice 1974). An additional 26 were taken off central and northern California between 1919 and 1926 (Clapham et al. 1997). There has been an IWC prohibition on taking sei whales since 1976, and commercial whaling in the U.S. has been prohibited since 1972.

Fishery Information

The offshore drift gillnet fishery is the only fishery that is likely to take sei whales from this stock, but no fishery mortalities or serious injuries have been observed (Table 1). Detailed information on this fishery is provided in Appendix 1. After the 1997 implementation of a Take Reduction Plan, which included skipper education workshops and required the use of pingers and minimum 6-fathom extenders, overall cetacean entanglement rates in the drift gillnet fishery dropped considerably (Barlow and Cameron 2003). Mean annual takes for this fishery (Table 1) are based on 1997-2001 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 (Cameron and Forney 1999, 2000; Carretta 2001, 2002). n/a indicates that data are not available. Mean annual takes are based on 1994-98 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	1997-2001	Observer data	20-23%	0,0,0,0,0	0,0,0,0,0	0
Total annual takes						0

Ship Strikes

Ship strikes may occasionally kill sei whales as they have been shown to kill their larger relatives: blue and fin whales. No ship strikes have been reported for this species in this area. During 1997-2001, there were 4 injuries and 2 mortalities of unidentified large whales attributed to ship strikes.

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). 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 estimated fishery mortality is zero and therefore is “approaching zero mortality and serious injury rate”. The increasing levels of anthropogenic noise 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).

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Revised 12/15/2003

MINKE WHALE (*Balaenoptera acutorostrata*): California/Oregon/Washington 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^{o}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). 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.

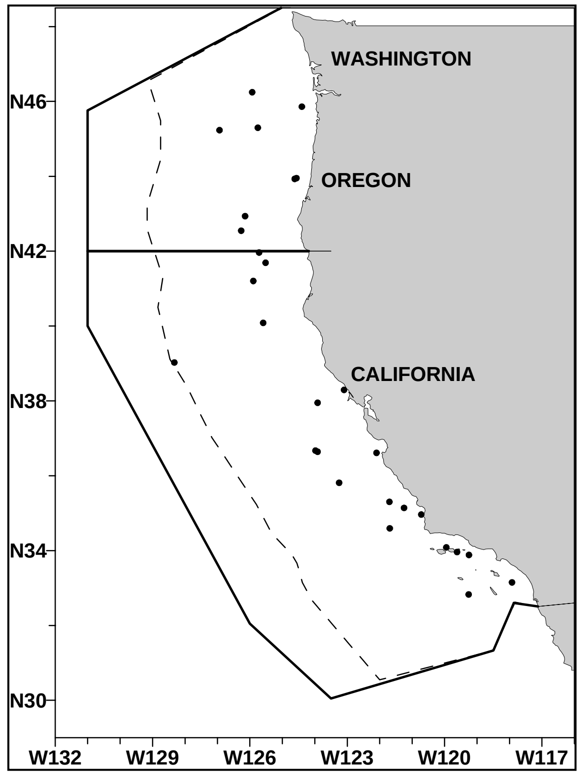

Figure 1. Minke whale sighting locations based on aerial and shipboard surveys off California, Oregon, and Washington, 1991-2001 (see Appendix 2 for data sources and information on timing and location of surveys). Dashed line represents the U.S. EEZ; bold line indicates the outer boundary of all surveys combined.

POPULATION SIZE

No estimates have been made for the number of minke whales in the entire North Pacific. The number of minke whales is estimated as 1,015 (CV = 0.73) based on ship surveys in 1996 and 2001 off California Oregon and Washington (Barlow 2003). Two minke whales were seen during 1996 aerial surveys in Washington and British Columbia inland waters (Calambokidis et al. 1997), but no abundance estimates are available for this area.

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 1996 and 2001 summer/fall ship surveys in California, Oregon, and Washington waters (Barlow 2003) or approximately 585.

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 (585) 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), resulting in a PBR of 5.8.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Historic Whaling

The estimated take of western North Pacific minke whales by commercial whalers was approximately 31,000 from 1930 to 1987 (C. Allison, IWC, pers. comm.). Minke whales were not harvested commercially in the eastern North Pacific: none were reported taken by shore-based whaling stations in central or northern California between 1919 and 1926 (Clapham et al. 1997) or between 1958 and 1965 (Rice 1974). Reported aboriginal takes of minke whales in Alaska totaled 7 between 1930 and 1987 (C. Allison, IWC, pers. comm.).

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 (Pierce et al. 1996; Cameron and Forney 1999, 2000; Carretta 2001, 2002). Mean annual takes are based on 1997-2001 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	1997 1998 1999 2000 2001	Observer data	23.0% 20.0% 20.0% 22.9% 20.4%	0 0 1 0 0	0 0 0 0 0	0
WA Puget Sound Region salmon drift gillnet fishery (areas 7 and 7A)	1997-2001	Self-reports	0%	0	0	n/a
CA angel shark/halibut and other species large mesh (>3.5") set gillnet fishery	1997 1998 1999 2000 2001	Extrapolated estimates & observer data	0% 0% 4.0%[1] 1.8%[1] 0%	0/0	0	n/a
Total annual takes						0

[1]In 1999/2000 approximately 25% of the Monterey Bay portion of this fishery was observed, accounting for less than 5% of all fishing effort.

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 and Oregon. A summary of known fishery mortality and injury for this stock of minke whales is given in Table 1. Detailed information on this fishery is provided in Appendix 1. After the 1997 implementation of a Take Reduction Plan, which included skipper education workshops and required the use of pingers and minimum 6-fathom extenders, overall cetacean entanglement rates in the drift gillnet fishery dropped considerably (Barlow and Cameron 2003). Mean annual takes for this fishery (Table 1) are based on 1997-2001 data. This results in an average estimate of zero minke whales taken annually. In 1999, a whale skin sample was retrieved from a large hole that had been punched through a drift gillnet (trip DN-SD-0941). The sample was later identified as a minke whale using genetic sequencing methods. Total fishery mortality for minke whales was not estimated for the 1980-86 California Department of Fish and Game observer program for the drift gillnet fishery, but based on the 2 observed deaths in 1% of the total sets, the total mortality during this time may have been on the order of 200 minke whales or 40 per year.

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). .

Ship Strikes

Ship strikes were implicated in the death of one minke whale in 1977 (J. Heyning and J. Cordaro, pers. comm.). The reported minke whale mortality due to ship strikes is zero for the period 1997-2001. 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

There were no known commercial whaling harvests of minke whales from Baja California to Washington. 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, the status of the west-coast stock should be considered "unknown". The annual mortality due to fisheries (0.0/yr) and ship strikes (0.0/yr) is less than the calculated PBR for this stock (5.8), so they are not considered a "strategic" stock under the MMPA. Fishery mortality is less than 10% of the PBR; therefore, total fishery mortality is approaching zero mortality and serious injury rate. There is no information on trends in the abundance of this stock. The increasing levels of anthropogenic noise 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 03/15/2005

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Rough-toothed dolphins are found throughout the world in tropical and warm-temperate waters (Miyazaki and Perrin 1994). They are present around all the main Hawaiian islands (Shallenberger 1981; Tomich 1986) and have been observed at least as far northwest as French Frigate Shoals (Nitta and Henderson 1993). Recent sighting locations of rough-toothed dolphins during a 2002 shipboard survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands are shown in Figure 1. Eight strandings have been reported from Maui, Oahu, and the island of Hawaii (Nitta 1991; Maldini 2005). Nothing is known about stock structure for this species in the North Pacific. Photographic identification studies around the main Hawaiian islands have not demonstrated any inter-island movement of this species (R.W. Baird, pers. comm.). For the Marine Mammal Protection Act (MMPA) stock assessment reports, there is a single Pacific management stock including only animals found within the U.S. EEZ of the Hawaiian Islands.

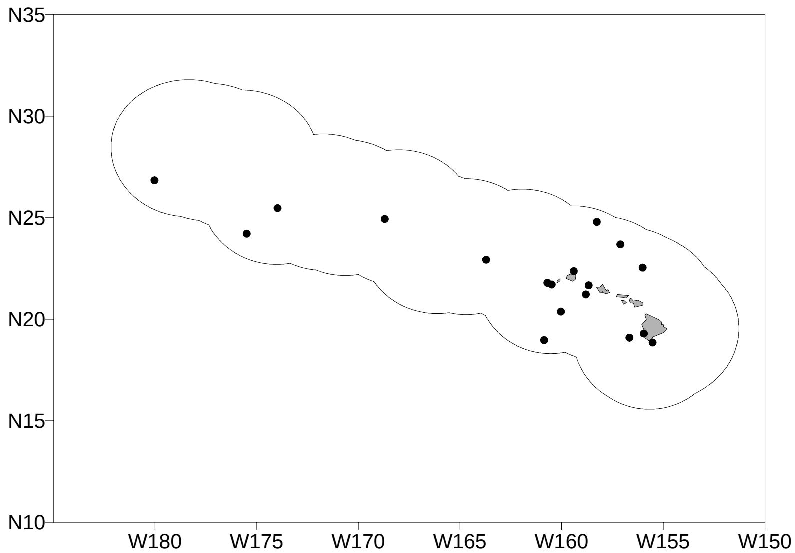

Figure 1. Rough-toothed dolphin sighting locations during the 2002 shipboard cetacean survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2003; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ.

POPULATION SIZE

A population estimate for this species has 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. 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 about 25 nmi of the main Hawaiian Islands in 1993, 1995 and 1998. An abundance estimate of 123 (CV=0.63) rough-toothed dolphins was calculated from the combined survey data (Mobley et al. 2000). This study underestimated the total number of rough-toothed dolphins within the U.S. EEZ off Hawaii, because areas around the Northwestern Hawaiian Islands (NWHI) and beyond 25 nautical miles from the main islands were not surveyed. Furthermore, the data on which this estimate was based are now over 5 years old. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 19,904 (CV=0.52) rough-toothed dolphins (Barlow 2003). This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate for Hawaiian Islands EEZ waters is 13,184 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

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (13,184) 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 132 rough-toothed dolphins per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

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. 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).

Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries, and some of these interactions involved rough-toothed dolphins (Nitta and Henderson 1993). None were observed hooked or entangled in the Hawaii-based longline fishery between 1994 and 2002, with approximately 4-25% of all effort observed (Forney 2004). Rough-toothed dolphins are known to take bait and catch from Hawaiian sport and commercial fisheries operating near the main islands and in a portion of the northwestern islands (Shallenberger 1981; Schlais 1984; Nitta and Henderson 1993), and they have been specifically reported to interact with the day handline fishery for tuna (palu-ahi) and the troll fishery for billfish and tuna (Schlais 1984; Nitta and Henderson 1993). Interaction rates between dolphins and the NWHI bottomfish fishery have been estimated based on studies conducted in 1990-1993, indicating that an average of 2.67 dolphin interactions, most likely involving bottlenose and rough-toothed dolphins, occurred for every 1000 fish brought on board (Kobayashi and Kawamoto 1995). Fishermen claim interactions with dolphins who steal bait and catch are increasing. It is not known whether these interactions result in serious injury or mortality of dolphins.

STATUS OF STOCK

The status of rough-toothed 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 species. They are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. Although information on rough-toothed dolphins in Hawaiian waters is limited, this stock would not be considered strategic under the 1994 amendments to the MMPA given the absence of reported fisheries related mortality or serious injury. However, there is no systematic monitoring of gillnet fisheries that may take this species, and the potential effects of interactions with the bottomfish fishery in the NWHI are not known. 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*): Hawaiian Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Risso's dolphins are found in tropical to warm-temperate waters worldwide (Kruse et al. 1999). Although they have been considered rare in Hawaiian waters (Shallenberger (1981), six sightings were made during a 2002 survey of the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands (Figure 1). There are five stranding records from the main islands (Nitta 1991; Maldini 2005). For the Marine Mammal Protection Act (MMPA) stock assessment reports, Risso's dolphins 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.

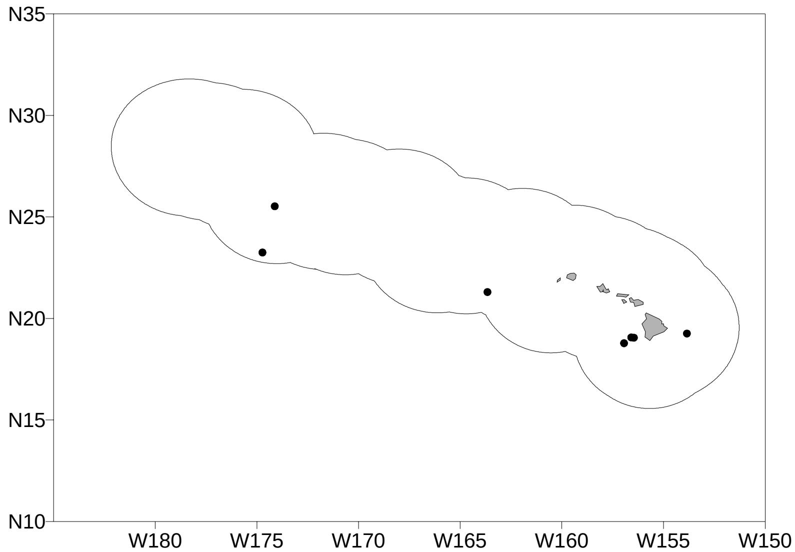

Figure 1. Risso's dolphin sighting locations during the 2002 shipboard cetacean survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2003; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ.

POPULATION SIZE

Population estimates have been made off Japan (Miyashita 1993) and 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. 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 about 25 nmi of the main Hawaiian Islands in 1993, 1995 and 1998 (Mobley et al. 2000). Only one sighting of a single Risso's dolphin was made, and no abundance estimate was calculated. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 2,351 (CV=0.65) Risso's dolphins (Barlow 2003). This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate is 1,426 Risso's 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 for Hawaiian animals.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (1,426) <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 known fishery mortality or serious injury within the U.S. EEZ of the Hawaiian Islands; Wade and Angliss 1997), resulting in a PBR of 14 Risso's dolphins per year.

HUMAN CAUSED MORTALITY AND SERIOUS INJURY

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. 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).

Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nitta and Henderson 1993), and some of these interactions involved Risso's dolphins. Between 1994 and 2002, seven Risso's dolphins were observed hooked or entangled in the Hawaii-based longline fishery outside of U.S. EEZ waters, with approximately 4-25% of all effort observed (Table 1; Figure 2; Forney 2004). During the 905 observed trips with 11,014 sets, the average interaction rate of Risso's dolphins was one animal per 129 fishing trips, or one animal per 1,573 sets. All Risso's dolphins caught were considered seriously injured (Forney 2004), based on an evaluation of the observer's description of the interaction and following established guidelines for assessing serious injury in marine mammals (Angliss and Demaster 1998). Average 5-yr estimates of annual mortality and serious injury for 1998-2002 are 8.2 (CV = 0.66) Risso's dolphins outside of U.S. EEZs, and none within the Hawaiian Islands EEZ. Several additional unidentified cetaceans, which may have been Risso's dolphins, were also taken in this fishery (Figure 2, Forney 2004) in international waters and U.S. EEZ waters of Palmyra Island. In 2001, regulations in the Hawaii-based longline fishery prohibited swordfish style fishing methods north of the equator in an effort to reduce sea turtle mortality (NMFS 2001); however, a portion of the Hawaii-based fleet subsequently moved to California and continued to fish in international waters of the North Pacific, in roughly the same areas as previously. No Risso's dolphins were observed taken in the California-based longline fishery during 2001 and 2002, with roughly 5.5% observer coverage (Forney 2004). Preliminary data for 2003 indicate one Risso's dolphin was hooked and released alive in international waters (NMFS/SWR, unpublished data). Since 2001, the Hawaii-based longline fishery has undergone further regulatory changes, but potential impacts of these changes on the rate of Risso's dolphin takes are unknown.

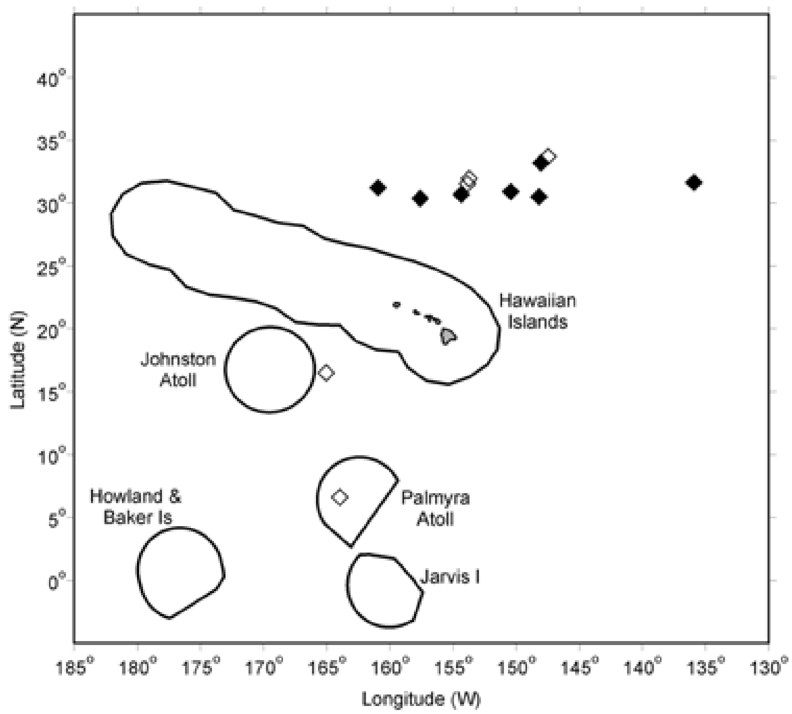

Figure 2. Locations of Risso's dolphin takes (filled diamonds) and possible takes of this species (open diamonds) in the Hawaii-based longline fishery, 1994-2002. Solid lines represent the U.S. EEZs. Set locations in this fishery are summarized in Appendix 1.

Table 1. Summary of available information on incidental mortality and serious injury of Risso's dolphin (Hawaii stock) in commercial fisheries, within and outside of U.S. EEZs (Forney 2004). Mean annual takes are based on 1998-2002 data unless otherwise indicated; n/a = not available.

Fishery Name	Year	Data Type	Percent Observer Coverage	Mortality and Serious Injury outside of U.S. EEZ			Mortality and Serious Injury within Hawaiian Islands EEZ		
				Observed	Estimated (CV)	Mean Annual Takes (CV)	Observed	Estimated (CV)	Mean Annual Takes (CV)
Hawaii-based longline fishery	1998	observer data	4.6%	0	0 (-)	8.2 (0.66)	0	0 (-)	0 (-)
	1999		3.5%	1	29 (1.0)		0	0 (-)	
	2000		11.8%	1	8 (1.0)		0	0 (-)	
	2001		22.7%	1	4 (1.0)		0	0 (-)	
	2002		24.9%	0	0 (-)		0	0 (-)	

Fishery Name	Year	Data Type	Percent Observer Coverage	Mortality and Serious Injury outside of U.S. EEZ			Mortality and Serious Injury within Hawaiian Islands EEZ		
				Observed	Estimated (CV)	Mean Annual Takes (CV)	Observed	Estimated (CV)	Mean Annual Takes (CV)
California-based longline fishery	2001	observer data	5.5% (2001-02)	0	0 (-)	0[1]			
	2002			0	0 (-)				
	2003	observer data	n/a	1	n/a				
Minimum total annual takes within U.S. EEZ waters									0 (-)

[1]Mean annual takes for the California-based longline fishery are based on 2001-2002.

Interaction rates between dolphins and the NWHI bottomfish fishery have been estimated based on studies conducted in 1990-1993, indicating that an average of 2.67 dolphin interactions, most likely involving bottlenose and rough-toothed dolphins, occurred for every 1000 fish brought on board (Kobayashi and Kawamoto 1995). Fishermen claim interactions with dolphins who steal bait and catch are increasing. It is not known whether these interactions result in serious injury or mortality of dolphins, nor whether Risso's dolphins are involved.

STATUS OF STOCK

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 species. They are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The Hawaiian stock of Risso's dolphin is not considered strategic under the 1994 amendments to the MMPA given the absence of reported fisheries related mortality within the U.S. EEZs. The potential effect of injuries sustained by Risso's dolphins in U.S. pelagic longline fisheries in international waters is not known. Insufficient information is available to determine whether the total fishery mortality and serious injury for Risso's dolphins is insignificant and approaching zero mortality and serious injury rate.

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Revised 03/15/2005

BOTTLENOSE DOLPHIN (*Tursiops truncatus*): Hawaiian Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bottlenose dolphins are widely distributed throughout the world in tropical and warm-temperate waters. The species is primarily coastal in much of its range, but there are populations in some offshore deepwater areas as well. Separate offshore and coastal forms have been identified along continental coasts in several areas (Ross and Cockcroft 1990; Van Waerebeek et al. 1990), and similar onshore-offshore forms may exist in Hawaiian waters.

Bottlenose dolphins are common throughout the Hawaiian Islands, from the island of Hawaii to Kure Atoll (Shallenberger 1981). Twelve strandings have been reported within the main Hawaiian Islands (Nitta 1991, Maldini 2005). Recent sighting locations based on a 2002 shipboard survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands are shown in Figure 1. In the Hawaiian Islands, they are found in shallow inshore waters and deep water, but relative to survey effort, occur primarily inshore of 500 m (Baird et al. 2003). Off the islands of Kauai and Ni'ihau, they are found out to at least 900 m depth. Despite extensive survey effort in waters deeper than 1500 m around the main islands, there are no sightings of bottlenose dolphins (Baird et al. 2003).

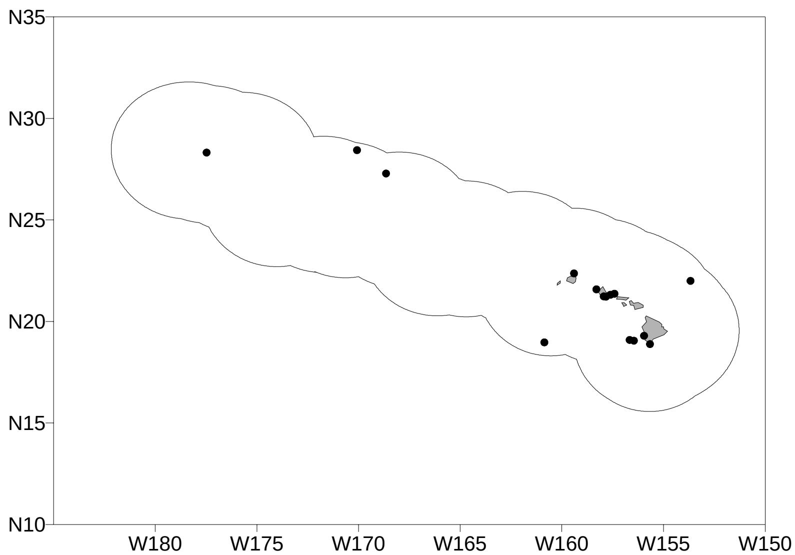

Figure 1. Bottlenose dolphin sighting locations during the 2002 shipboard cetacean survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2003; see Appendix 2 for details on timin and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ.

Photographic identification surveys have shown that there is no movement of animals between the island groups of 1) Hawaii, 2) Maui, Molokai, Lanai and Kahoolawe, 3) Oahu and 4) Kauai and Niihau (Baird et al. 2003). There is also a bimodal depth distribution in sightings off Kauai and Niihau, suggesting separate shallow and deep water populations. In their analysis of sightings of bottlenose dolphins in the eastern tropical Pacific (ETP), Scott and Chivers (1990) noted that there was 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. An analysis of genetic samples collected around the Hawaiian islands is ongoing and this analysis will provide additional information on stock structure around the islands (NMFS, unpublished data). For the Marine Mammal Protection Act (MMPA) stock assessment reports, bottlenose dolphins within the Pacific U.S. EEZ are divided into three stocks: 1) Hawaiian Stock (this report), 2) California, Oregon and Washington offshore stock, and 3) California coastal stock.

POPULATION SIZE

Population estimates have been made in Japanese waters (Miyashita 1993) and 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. Photographic mark-recapture studies off Maui and Lanai estimated 134 (95% C.I. 107- 180) bottlenose dolphins inhabiting that area (Baird et al. 2002). More recently, a minimum of 219 distinct bottlenose dolphins were identified around all the main Hawaiian Islands (Baird et al. 2003). 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 about 25 nmi of the main Hawaiian Islands in 1993, 1995 and 1998. An abundance estimate of 743 (CV=0.56) bottlenose dolphins was calculated from the combined survey data (Mobley et al. 2000). This abundance underestimates the total number of bottlenose dolphins within the U.S. EEZ off Hawaii, because areas around the Northwestern Hawaiian Islands (NWHI) and beyond 25 nautical miles from the main islands were not surveyed. Furthermore, the data on which this estimate was based are now over 5 years old. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 3,263 (CV=0.60) bottlenose dolphins (Barlow 2003). This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate is 2,046 bottlenose 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 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 (2,046) <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 20 bottlenose dolphins per year.

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 Hawaiian 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). In Hawaii, some mortality of bottlenose dolphins has been observed in inshore gillnets (including an entangled dolphin that stranded in 1998; NMFS/PIR, unpublished data), but no estimate of annual human-caused mortality and serious injury is available, because these fisheries are not observed or monitored.

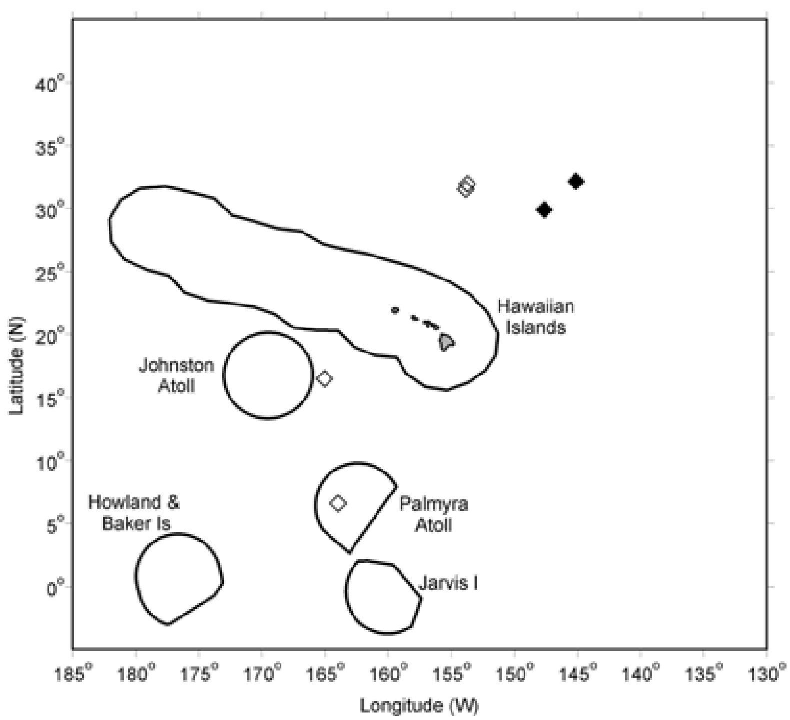

Figure 2. Locations of bottlenose dolphin takes (filled diamonds) in the Hawaii-based longline fishery, 1994-2002. Solid lines represent the U.S. EEZ. Set locations in this fishery are summarized in Appendix 1.

Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries, and some of these interactions involved bottlenose dolphins (Nitta and Henderson 1993). Between 1994 and 2002 two bottlenose dolphins were observed hooked or entangled in the Hawaii-based longline fishery outside of U.S. EEZ waters, with approximately 4-25% of all effort observed (Table 1; Forney 2004). During the 905 observed trips with 11,014 sets, the average interaction rate of bottlenose dolphins was one animal per 905 fishing trips, or one animal per 11,014 sets. Both animals caught were considered seriously injured (Forney 2004), based on an evaluation of the observer's description of the interaction and following established guidelines for assessing serious injury in marine mammals (Angliss and Demaster 1998). Average 5-yr estimates of annual mortality and serious injury for 1998-2002 are 5.8 (CV = 1.00) bottlenose dolphins outside of U.S. EEZs, and none within U.S. EEZs. Several additional unidentified cetaceans, which may have been bottlenose dolphins, were also taken in this fishery (Figure 2, Forney 2004). Since 2001, the Hawaii-based longline fishery has undergone a series of regulatory changes, primarily to protect sea turtles (NMFS 2001). Potential impacts of these regulatory changes on the rate of bottlenose dolphin takes are unknown.

Table 1. Summary of available information on incidental mortality and serious injury of bottlenose dolphins (Hawaii stock) in commercial and gillnet fisheries, within and outside of the U.S. EEZs (Forney 2004; NMFS/PIR unpublished data). Mean annual takes are based on 1998-2002 data unless otherwise indicated; n/a = not available.

Fishery Name	Year	Data Type	Percent Observer Coverage	Mortality and Serious Injury outside of U.S. EEZs			Mortality and Serious Injury within Hawaiian Islands EEZ		
				Observed	Estimated (CV)	Mean Annual Takes (CV)	Observed	Estimated (CV)	Mean Annual Takes (CV)
Hawaii-based longline fishery	1998	1998-2002 observer data	4.6%	0	0 (-)	5.8 (1.0)	0	0 (-)	0 (-)
	1999		3.5%	1	29 (1.0)		0	0 (-)	
	2000		11.8%	0	0 (-)		0	0 (-)	
	2001		22.7%	0	0 (-)		0	0 (-)	
	2002		24.9%	0	0 (-)		0	0 (-)	
Unidentified gillnet fishery	1998	strandings					1	n/a	$0.2 (n/a)
Minimum total annual takes within U.S. EEZ waters									$0.2 (n/a)

Bottlenose dolphins are one of the species commonly reported to take bait and catch from several Hawaiian sport and commercial fisheries (Nitta and Henderson 1993; Schlais 1984). Observations of bottlenose dolphins taking bait or catch have also been made in the day handline fishery (palu-ahi) for tuna, 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 on several banks of the Northwestern Hawaiian Islands. Fishermen claim interactions with dolphins who steal bait and catch are increasing. Interaction rates between dolphins and the NWHI bottomfish fishery have been estimated based on studies conducted in 1990-1993, indicating that an average of 2.67 dolphin interactions, most likely involving bottlenose and rough-toothed dolphins, occurred for every 1000 fish brought on board (Kobayashi and Kawamoto 1995). It is not known whether these interactions result in serious injury or mortality of dolphins. Beginning in the early 1970s the National Marine Fisheries Service received reports of fishermen shooting at bottlenose dolphins to deter them from taking fish catches (Nitta and Henderson 1993). Nitta and Henderson (1993) also reported that one bottlenose dolphin calf was removed from small-mesh set gillnet off Maui in 1991 and expressed surprise that bottlenose dolphins are "rarely reported entangled or raiding set gill nets in Hawaii," considering that they so often remove fish from fishing lines.

STATUS OF STOCK

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 species. They are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The Hawaiian stock of bottlenose dolphins is not considered strategic under the 1994 amendments to the MMPA, because 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 (20). However, there is no systematic monitoring of gillnet fisheries that may take this species, and the potential effects of interactions with the Hawaii-based longline fishery in international waters or the bottomfish fishery in the NWHI are not known. 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.

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PANTROPICAL SPOTTED DOLPHIN
(*Stenella attenuata*): Hawaiian Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Pantropical spotted dolphins are primarily found in tropical and subtropical waters worldwide (Perrin and Hohn 1994). 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 and Hohn 1994). These dolphins are common and abundant throughout the Hawaiian archipelago, particularly in channels between islands, over offshore banks (e.g. Penguin Banks), and off the lee shores of the islands (see Shallenberger 1981). Recent sighting locations from a 2002 shipboard survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands are shown in Figure 1 (Barlow 2003). Twelve strandings of this species have been documented in Hawaii (Nitta 1991, Maldini 2005). Morphological differences and distribution patterns have been used to establish that the spotted dolphins around Hawaii 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.

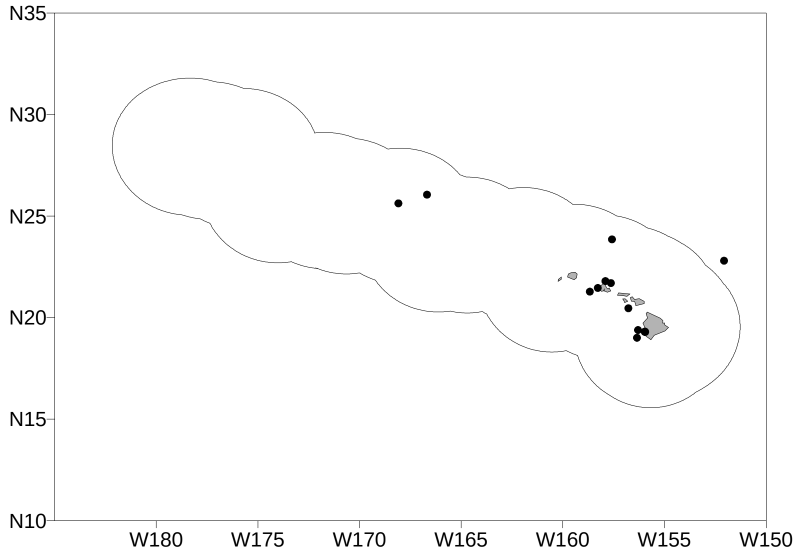

Figure 1. Pantropical spotted dolphin sighting locations during the 2002 shipboard survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2003; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ.

Fishery interactions with pantropical spotted dolphins demonstrate that this species also occurs in U.S. EEZ waters around Palmyra Island (Figure 2), but it is not known whether these animals are part of the Hawaiian stock or a separate stock of pantropical spotted dolphins. Based on patterns of movement and population structure observed in other island-associated cetaceans (Norris and Dohl 1980; Norris et al.1994; Baird et al. 2001, 2003; S. Chivers, pers. comm.), the animals around Palmyra Island may represent a separate stock. Efforts are currently underway to obtain additional tissue samples of pantropical spotted dolphins for further studies of population structure in the North Pacific Ocean. There are at least 113 genetic samples available from Hawaiian waters for stock structure analyses (R.W. Baird, pers. comm.). For the Marine Mammal Protection Act (MMPA) stock assessment reports, there is a single Pacific management stock including only animals found within the U.S. EEZ of the Hawaiian Islands. Spotted dolphins involved in eastern tropical Pacific tuna purse-seine fisheries are managed separately under the MMPA. Information on pantropical spotted dolphins around Palmyra Island will provisionally be included with this stock assessment report, recognizing that separate stock status may be warranted for these animals in the future. Estimates of abundance, potential biological removals, and status determinations will be presented separately for U.S. EEZ waters of the Hawaiian Islands and Palmyra Island.

POPULATION SIZE

Population estimates are available for Japanese waters (Miyashita 1993) and the eastern tropical Pacific (Wade and Gerrodette 1993). 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 about 25 nmi of the main Hawaiian Islands in 1993, 1995 and 1998. An abundance estimate of 2,928 (CV=0.45) pantropical spotted dolphins was calculated from the combined survey data (Mobley et al. 2000). This abundance underestimates the total number of pantropical spotted dolphins within the U.S. EEZ off Hawaii, because areas around the Northwestern

Hawaiian Islands (NWHI) and beyond 25 nautical miles from the main islands were not surveyed. Furthermore, the data on which this estimate was based are now over 5 years old. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 10,260 (CV=0.41) pantropical spotted dolphins (Barlow 2003). This is currently the best available abundance estimate for pantropical spotted dolphins within the Hawaiian Islands EEZ.

No abundance estimates are currently available for pantropical spotted dolphins in U.S. EEZ waters of Palmyra Island; however, density estimates for pantropical spotted dolphins in other Pacific regions can provide a range of likely abundance estimates in this unsurveyed region. Published estimates of pantropical spotted dolphins (animals per km^2) in the Pacific are: 0.0046 (CV=0.41) for the U.S. EEZ of the Hawaiian Islands (Barlow 2003); 0.0407 (CV=0.45) for nearshore waters surrounding the main Hawaiian Islands (Mobley et al. 2000), 0.0678 (CV=0.15) and 0.1064 (CV=0.09) for the eastern tropical Pacific Ocean (Wade and Gerrodette 1993; Ferguson and Barlow 2003), and 0.0731 (CV=0.33) for the eastern tropical Pacific Ocean west of 120°W and north of 5°N (Ferguson and Barlow 2003). Applying the lowest and highest of these density estimates to U.S. EEZ waters surrounding Palmyra Island (area size = 347,216 km^2) yields a range of plausible abundance estimates of 1,590 - 36,928 pantropical spotted dolphins.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate for the Hawaiian Islands EEZ (Barlow 2003) is 7,362 pantropical spotted dolphins. No minimum population estimate is currently available for waters surrounding Palmyra Island, but the pantropical spotted dolphin density estimates from other 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 20^{th} percentiles of plausible abundance estimates for the Palmyra Island EEZ, based on the densities observed elsewhere, range from 1,141 - 34,238 pantropical 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 Hawaiian pantropical spotted dolphin stock is calculated as the minimum population size (7,362) 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 U.S. EEZ of the Hawaiian Islands; Wade and Angliss 1997), resulting in a PBR of 59 pantropical spotted dolphins per year. No separate PBR can presently be calculated for pantropical spotted dolphins within the Palmyra Island EEZ, but based on the range of plausible minimum abundance estimates (1,141 - 34,238), 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 Palmyra Islands EEZ; Wade and Angliss 1997), and the default growth rate (½ of 4%), the PBR would likely fall between 9.1 and 274 pantropical spotted dolphins per year.

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 Hawaiian 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. 1994a). Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nitta and Henderson 1993). Between 1994 and 2002 one pantropical spotted dolphin was observed entangled and killed in the Hawaii-based longline fishery within U.S. EEZ waters, with approximately 4-25% of all effort observed (Table 1; Forney 2004). During the 905 observed trips with 11,014 sets, the average take rate of pantropical spotted dolphins was one animal per 905 fishing trips, or one animal per 11,014 sets. Average 5-yr estimates of annual mortality and serious injury for pantropical spotted dolphins during 1998-2002 are zero outside of the U.S. EEZs, and 0.8 (CV=1.0) within the U.S. EEZ of Palmyra Island. No pantropical spotted dolphins were observed taken within the Hawaiian Islands EEZ during 1998-2002. One unidentified cetacean, which may have been a pantropical spotted dolphin, was also taken in this fishery within the EEZ of Palmyra Island (Figure 2, Forney 2004). Since 2001, the Hawaii-based longline fishery has undergone a series of regulatory changes, primarily to protect sea turtles (NMFS 2001). Potential impacts of these regulatory changes on the rate of pantropical spotted dolphin takes are unknown. Interaction rates between dolphins and the NWHI bottomfish fishery have been estimated based on studies conducted in 1990-1993, indicating that an average of 2.67 dolphin interactions, most likely involving bottlenose and rough-toothed dolphins, occurred for every 1000 fish brought on board (Kobayashi and Kawamoto 1995). Fishermen claim interactions with dolphins who steal bait and catch are increasing. It is not known whether these interactions result in serious injury or mortality of dolphins, nor whether pantropical spotted dolphins are involved.

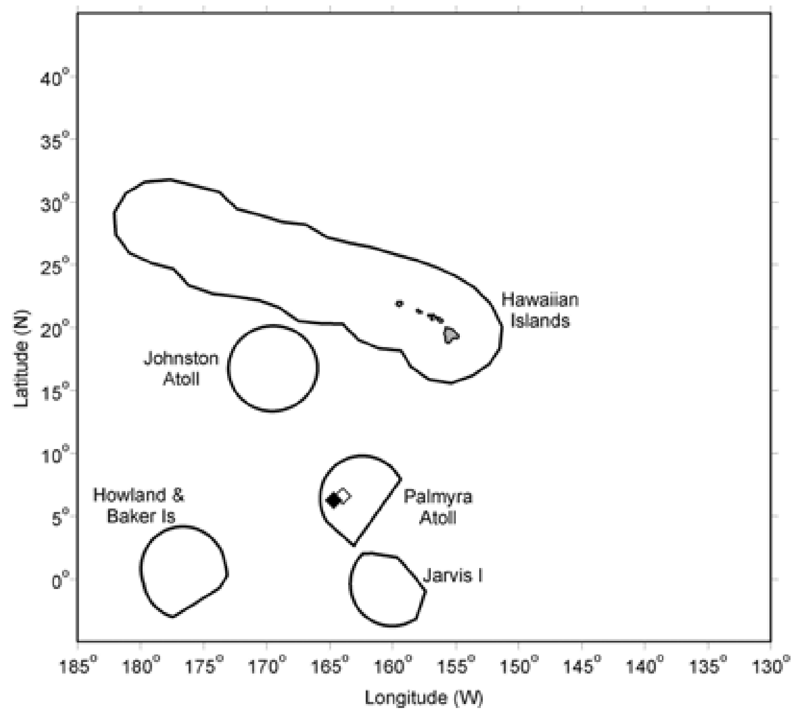

Figure 2. Locations of observed pantropical spotted dolphin take (filled diamond) and a possible take (open diamond) in the Hawaiian longline fishery, 1994-2002. Solid lines represent the U.S. EEZ. Set locations in this fishery are summarized in Appendix 1.

STATUS OF STOCK

The status of pantropical spotted 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 species. They are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The Hawaiian stock of pantropical spotted dolphins is not considered strategic under the 1994 amendments to the MMPA, because the estimated rate of fisheries related mortality or serious injury within the Palmyra Island EEZ (0.8 animals per year) is less than the range of likely PBRs (9.1 – 274) for this region. Insufficient information is available to determine whether the total fishery mortality and serious injury for pantropical spotted dolphins is insignificant and approaching zero mortality and serious injury rate.

Table 1. Summary of available information on incidental mortality and serious injury of pantropical spotted dolphins (Hawaiian stock) in commercial fisheries, within and outside of the U.S. EEZs (Forney 2004). Mean annual takes are based on 1998-2002 data unless otherwise indicated.

Fishery Name	Year	Data Type	Percent Observer Coverage	Observed and estimated mortality and serious injury of pantropical spotted dolphins, by EEZ region								
				Outside of U.S. EEZs			Hawaiian Islands EEZ			Palmyra Island EEZ		
				Obs.	Estimated (CV)	Mean Annual Takes (CV)	Obs.	Estimated (CV)	Mean Annual Takes (CV)	Obs.	Estimated (CV)	Mean Annual Takes (CV)
Hawaii-based longline fishery	1998 1999 2000 2001 2002	observer data	4.6% 3.5% 11.8% 22.7% 24.9%	0 0 0 0 0	0 0 0 0 0	0 (-) 0 (-) 0 (-) 0 (-) 0 (-)	0 0 0 0 0	0 (-) 0 (-) 0 (-) 0 (-) 0 (-)	0 (-)	0 0 0 1 0	0 (-) 0 (-) 0 (-) 4 (1.0) 0 (-)	0.8 (1.0)
Minimum total annual takes within U.S. EEZ waters							0.8 (1.0)					

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SPINNER DOLPHIN (*Stenella longirostris*): Hawaiian Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Spinner dolphins are found throughout the world in tropical and warm-temperate waters (Perrin and Gilpatrick 1994). They are common and abundant throughout the entire Hawaiian archipelago (Shallenberger 1981; Norris and Dohl 1980; Norris et al. 1994), and 26 strandings have been reported (Maldini 2005). Recent sighting locations from a 2002 shipboard survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the main Hawaiian Islands (Barlow 2003) are shown in Figure 1. There is some suggestion from an intensive study of spinner dolphins off the Kona Coast of Hawaii that the waters surrounding this island may have a large, relatively stable "resident" population (Norris et al. 1994). Currently, it is not known whether spinner dolphins regularly move between islands or island groups, or whether separate populations may exist.

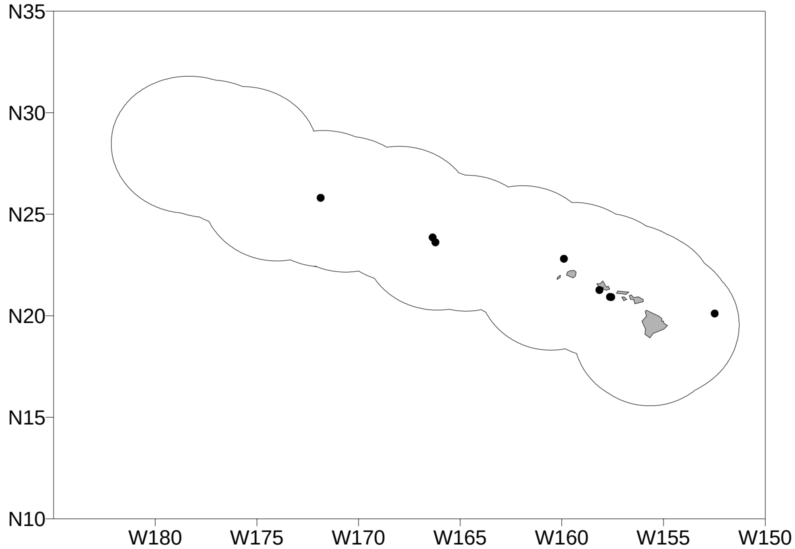

Figure 1. Spinner dolphin sighting locations during the 2002 shipboard cetacean survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2003; see Appendix 2 for details on timing and location of survey effort). Outer line indicates approximate boundary of survey area and U.S. EEZ.

Hawaiian spinner dolphins belong to a stock that is separate from those involved in the tuna purse-seine fishery 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). For the Marine Mammal Protection Act (MMPA) stock assessment reports, there is a single Pacific management stock including only animals found within the U.S. EEZ of the Hawaiian Islands. Spinner dolphins involved in eastern tropical Pacific tuna purse-seine fisheries are managed separately under the MMPA.

POPULATION SIZE

Although spinner dolphins are clearly among the most abundant cetaceans in Hawaiian waters, previously available population estimates apply only to the west coast of Hawaii. Norris et al. (1994) photo-identified 192 individuals along the west coast of Hawaii and estimated 960 animals for this area in 1979-1980. Östman (1994) photoidentified 677 individual spinner dolphins in the same area from 1989 to 1992. Using the same estimation procedures as Norris et al. (1994), Östman (1994) estimated a population size of 2,334 for his study area along the Kona coast of Hawaii. 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 about 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). This study underestimated the total number of spinner dolphins within the U.S. EEZ off Hawaii, because areas around the Northwestern Hawaiian Islands (NWHI) and beyond 25 nautical miles from the main islands were not surveyed. Furthermore, the data on which this estimate was based are now over 5 years old. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 2,805 (CV=0.66) spinner dolphins (Barlow 2003). This is currently the best available abundance estimate for this stock, but it may be negatively biased because relatively little survey effort occurred in nearshore areas where these dolphins are abundant. Nearshore aerial surveys are currently being conducted for this species.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate is 1,690 spinner dolphins.

Current Population Trend

No data on current population trend are available.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No information on current or maximum net productivity rate is currently available for the Hawaiian stock.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (1,690) 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 17 spinner dolphins per year.

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 Hawaiian 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). In Hawaii, some entanglements of spinner dolphins have been observed (Nitta and Henderson 1993; NMFS/PIR, unpublished data), but no estimate of annual human-caused mortality and serious injury is available, because the nearshore gillnet fisheries are not observed or monitored.

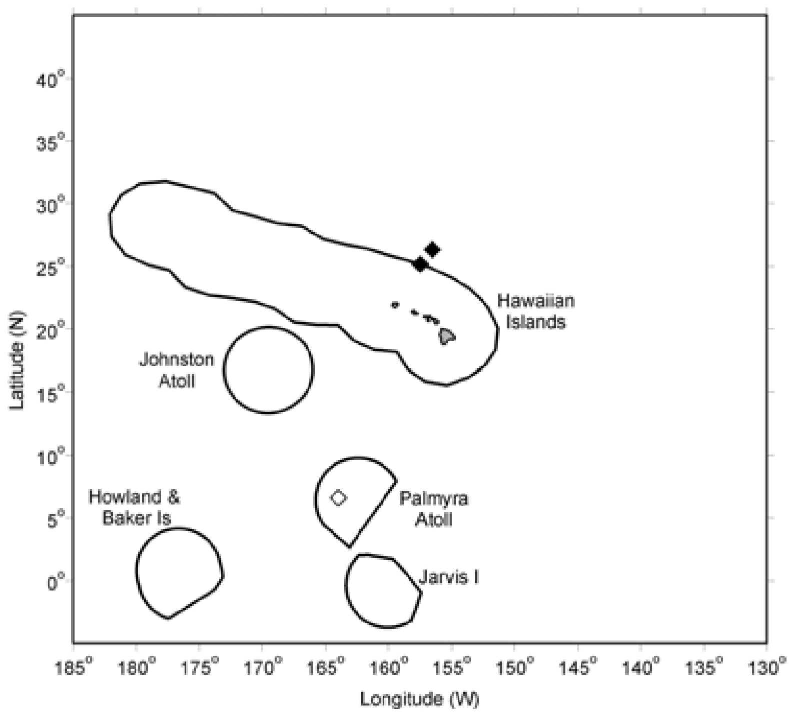

Figure 2. Locations of observed spinner dolphin takes (filled diamonds) and possible takes of this species (open diamond) in the Hawaii-based longline fishery, 1994-2002. Solid lines represent the U.S. EEZ. Set locations in this fishery are summarized in Appendix 1.

Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nitta and Henderson 1993). Between 1994 and 2002, two spinner dolphins were observed hooked or entangled in the Hawaii-based longline fishery, with approximately 4-25% of all effort observed (Forney 2004). During the 905 observed trips with 11,014 sets, the average interaction rate of spinner dolphins was one animal per 453 fishing trips, or one animal per 5,507 sets. Neither of the animals caught was considered seriously injured (Forney 2004), based on an evaluation of the observer's description of the interaction and following established guidelines for assessing serious injury in marine mammals (Angliss and Demaster 1998). The average 5-yr estimate of annual mortality and serious injury within the Hawaiian Islands EEZ during 1998-2002 is zero spinner dolphins. One additional unidentified cetacean, which may have been a spinner dolphin, was taken in this fishery within the U.S. EEZ surrounding Palmyra Island (Figure 2, Forney 2004). Since 2001, the Hawaii-based longline fishery has undergone a series of regulatory changes, primarily to protect sea turtles (NMFS 2001). Potential impacts of these regulatory changes on the rate of spinner dolphin takes are unknown.

Interaction rates between dolphins and the NWHI bottomfish fishery have been estimated based on studies conducted in 1990-1993, indicating that an average of 2.67 dolphin interactions, most likely involving bottlenose and rough-toothed dolphins, occurred for every 1000 fish brought on board (Kobayashi and Kawamoto 1995).

Fishermen claim interactions with dolphins who steal bait and catch are increasing. It is not known whether these interactions result in serious injury or mortality of dolphins, nor whether spinner dolphins are involved.

STATUS OF STOCK

The status of spinner dolphins in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. 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. Spinner dolphins are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The Hawaiian 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 Hawaiian Islands EEZ is zero. However, there is no systematic monitoring of gillnet fisheries that may take this species. 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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STRIPED DOLPHIN (*Stenella coeruleoalba*): Hawaiian Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Striped dolphins are found in tropical to warm-temperate waters throughout the world (Perrin et al. 1994b). They have been documented in the Hawaiian Islands from 20 strandings (Nitta 1991, Maldini 2005), although sightings have historically been infrequent (Shallenberger 1981, Mobley et al. 2000). A comprehensive shipboard survey of the Hawaiian Exclusive Economic Zone (EEZ), resulted in 15 sightings of striped dolphins (Figure 1; Barlow 2003).

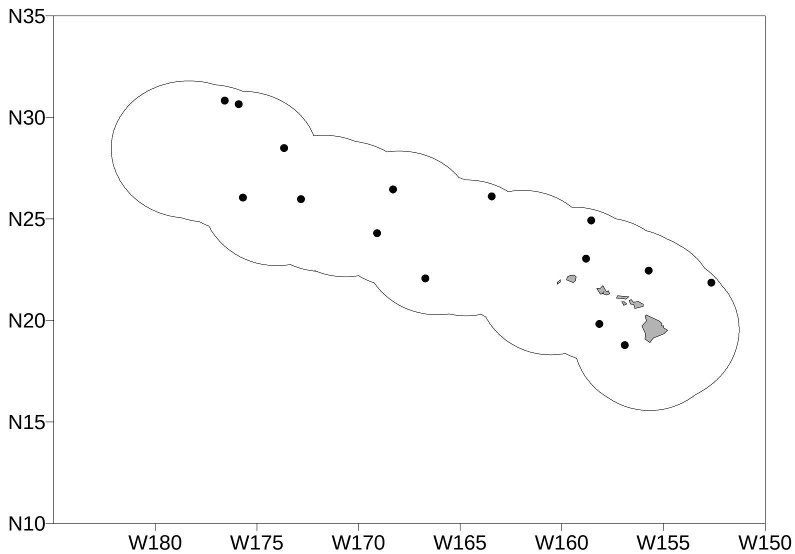

Figure 1. Striped dolphin sighting locations during the 2002 shipboard survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2003; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ.

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 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, non-contiguous areas: 1) waters off California, Oregon and Washington, and 2) waters around Hawaii (this report). 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. 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 about 25 nmi of the main Hawaiian Islands in 1993, 1995 and 1998. An abundance estimate of 114 (CV=1.19) striped dolphins was calculated from the combined survey data (Mobley et al. 2000). This study underestimated the total number of striped dolphins within the U.S. EEZ off Hawaii, because areas around the Northwestern Hawaiian Islands (NWHI) and beyond 25 nautical miles from the main islands were not surveyed. Furthermore, the data on which this estimate was based are now over 5 years old. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 10,385 (CV=0.48) striped dolphins (Barlow 2003). This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate is 7,078 striped 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 this stock is calculated as the minimum population size (7,078) 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 71 striped dolphins per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

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. 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. 1994a).

Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nitta and Henderson 1993), but no interactions with striped dolphins have been documented. None were observed hooked or entangled in the Hawaii-based longline fishery between 1994 and 2002, with approximately 4-25% of all effort observed (Forney 2004). Interaction rates between dolphins and the NWHI bottomfish fishery have been estimated based on studies conducted in 1990-1993, indicating that an average of 2.67 dolphin interactions, most likely involving bottlenose and rough-toothed dolphins, occurred for every 1000 fish brought on board (Kobayashi and Kawamoto 1995). Fishermen claim interactions with dolphins who steal bait and catch are increasing. It is not known whether these interactions result in serious injury or mortality of dolphins, nor whether striped dolphins are involved.

STATUS OF STOCK

The status of striped 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 species. They are not listed as “threatened” or “endangered” under the Endangered Species Act (1973), nor as “depleted” under the MMPA. The Hawaiian stock of striped dolphins is not considered strategic under the 1994 amendments to the MMPA given the absence of reported fisheries related mortality. Insufficient information is available to determine whether the total fishery mortality and serious injury for striped dolphins is insignificant and approaching zero mortality and serious injury rate.

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FRASER'S DOLPHIN (*Lagenodelphis hosei*): Hawaiian Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Fraser's dolphins are distributed worldwide in tropical waters (Perrin et al. 1994b). They have only recently been documented within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands, during a 2002 cetacean survey (Barlow 2003, Figure 1). No strandings of Fraser's dolphins have been documented in the Hawaiian Islands (Nitta 1991; Maldini 2005). For the Marine Mammal Protection Act (MMPA) stock assessment reports, there is a single Pacific management stock including only animals found within the U.S. EEZ of the Hawaiian Islands.

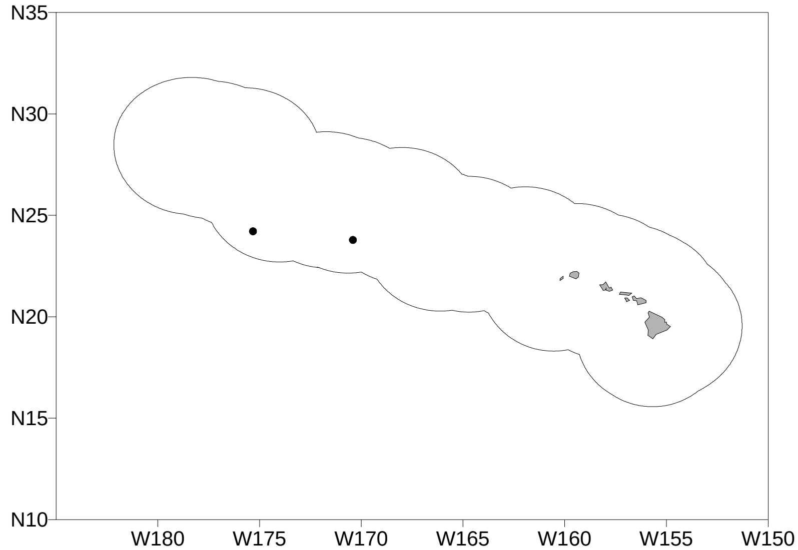

Figure 1. Fraser's dolphin sighting locations during the 2002 shipboard cetacean survey of U.S. waters surrounding the Hawaiian Islands (Barlow 2003; see Appendix 2 for details on timing and location of survey effort). Outer line indicates approximate boundary of survey area and U.S. EEZ.

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. No sightings of this species were made during twelve aerial surveys, conducted as part of the Marine Mammal Research Program of the Acoustic Thermometry of Ocean Climate (ATOC) study, within about 25 nmi of the main Hawaiian Islands in 1993, 1995 and 1998 (Mobley et al. 2000). A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 16,836 (CV=1.11) Fraser's dolphins (Barlow 2003). This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate is 7,917 Fraser's 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 for the Hawaiian stock of Fraser's dolphin.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock of Fraser's dolphin is calculated as the minimum population size (7,917) <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 known fishery mortality or serious injury within the Hawaiian Islands EEZ; Wade and Angliss 1997), resulting in a PBR of 79 Fraser's dolphins per year.

HUMAN CAUSED MORTALITY AND SERIOUS INJURY

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. 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. 1994a). Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nitta and Henderson 1993), but none of these interactions are known to have involved Fraser's dolphins. None were observed hooked or entangled in the Hawaii-based longline fishery between 1994 and 2002, with approximately 4-25% of all effort observed (Forney 2004). Interaction rates between dolphins and the NWHI bottomfish fishery have been estimated based on studies conducted in 1990-1993, indicating that an average of 2.67 dolphin interactions, most likely involving bottlenose and rough-toothed dolphins, occurred for every 1000 fish brought on board (Kobayashi and Kawamoto 1995). Fishermen claim interactions with dolphins who steal bait and catch are increasing. It is not known whether these interactions result in serious injury or mortality of dolphins, nor whether Fraser's dolphins are involved.

STATUS OF STOCK

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 species. They are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The Hawaiian stock of Fraser's dolphins is not considered strategic under the 1994 amendments to the MMPA, because there has been no reported fisheries related mortality or serious injury within the U.S. EEZ of the Hawaiian Islands. Insufficient information is available to determine whether the total fishery mortality and serious injury for Fraser's dolphins is insignificant and approaching zero mortality and serious injury rate.

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MELON-HEADED WHALE (*Peponocephala electra*): Hawaiian Stock

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 eastern tropical Pacific, and they are occasionally killed in direct fisheries in Japan and elsewhere in the western Pacific. Large herds are seen regularly in Hawaiian waters, especially off the Waianae coast of Oahu, the north Kohala coast of Hawaii, and the leeward coast of Lanai (Shallenberger 1981). A comprehensive shipboard survey of the Hawaiian Exclusive Economic Zone (EEZ), resulted in only one sighting of melon-headed whales (Figure 1; Barlow 2003). Inter-island movements from Kauai to Hawaii have been documented and genetic samples from at least 82 animals are available for future stock structure analyses (R.W. Baird, pers. comm.). Little is known about this species elsewhere in its range, and most knowledge about its biology comes from mass strandings (Perryman et al. 1994). Fourteen strandings are known from Hawaii (Nishiwaki and Norris 1966; Shallenberger 1981; Nitta 1991; Maldini 2005). For the Marine Mammal Protection Act (MMPA) stock assessment reports, there is a single Pacific management stock including only animals found within the U.S. EEZ of the Hawaiian Islands.

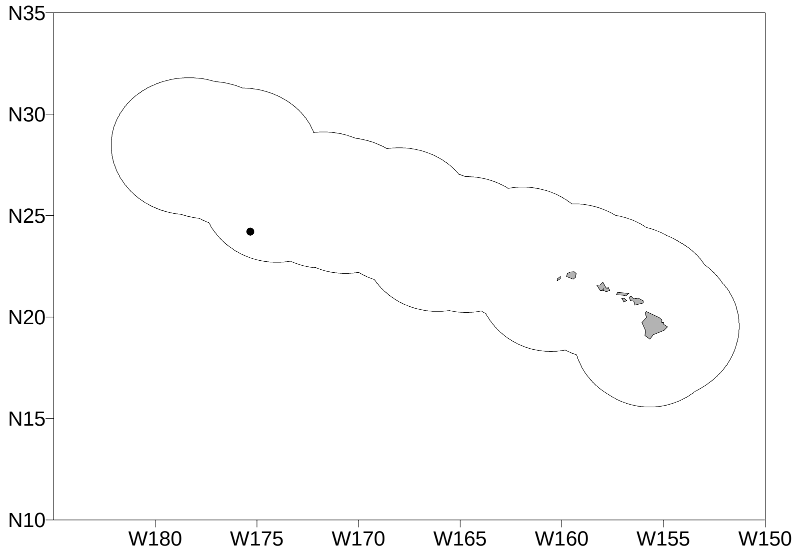

Figure 1. Melon-headed whale sighting location during the 2002 shipboard survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2003; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ.

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. 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 about 25 nmi of the main Hawaiian Islands in 1993, 1995 and 1998. An abundance estimate of 154 (CV=0.88) melon-headed whales was calculated from the combined survey data (Mobley et al. 2000). This study underestimated the total number of melon-headed whales within the U.S. EEZ off Hawaii, because areas around the Northwestern Hawaiian Islands (NWHI) and beyond 25 nautical miles from the main islands were not surveyed. Furthermore, the data on which this estimate was based are now over 5 years old. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 2,947 (CV=1.11) melon-headed whales (Barlow 2003). This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate is 1,386 melon-headed 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

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (1,386) 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 14 melon-headed whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

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. 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).

Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nitta and Henderson 1993), but no interactions with melon-headed whales have been documented. None were observed hooked in the Hawaii-based longline fishery between 1994 and 2002, with approximately 4-25% of all effort observed (Forney 2004). Interaction rates between dolphins and the NWHI bottomfish fishery have been estimated based on studies conducted in 1990-1993, indicating that an average of 2.67 dolphin interactions, most likely involving bottlenose and rough-toothed dolphins, occurred for every 1000 fish brought on board (Kobayashi and Kawamoto 1995). Fishermen claim interactions with dolphins who steal bait and catch are increasing. It is not known whether these interactions result in serious injury or mortality of dolphins, nor whether melon-headed whales are involved.

STATUS OF STOCK

The status of melon-headed 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 species. They are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The Hawaiian stock of melon-headed whales is not considered strategic under the 1994 amendments to the MMPA given the absence of reported fisheries related mortality or serious injury. Insufficient information is available to determine whether the total fishery mortality and serious injury for melon-headed whales is insignificant and approaching zero mortality and serious injury rate.

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PYGMY KILLER WHALE (*Feresa attenuata*): Hawaiian Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

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." Although all sightings up to that time had been off Oahu and the Big Island, Shallenberger (1981) stated that this species might be found elsewhere in Hawaii, as well. No pygmy killer whales were seen during 1993-98 aerial surveys within about 25 nmi of the main Hawaiian Islands (Mobley et al. 2000). Three sightings of pygmy killer whales were made during a 2002 shipboard survey of U.S. Exclusive Economic Zone (EEZ) waters surrounding the Hawaiian Islands (Figure 1; Barlow 2003). Six strandings have been documented from Maui and the island of Hawaii (Nitta 1991, Maldini 2005). For the Marine Mammal Protection Act (MMPA) stock assessment reports, there is a single Pacific management stock including only animals found within the U.S. EEZ of the Hawaiian Islands.

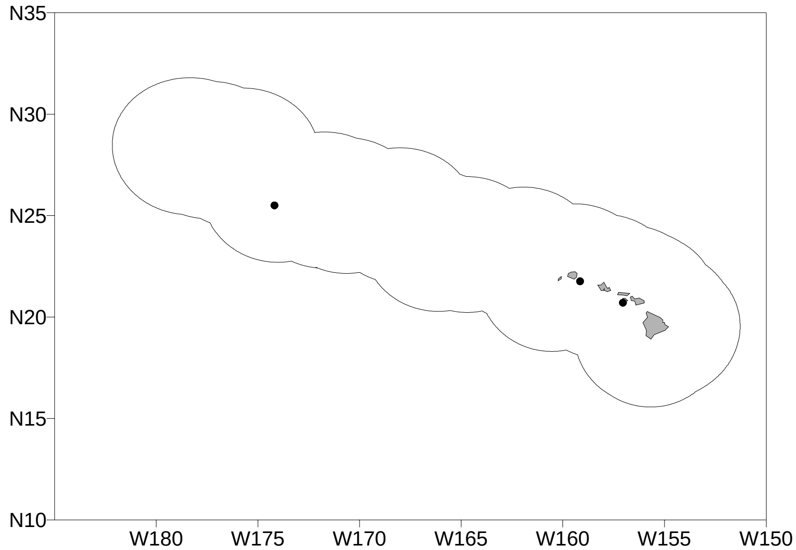

Figure 1. Pygmy killer whale sighting locations during the 2002 shipboard survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2003; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ.

POPULATION SIZE

A population estimate has been made for this species in 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. 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 about 25 nmi of the main Hawaiian Islands in 1993, 1995 and 1998 (Mobley et al. 2000), but there were no sightings of pygmy killer whales. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 817 (CV=1.12) pygmy killer whales (Barlow 2003). This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate is 382 pygmy 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

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (382) 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 3.8 pygmy killer whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

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. 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).

Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nitta and Henderson 1993), but no interactions with pygmy killer whales have been documented. None were observed hooked or entangled in the Hawaii-based longline fishery between 1994 and 2002, with approximately 4-25% of all effort observed (Forney 2004). Interaction rates between dolphins and the NWHI bottomfish fishery have been estimated based on studies conducted in 1990-1993, indicating that an average of 2.67 dolphin interactions, most likely involving bottlenose and rough-toothed dolphins, occurred for every 1000 fish brought on board (Kobayashi and Kawamoto 1995). Fishermen claim interactions with dolphins who steal bait and catch are increasing. It is not known whether these interactions result in serious injury or mortality of dolphins, nor whether pygmy killer whales are involved.

STATUS OF STOCK

The status of pygmy 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 species. This species is not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The Hawaiian stock of pygmy killer whales is not considered strategic under the 1994 amendments to the MMPA given the absence of reported fisheries related mortality or serious injury. Insufficient information is available to determine whether the total fishery mortality and serious injury for pygmy killer whales is insignificant and approaching zero mortality and serious injury rate.

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Revised 11/01/2005

FALSE KILLER WHALE (*Pseudorca crassidens*): Hawaiian Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

False killer whales are found worldwide mainly 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. Most knowledge about this species comes from outside Hawaiian waters (Stacey et al. 1994). There are six stranding records from Hawaiian waters (Nitta 1991; Maldini 2005). Two sightings of false killer whales were made during a 2002 shipboard survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands (Figure 1; Barlow 2003). Smaller-scale surveys conducted around the Main Hawaiian Islands (Figure 2) show that false killer whales are also commonly encountered in nearshore waters (Baird et al. 2005, Mobley et al. 2000, Mobley 2001, 2002, 2003, 2004).

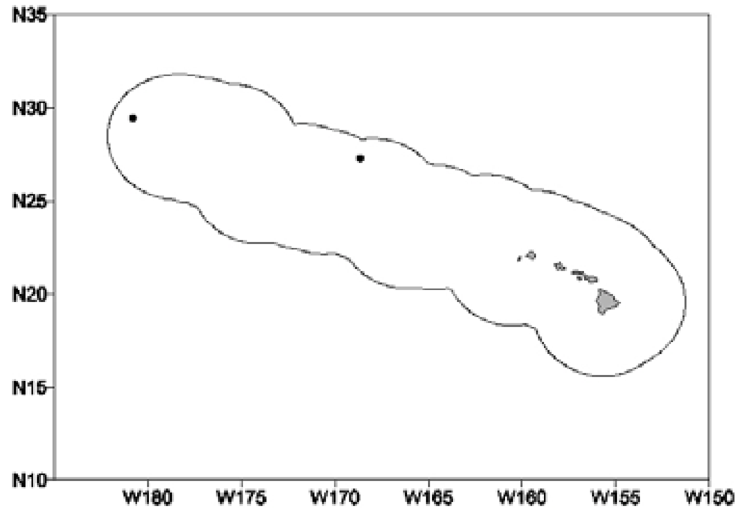

Figure 1. False killer whale sighting locations during the 2002 shipboard survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2003; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ.

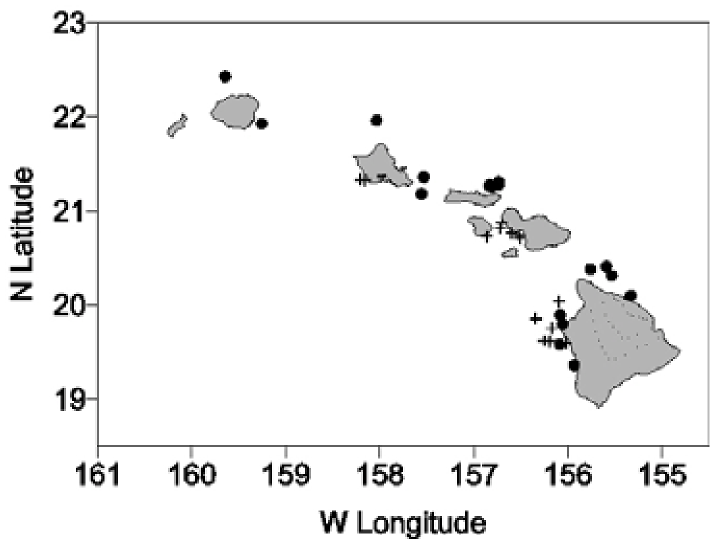

Figure 2. False killer whale sighting locations during 2000-2004 boat-based surveys (+) (Baird et al. 2005) and 1993-2003 aerial surveys (•) (Mobley et al. 2000, Mobley 2001, 2002, 2003, 2004) around the Main Hawaiian Islands. See Appendix 2 for details on timing and location of survey effort.

Genetic analyses of tissue samples collected near the main Hawaiian Islands indicate that Hawaiian false killer whales are reproductively isolated from false killer whales found in the eastern tropical Pacific Ocean (S. Chivers, NMFS/SWFSC, unpublished data); however, the offshore range of this Hawaiian population is unknown. Fishery interactions with false killer whales demonstrate that this species also occurs in U.S. EEZ waters around Palmyra Atoll (Figure 2), but it is not known whether these animals are part of the Hawaiian stock or whether they represent a separate stock of false killer whales. Based on patterns of movement and population structure observed in other island-associated cetaceans (Norris and Dohl 1980; Norris et al.1994; Baird et al. 2001, 2003; S. Chivers, pers. comm.), the animals around Palmyra Atoll may represent a separate stock. Unconfirmed sightings of false killer whales have also been reported near Johnston Atoll and require further investigation (NMFS/PIR, unpublished data). Efforts are currently underway to obtain additional tissue samples of false killer whales for further studies of population structure in the North Pacific Ocean. For the Marine Mammal Protection Act (MMPA) stock assessment reports, there is currently a single Pacific management stock including animals found within the U.S. EEZ of the Hawaiian Islands. Information on false killer whales around Palmyra Atoll will provisionally be included with this stock assessment report, recognizing that separate stock status may be warranted for these animals in the future. Estimates of abundance, potential biological removals, and status determinations will be presented separately for U.S. EEZ waters of the Hawaiian Islands and Palmyra Atoll.

POPULATION SIZE

Population estimates for this species have been made from shipboard surveys in Japan (Miyashita 1993) and the eastern tropical Pacific (Wade and Gerrodette 1993), but evidence suggests that false killer whales around Hawaii form a distinct population (S. Chivers, NMFS/SWFSC, unpublished data). 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 about 25 nmi of the main Hawaiian Islands in 1993, 1995 and 1998. An abundance estimate of 121 (CV=0.47) false killer whales was calculated from the combined survey data (Mobley et al. 2000). This study underestimated the total number of false killer whales within the U.S. EEZ off Hawaii, because areas around the Northwestern Hawaiian Islands (NWHI) and beyond 25 nautical miles from the main islands were not surveyed and estimates were uncorrected for the proportion of diving animals missed from the survey aircraft. Furthermore, the data on which this estimate was based are now over 5 years old. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 268 (CV=1.08) false killer whales (Barlow 2003). This is the best available abundance estimate for false killer whales within the Hawaiian Islands EEZ.

No abundance estimates are currently available for false killer whales in U.S. EEZ waters of Palmyra Atoll; however, density estimates for false killer whales in other Pacific regions can provide a range of likely abundance estimates in this unsurveyed region. Published estimates of false killer whale density (animals per km^2) in the Pacific are: 0.0001 (CV=1.08) for the U.S. EEZ of the Hawaiian Islands (Barlow 2003); 0.0017 (CV=0.47) for nearshore waters surrounding the main Hawaiian Islands (Mobley et al. 2000), 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), and 0.0033 (CV=0.56) for the eastern tropical Pacific Ocean west of 120°W and north of 5°N (Ferguson and Barlow 2003). Applying the lowest and highest of these density estimates to U.S. EEZ waters surrounding Palmyra Atoll (area size = 347,216 km^2) yields a range of plausible abundance estimates of 42 - 1,160 false killer whales.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate for the Hawaiian Islands EEZ (Barlow 2003) is 128 false killer whales. No minimum population estimate is currently available for waters surrounding Palmyra Atoll, but the false killer whale density estimates from other 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 20^{th} percentiles of plausible abundance estimates for the Palmyra Atoll EEZ, based on the densities observed elsewhere, range from 20 - 746 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 Hawaiian waters.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Hawaiian false killer whale stock is calculated as the minimum population size (128) <u>times</u> one half the default maximum net growth rate for cetaceans (½ of 4%) <u>times</u> a recovery factor of 0.45 (for a stock of unknown status with a Hawaiian Islands EEZ mortality and serious injury rate CV between 0.60 and 0.80; Wade and Angliss 1997), resulting in a PBR of 1.2 false killer whales per year. No separate PBR can presently be calculated for false killer whales within the Palmyra Atoll EEZ, but based on the range of plausible minimum abundance estimates (20 - 746), a recovery factor of 0.48 (for a species of unknown status with a fishery mortality and serious injury rate CV between 0.30 and 0.60 within the Palmyra Atoll EEZ; Wade and Angliss 1997), and the default growth rate (½ of 4%), the PBR would likely fall between 0.2 and 7.2 false killer whales per year.

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 Hawaiian 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). In Hawaii, no mortality of false killer whales has been observed in inshore gillnets, but these fisheries are not observed or monitored.

Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries, and false killer whales have been identified in fishermen's logs and NMFS observer records as taking catches from pelagic longlines (Nitta and Henderson 1993, NMFS/PIR unpublished data). They have also been observed feeding on mahi mahi, *Coryphaena hippurus*, and yellowfin tuna, *Thunnus albacares*, and frequently steal large fish (up to 70 pounds) (Shallenberger 1981) from the trolling lines of both commercial and recreational fishermen (S. Kaiser, pers. comm.).

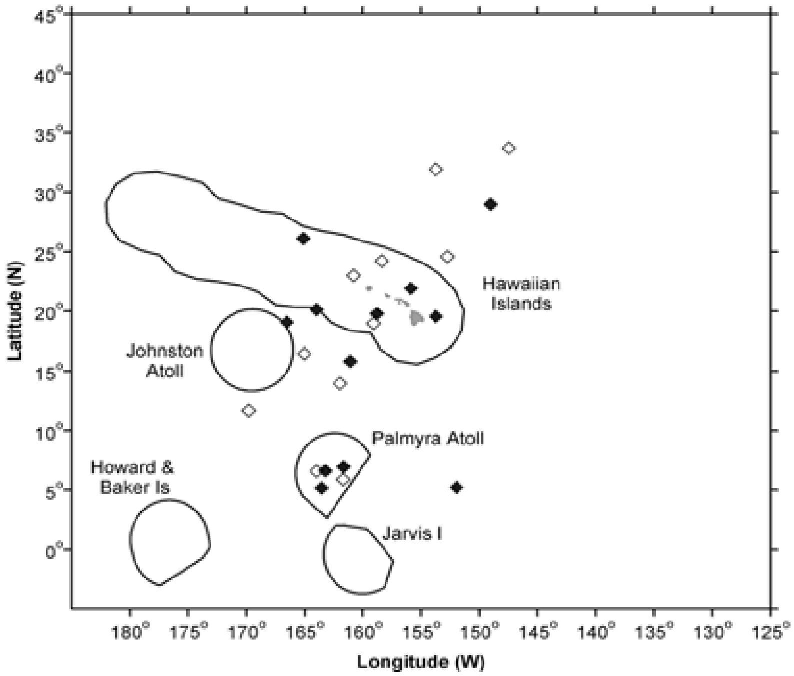

Figure 3. Locations of observed false killer whale takes (filled diamonds) and possible takes of this species (open diamonds) in the Hawaii-based longline fishery, 1994-2003 . Solid lines represent the U.S. EEZ. Set locations in this fishery are summarized in Appendix 1.

Between 1994 and 2003, 12 false killer whales were observed hooked in the Hawaii-based longline fishery with approximately 4-25% of all effort observed (Table 1; Forney and Kobayashi 2005). Eleven additional unidentified cetaceans, which may have been false killer whales, were also taken in this fishery (Figure 3, Forney and Kobayashi 2005). During the 15,859 observed sets, the average interaction rate of false killer whales was 1.01 false killer whales per 1000 sets. All false killer whales caught were considered seriously injured (Forney and Kobayashi 2005), based on an evaluation of the observer's description of the interaction and following established guidelines for assessing serious injury in marine mammals (Angliss and DeMaster 1998). Average 5-yr estimates of annual mortality and serious injury for 1999-2003 are 4.2 (CV = 0.45) false killer whales outside of U.S. EEZs, 1.6 (CV = 0.71) within the Hawaiian Islands EEZ, and 1.8 (CV = 0.59) within the EEZ of Palmyra Atoll (Table 1). Total estimated annual mortality and serious injury for all U.S. EEZs combined averaged 3.4 (CV = 0.33) between 1999 and 2003. Since 2001, the Hawaii-based longline fishery has undergone a series of regulatory changes, primarily to protect sea turtles (NMFS 2001). Potential impacts of these regulatory changes on the rate of false killer whale interactions are unknown.

Interaction rates between dolphins and the NWHI bottomfish fishery have been estimated based on studies conducted in 1990-1993, indicating that an average of 2.67 dolphin interactions, most likely involving bottlenose and rough-toothed dolphins, occurred for every 1000 fish brought on board (Kobayashi and Kawamoto 1995). Fishermen claim interactions with dolphins that steal bait and catch are increasing. It is not known whether these interactions result in serious injury or mortality of dolphins, nor whether false killer whales are involved.

STATUS OF STOCK

The status of false 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 species. They are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. Because the rate of mortality and serious injury to false killer whales within the Hawaiian Islands EEZ in the Hawaii-based longline fishery (1.6 animals per year) exceeds the PBR (1.2), this stock is considered a strategic stock under the 1994 amendments to the MMPA. The total fishery mortality and serious injury for Hawaiian false killer whales cannot be considered to be insignificant and approaching zero, because it exceeds the PBR. Although no estimates of abundance or PBR are currently available for false killer whales around Palmyra Atoll, the average rate of mortality and serious injury within the Palmyra Atoll EEZ (1.8 animals per year) falls within the range of likely PBRs (0.2 to 7.2) for this region.

Table 1. Summary of available information on incidental mortality and serious injury of false killer whales (Hawaiian stock) in commercial fisheries, within and outside of U.S. EEZs (Forney and Kobayashi 2005). Mean annual takes are based on 1999-2003 data unless otherwise indicated.

Fishery Name	Year	Data Type	Percent Observer Coverage	Observed and estimated mortality and serious injury of false killer whales, by EEZ region								
				Outside of U.S. EEZs			Hawaiian Islands EEZ			Palmyra Atoll EEZ		
				Obs.	Estimated (CV)	Mean Annual Takes (CV)	Obs.	Estimated (CV)	Mean Annual Takes (CV)	Obs.	Estimated (CV)	Mean Annual Takes (CV)
Hawaii-based longline fishery	1999	observer data	3.6%	0	0 (-)	4.2 (0.45)	0	0 (-)	1.6 (0.71)	0	0 (-)	1.8 (0.59)
	2000		11.1%	0	0 (-)		0	0 (-)		0	0 (-)	
	2001		23.0%	2	10 (0.71)		0	0 (-)		1	4 (1.00)	
	2002		24.8%	3	11 (0.58)		0	0 (-)		2	5 (0.71)	
	2003		21.9%	0	0 (-)		2	8 (0.71)		0	0 (-)	
Minimum total annual takes within U.S. EEZ waters							3.4 (0.33)					

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Revised 03/15/2005

KILLER WHALE (*Orcinus orca*): Hawaiian 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 (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). Two sightings of killer whales were made during a 2002 shipboard survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands (Figure 1; Barlow 2003). One stranding from the island of Hawaii was reported in 1950 (Richards 1952) and another in 2004 (R.W. Baird, pers. comm.). 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. Baird et al. (2003) report a sighting of this species off the island of Hawaii in 2003, and also note analyses of genetic results from one sample collected, indicating a haplotype similar to the Gulf of Alaska “transient” killer whales. For the Marine Mammal Protection Act (MMPA) stock assessment reports, five killer whale stocks are recognized within the Pacific U.S. EEZ 1) the Eastern North Pacific Northern Resident stock - occurring from British Columbia through Alaska, 2) the Eastern North Pacific Southern Resident stock - occurring within the inland waters of Washington State and southern British Columbia, 3) the Eastern North Pacific Transient stock - occurring from Alaska through California, 4) the Eastern North Pacific Offshore stock - occurring from Southeast Alaska through California, and 5) the Hawaiian stock (this report). Stock Assessment Reports for the Eastern North Pacific Northern Resident stock and the Eastern North Pacific Transient stocks can be found in the Alaska Region stock assessment reports; all other killer whale stock assessments are included in the Pacific Region stock assessments.

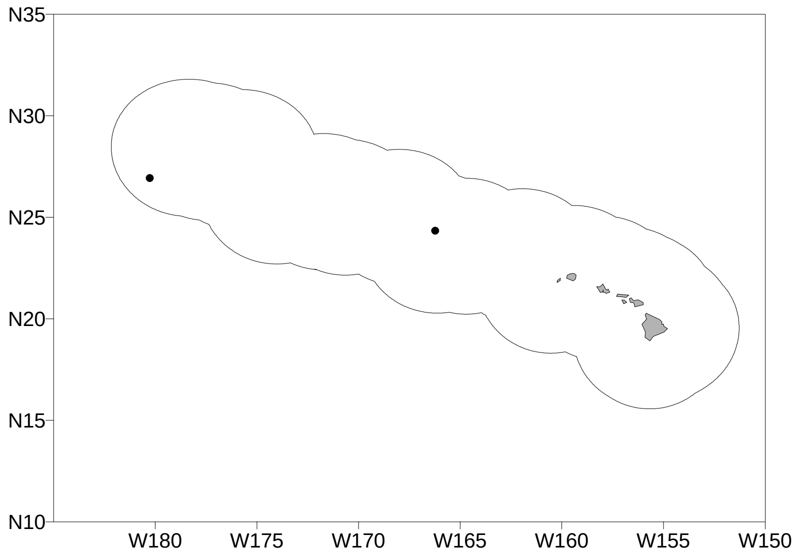

Figure 1. Killer whale sighting locations during the 2002 shipboard survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2003; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ.

POPULATION SIZE

Population sizes for killer whales in the coastal waters of British Columbia and Washington are known from photo-identification studies (Bigg et al. 1990). The population of killer whales in the eastern tropical Pacific has been estimated from shipboard sightings surveys (Wade and Gerrodette 1993). 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 about 25 nmi of the main Hawaiian Islands in 1993, 1995 and 1998 (Mobley et al. 2000), but no sightings of killer whales were made. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 430 (CV=0.72) killer whales (Barlow 2003). This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate is 250 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 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 (250) 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 2.5 killer whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

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. 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).

Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nitta and Henderson 1993), but killer whale interactions appear to be rare. In 1990, a solitary killer whale was reported to have removed the catch from a longline in Hawaii (Dollar 1991). None were observed hooked or entangled in the Hawaii-based longline fishery between 1994 and 2002, with approximately 4-25% of all effort observed (Forney 2004). Interaction rates between dolphins and the NWHI bottomfish fishery have been estimated based on studies conducted in 1990-1993, indicating that an average of 2.67 dolphin interactions, most likely involving bottlenose and rough-toothed dolphins, occurred for every 1000 fish brought on board (Kobayashi and Kawamoto 1995). Fishermen claim interactions with dolphins that steal bait and catch are increasing. It is not known whether these interactions result in serious injury or mortality of dolphins, nor whether killer whales are involved.

STATUS OF STOCK

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 species. This species is not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The Hawaiian stock of killer whales is not considered strategic under the 1994 amendments to the MMPA given the absence of reported fisheries related mortality or serious injury. Insufficient information is available to determine whether the total fishery mortality and serious injury for killer whales is insignificant and approaching zero mortality and serious injury rate.

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Revised 03/15/2005

SHORT-FINNED PILOT WHALE (*Globicephala macrorhynchus*): Hawaiian Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

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; Barlow 2003). During a 2002 shipboard survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands, 25 sightings of short-finned pilot whales were made (Figure 1; Barlow 2003). Fourteen strandings of short-finned pilot whales have been documented from the main Hawaiian Islands, including five mass strandings (Tomich 1986; Nitta 1991; Maldini 2005). Stock structure of short-finned pilot whales has not been adequately studied in the North Pacific, except in Japanese waters, where two stocks have been identified 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." Preliminary photo-identification work with pilot whales in Hawaii indicated a high degree of site fidelity around the main island of Hawaii (Shane and McSweeney 1990). Additional photo-identification work around the Hawaiian Islands is being done to examine whale movements between islands (R.W. Baird, pers. comm.).

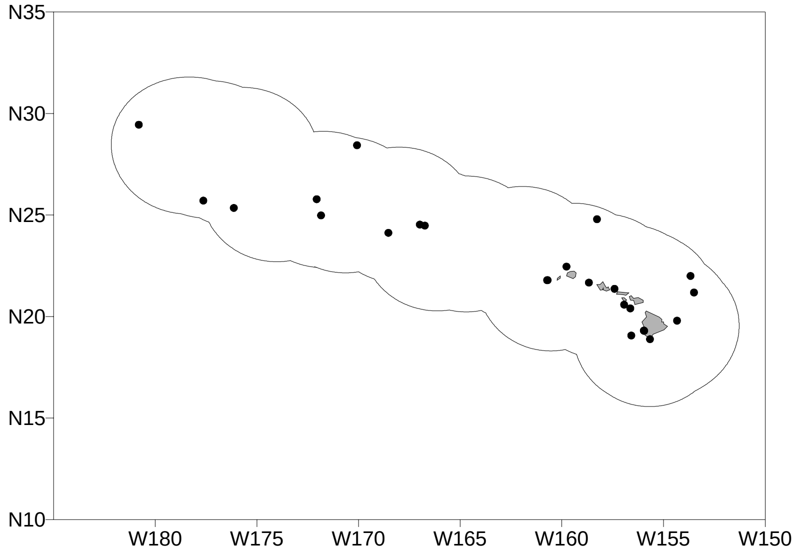

Figure 1. Short-finned pilot whale sighting locations during the 2002 shipboard survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2003; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ.

Genetic analyses of tissue samples collected near the main Hawaiian Islands indicate that Hawaiian short-finned pilot whales are reproductively isolated from short-finned pilot whales found in the eastern Pacific Ocean (S. Chivers, NMFS/SWFSC, unpublished data); however, the offshore range of this Hawaiian population is unknown. Fishery interactions with short-finned pilot whales demonstrate that this species also occurs in U.S. EEZ waters of Palmyra Island (Figure 2), but it is not known whether these animals are part of the Hawaiian stock or whether they represent a separate stock of short-finned pilot whales. Based on patterns of movement and population structure observed in other island-associated cetaceans (Norris and Dohl 1980; Norris et al.1994; Baird et al. 2001, 2003; S. Chivers, pers. comm.), it is possible that the animals around Palmyra Island are a separate stock. Efforts are currently underway to obtain additional samples of short-finned pilot whales for further studies of population structure in the North Pacific Ocean. 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, non-contiguous areas: 1) Hawaiian waters (this report), and 2) waters off California, Oregon and Washington. Information on short-finned pilot whales around Palmyra Island will provisionally be included with this stock assessment report, recognizing that separate stock status may be warranted for these animals in the future. Estimates of abundance, potential biological removals, and status determinations will be presented separately for U.S. waters of the Hawaiian Islands and Palmyra Island.

POPULATION SIZE

Estimates of short-finned pilot whale populations have been made off Japan (Miyashita 1993) and in 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. 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 about 25 nmi of the main Hawaiian Islands in 1993, 1995 and 1998. An abundance estimate of 1,708 (CV=0.32) short-finned pilot whales was calculated from the combined survey data (Mobley et al. 2000). This study underestimated the total number of short-finned pilot whales within the U.S. EEZ off Hawaii, because areas around the Northwestern Hawaiian Islands (NWHI) and beyond 25 nautical miles from the main islands were not surveyed. Furthermore, the data on which this estimate was based are now over 5 years old. 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 2003). This is currently the best available abundance estimate for short-finned pilot whales within the Hawaiian Islands EEZ.

No abundance estimates are currently available for short-finned pilot whales in U.S. EEZ waters of Palmyra Island; however, density estimates for short-finned pilot whales in other Pacific regions can provide a range of likely abundance estimates in this unsurveyed region. Published estimates of short-finned pilot whale density (animals per km^2) in the Pacific are: 0.0036 (CV=0.49) for the U.S. EEZ of the Hawaiian Islands (Barlow 2003); 0.0237 (CV=0.32) for nearshore waters surrounding the main Hawaiian Islands (Mobley et al. 2000), 0.0084 (CV=0.14) and 0.0040 (CV=0.23) for the eastern tropical Pacific Ocean (Wade and Gerrodette 1993; Ferguson and Barlow 2003), and 0.0025 (CV=0.29) for the eastern tropical Pacific Ocean west of 120°W and north of 5°N (Ferguson and Barlow 2003). Applying the lowest and highest of these density estimates to U.S. EEZ waters surrounding Palmyra Island (area size = 347,216 km^2) yields a range of plausible abundance estimates of 877 - 8,229 short-finned pilot whales.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate for the Hawaiian Islands EEZ (Barlow 2004) is 5,986 short-finned pilot whales. No minimum population estimate is currently available for waters surrounding Palmyra Island, but the short-finned pilot whale density estimates from other 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 20^{th} percentiles of plausible abundance estimates for the Palmyra Island EEZ, based on the densities observed elsewhere, range from 690 - 6,327 short-finned pilot 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

The potential biological removal (PBR) level for the Hawaiian short-finned pilot whale stock is calculated as the minimum population size (5,986) <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 a no known fishery mortality and serious injury within the U.S. EEZ of the Hawaiian Islands; Wade and Angliss 1997), resulting in a PBR of 60 short-finned pilot whales per year. No separate PBR can presently be calculated for Palmyra Island waters, but based on the range of plausible minimum abundance estimates (690 - 6,327), 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 Palmyra Islands EEZ; Wade and Angliss 1997), and the default growth rate (½ of 4%), the PBR would likely fall between 5.5 and 51 short-finned pilot whales per year.

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 Hawaiian 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). Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nitta and Henderson 1993). Between 1994 and 2002, five short-finned pilot whales were observed hooked in the Hawaii-based longline fishery with approximately 4-25% of all effort observed (Table 1; Forney 2004). During the 905 observed trips with 11,014 sets, the average interaction rate of short-finned pilot whales was one animal per 181 fishing trips, or one animal per 2,203 sets. Two of the animals caught were dead upon gear retrieval, and two additional animals were considered seriously injured (Forney 2004), based on an evaluation of the observer's description of the interaction and following established guidelines for assessing serious injury in marine mammals (Angliss and DeMaster 1998). Average 5-yr estimates of annual mortality and serious injury for 1998-2002 are 4.2 (CV = 0.78) short-finned pilot whales outside of the U.S. EEZs, and 0.8 (CV = 1.00) within the U.S. EEZ of Palmyra Island (Table 1). No short-finned pilot whales were observed taken within the Hawaiian Islands EEZ during 1998-2002. Six additional unidentified cetaceans, which may have been short-finned pilot whales, were also taken in this fishery. Two of these unidentified cetaceans were within the EEZ of Palmyra Island, and four were in international waters (Figure 2, Forney 2004). Since 2001, the Hawaii-based longline fishery has undergone a series of regulatory changes, primarily to protect sea turtles (NMFS 2001). Potential impacts of these regulatory changes on the rate of short-finned pilot whale interactions are unknown.

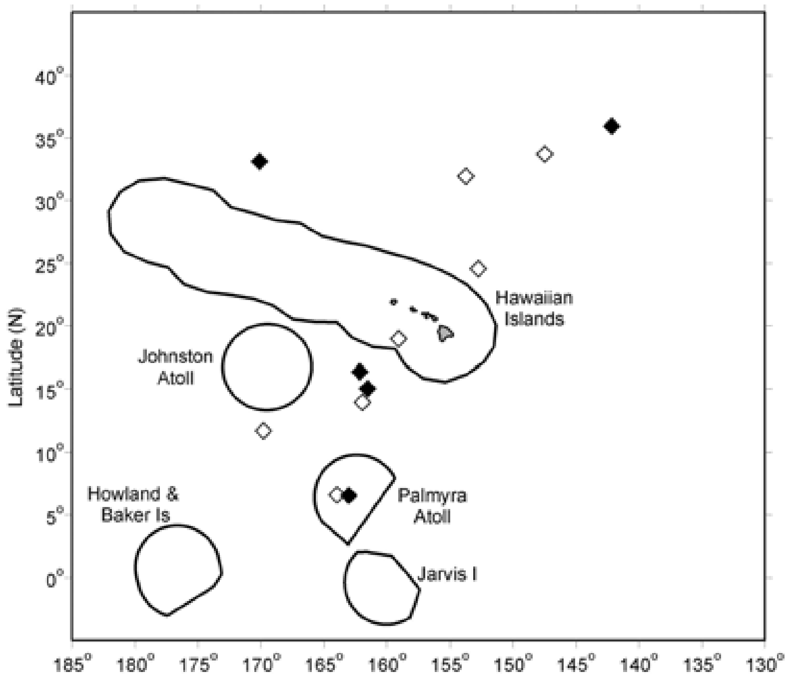

Figure 2. Locations of observed short-finned pilot whale takes (filled diamonds) and possible takes of this species (open diamonds) in the Hawaii-based longline fishery, 1994-2002. Solid lines represent the U.S. EEZ. Set locations in this fishery are summarized in Appendix 1.

Interaction rates between dolphins and the NWHI bottomfish fishery have been estimated based on studies conducted in 1990-1993, indicating that an average of 2.67 dolphin interactions, most likely involving bottlenose and rough-toothed dolphins, occurred for every 1000 fish brought on board (Kobayashi and Kawamoto 1995). Fishermen claim interactions with dolphins who steal bait and catch are increasing. It is not known whether these interactions result in serious injury or mortality of dolphins, nor whether short-finned pilot whales are involved.

Table 1. Summary of available information on incidental mortality and serious injury of short-finned pilot whales (Hawaiian stock) in commercial fisheries, within and outside of the U.S. EEZs (Forney 2004). Mean annual takes are based on 1998-2002 data unless otherwise indicated.

Fishery Name	Year	Data Type	Percent Observer Coverage	Observed and estimated mortality and serious injury of short-finned pilot whales, by EEZ region								
				Outside of U.S. EEZs			Hawaiian Islands EEZ			Palmyra Island EEZ		
				Obs.	Estimated (CV)	Mean Annual Takes (CV)	Obs.	Estimated (CV)	Mean Annual Takes (CV)	Obs.	Estimated (CV)	Mean Annual Takes (CV)
Hawaii-based longline fishery	1998	observer data	4.6%	0	0 (-)	4.2 (0.78)	0	0 (-)	0 (-)	0	0 (-)	0.8 (1.00)
	1999		3.5%	0	0 (-)		0	0 (-)		0	0 (-)	
	2000		11.8%	2	17 (0.71)		0	0 (-)		0	0 (-)	
	2001		22.7%	1	4 (1.00)		0	0 (-)		1	4 (1.00)	
	2002		24.9%	0	0 (-)		0	0 (-)		0	0 (-)	
Minimum total annual takes within U.S. EEZ waters							0.8 (1.00)					

Ship Strikes

Short-finned pilot whales with propeller scars have been seen around the Hawaiian islands (R.W. Baird, pers. comm.). It is unknown if any of these injuries were serious or resulted in mortalities.

STATUS OF STOCK

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 species. They are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The Hawaiian stock of short-finned pilot whales is not considered strategic under the 1994 amendments to the MMPA, because the estimated rate of mortality and serious injury within the Hawaiian Islands EEZ is zero. However, there is no systematic monitoring of gillnet fisheries that may take this species, and the potential effect of mortality in the Hawaii-based fishery in international waters is not known. Although no estimates of abundance or PBR are currently available for short-finned pilot whales around Palmyra Island, the average rate of mortality and serious injury within the Palmyra Island EEZ (0.8 animals per year) falls below the range of likely PBRs (5.5 - 51) for this region. Insufficient information is available to determine whether the total fishery mortality and serious injury for short-finned pilot whales is insignificant and approaching zero mortality and serious injury rate.

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Revised 03/15/2005

BLAINVILLE'S BEAKED WHALE (*Mesoplodon densirostris*): Hawaiian 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). Two strandings were reported in 1961 from Midway Island (Galbreath 1963) and another in 1983 from Laysan Island (Nitta 1991). Sixteen sightings were reported from the main islands by Shallenberger (1981), who suggested that Blainville's beaked whales were present off the Waianae Coast of Oahu for prolonged periods annually. Three 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 2003). While nothing is known about stock structure, some genetic samples have been collected recently from around the main Hawaiian islands, and there have been re-sightings of individuals from the island of Hawaii (R.W. Baird, pers. comm.). 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.

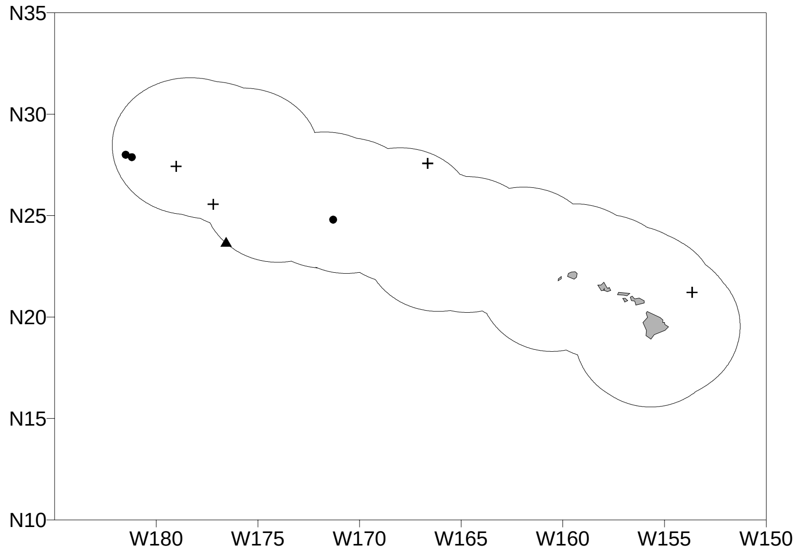

Figure 1. Sighting locations of Mesoplodon densirostris (filled circles), Indopacetus pacificus (triangle), and unidentified Mesoplodon beaked whales (cross) during the 2002 shipboard cetacean survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2003; see Appendix 2 for details on timing and location of survey effort). Outer line indicates approximate boundary of survev area and U.S. EEZ.

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 about 25 nmi of the main Hawaiian Islands in 1993, 1995 and 1998. Seven sightings of Blainville’s beaked whales were made. An abundance estimate of 68 (CV=0.60) Blainville’s beaked whales was calculated from the combined survey data (Mobley et al. 2000). This study underestimated the total number of Blainville’s beaked whales within the U.S. EEZ off Hawaii, because areas around the Northwestern Hawaiian Islands (NWHI) and beyond 25 nautical miles from the main islands were not surveyed. Furthermore, this species is known to spend a large proportion of time diving, causing additional downward bias in the abundance estimate. The data on which this estimate was based are now over 5 years old. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 2,138 (CV=0.77) Blainville’s beaked whales (Barlow 2003), including a correction factor for missed diving animals. This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate is 1,204 Blainville’s beaked 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

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (1,204) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.40 (for a species 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 9.6 Blainville's beaked whales per year.

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 Hawaiian 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).

Interactions with cetaceans are reported for all pelagic fisheries (Nitta and Henderson 1993). Between 1994 and 2002, one Blainville's beaked whale was observed hooked and killed in the Hawaii-based longline fishery, with approximately 4-25% of all effort observed (Table 1; Forney 2004). Three additional unidentified cetaceans, which may have been Blainville's beaked whales, were also taken in this fishery (Figure 2, Forney 2004). During the 905 observed trips with 11,014 sets, the average interaction rate of Blainville's beaked whales was one animal per 905 fishing trips, or one animal per 11,014 sets. Average 5-yr estimates of annual mortality and serious injury for 1998-2002 are zero Blainville's beaked whales outside of the U.S. EEZs, and 0.8 (CV = 1.00) within the Hawaiian Islands EEZ (Table 1). Since 2001, the Hawaii-based longline fishery has undergone a series of regulatory changes, primarily to protect sea turtles (NMFS 2001). Potential impacts of these regulatory changes on the rate of Blainville's beaked whale interactions are unknown.

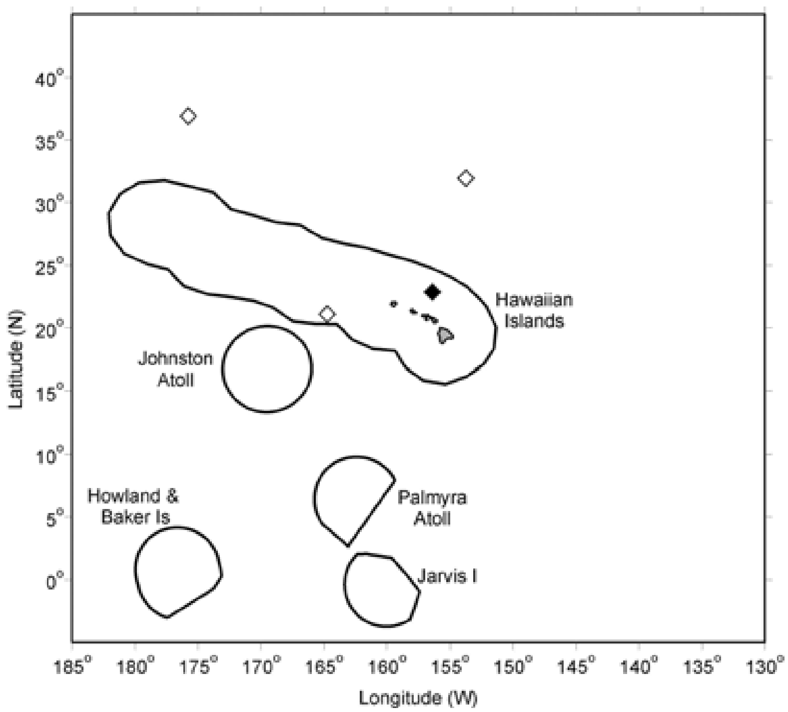

Figure 2. Location of the single Blainville's beaked whale take (filled diamond) and possible takes of this species (open diamonds) in the Hawaii-based longline fishery, 1994-2002. Solid lines represent the U.S. EEZ.

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 (Malakoff 2002). The use of active sonar from military vessels has been implicated in mass strandings of beaked whales in the Mediterranean Sea during 1996 (Frantzis 1998), the Bahamas during 2000 (U.S. Dept. of Commerce and Secretary of the Navy 2001), and the Canary Islands 2002 (Martel 2002). Similar military active sonar operations occur around the Hawaiian islands. No estimates of potential mortality or serious injury are available for U.S. waters.

Table 1. Summary of available information on incidental mortality and serious injury of Blainville's beaked whales (Hawaiian stock) in commercial fisheries, within and outside of the Hawaiian Islands EEZ (Forney 2004). Mean annual takes are based on 1998-2002 data unless otherwise indicated.

Fishery Name	Year	Data Type	Percent Observer Coverage	Mortality and Serious Injury outside of U.S. EEZ			Mortality and Serious Injury within Hawaiian Islands EEZ		
				Observed	Estimated (CV)	Mean Annual Takes (CV)	Observed	Estimated (CV)	Mean Annual Takes (CV)
Hawaii-based longline fishery	1998	1998-2002 observer data	4.6%	0	0 (-)	0 (-)	0	0 (-)	0.8 (1.00)
	1999		3.5%	0	0 (-)		0	0 (-)	
	2000		11.8%	0	0 (-)		0	0 (-)	
	2001		22.7%	0	0 (-)		0	0 (-)	
	2002		24.9%	0	0 (-)		1	4 (1.00)	
Minimum total annual takes within U.S. EEZ waters									0.8 (1.00)

STATUS OF STOCK

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. They are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The Hawaiian stock of Blainville's beaked whales is not considered strategic under the 1994 amendments to the MMPA because the estimated rate of fisheries related mortality or serious injury within the Hawaiian Islands EEZ (0.8 animals per year) is less than the PBR (9.6). However, the effect of potential interactions of unidentified beaked whales (which may have been Blainville's beaked whales) with the Hawaii-based longline fishery in U.S. and international waters is not known. Insufficient information is available to determine whether the total fishery mortality and serious injury for Blainville's beaked whales is insignificant and approaching zero mortality and serious injury rate. 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 Blainville's beaked whales that feed in the oceans' "sound channel".

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Revised 03/15/2005

CUVIER'S BEAKED WHALE (*Ziphius cavirostris*): Hawaiian Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Cuvier's beaked whales occur in all oceans and major seas (Heyning 1989). In Hawaii, five strandings have been reported from Midway Islands, Pearl and Hermes Reef, Oahu, and Hawaii Islands (Shallenberger 1981; Galbreath 1963; Richards 1952; Nitta 1991; Maldini 2005). Sightings have been reported off Lanai and Maui (Shallenberger 1981) and Hawaii, Ni'ihau, and Kauai (Mobley 2000, Baird et al. 2004). Four 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 2003). While nothing is known about stock structure, some genetic samples have been collected recently from around the island of Hawaii, and there have been re-sightings of individuals from the island of Hawaii (R.W. Baird, pers. comm.). 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.

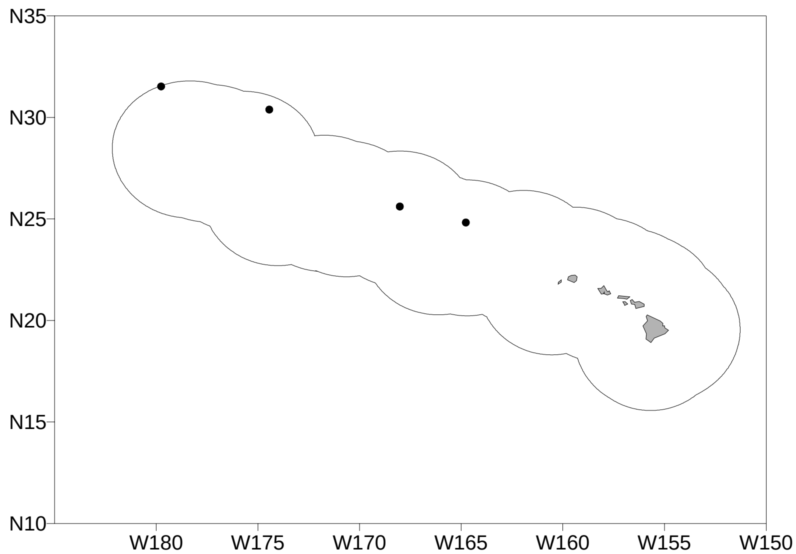

Figure 1. Cuvier's beaked whale sighting locations during the 2002 shipboard survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2003; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ.

POPULATION SIZE

Wade and Gerrodette (1993) made an estimate 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. 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 about 25 nmi of the main Hawaiian Islands in 1993, 1995 and 1998. Seven sightings of Cuvier's beaked whales were made. An abundance estimate of 43 (CV=0.51) Cuvier's beaked whales was calculated from the combined survey data (Mobley et al. 2000). This study underestimated the total number of Cuvier's beaked whales within the U.S. EEZ off Hawaii, because areas around the Northwestern Hawaiian Islands (NWHI) and beyond 25 nautical miles from the main islands were not surveyed. Furthermore, this species is known to spend a large proportion of time diving, causing additional downward bias in the abundance estimate. The data on which this estimate was based are now over 5 years old. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 12,728 (CV=0.83) Cuvier's beaked whales (Barlow 2003), including a correction factor for missed diving animals. This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate is 6,919 Cuvier's beaked 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

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (6,919) 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 69 Cuvier's beaked whales per year.

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 Hawaiian 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).

Interactions with cetaceans are reported for all pelagic fisheries (Nitta and Henderson 1993), but no takes of Cuvier's beaked whales have been documented. None were observed hooked or entangled in the Hawaii-based longline fishery between 1994 and 2002, with approximately 4-25% of all effort observed (Forney 2004). However, three unidentified cetaceans, which may have been Cuvier's beaked whales, were taken in this fishery (Figure 2, Forney 2004). Since 2001, the Hawaii-based longline fishery has undergone a series of regulatory changes, primarily to protect sea turtles (NMFS 2001). Potential impacts of these regulatory changes on the rate of Cuvier's beaked whale interactions are unknown.

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 (Malakoff 2002). The use of active sonar from military vessels has been implicated in mass strandings of beaked whales in the Mediterranean Sea during 1996 (Frantzis 1998), the Bahamas during 2000 (U.S. Dept. of Commerce and Secretary of the Navy 2001), and the Canary Islands 2002 (Martel 2002). Similar military active sonar operations occur around the Hawaiian islands. No estimates of potential mortality or serious injury are available for U.S. waters.

STATUS OF STOCK

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. They are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The Hawaiian stock of Cuvier's beaked whales is not considered strategic under the 1994 amendments to the MMPA because there has been no reported fisheries related mortality within the Hawaiian Islands EEZ. However, the effect of potential interactions of unidentified beaked whales (which may have been Cuvier's beaked whales) with the Hawaii-based longline fishery in U.S. and international waters is not known. Insufficient information is available to determine whether the total fishery mortality and serious injury for Cuvier's beaked whales is insignificant and approaching zero mortality and serious injury rate. 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 Cuvier's beaked whales that feed in the oceans' "sound channel".

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Revised 03/15/2005

LONGMAN'S BEAKED WHALE (*Indopacetus pacificus*): Hawaiian Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Longman's beaked whale is considered one of the rarest and 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 Indopacific 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. No strandings of Longman's beaked whales have been documented in Hawaiian waters, although numerous strandings of unidentified beaked whales have been reported (Nitta 1991; Maldini 2005). One sighting of Longman's beaked whale was made during a 2002 survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands (Figure 1; Barlow 2003). 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.

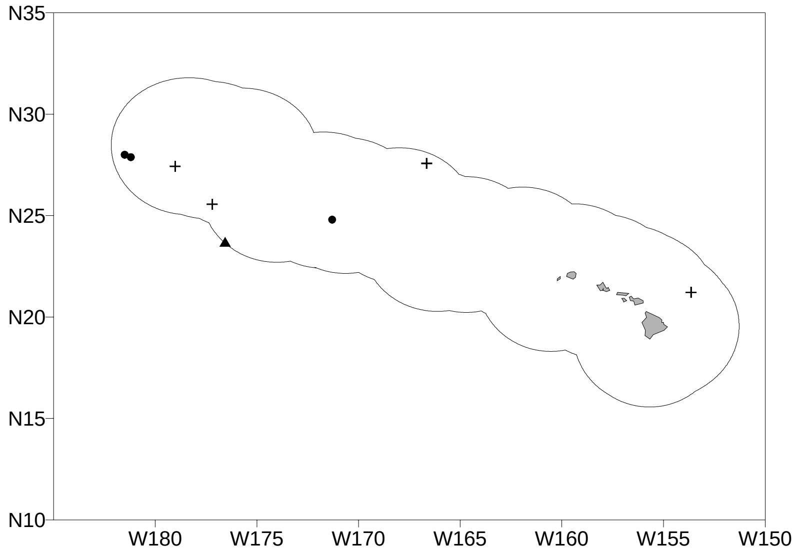

Figure 1. Sighting locations of Indopacetus pacificus (triangle), Mesoplodon densirostris (circle) and unidentified Mesoplodon beaked whales (crosses) during the 2002 shipboard cetacean survey of U.S. waters surrounding the Hawaiian Islands (Barlow 2003; see Appendix 2 for details on timing and location of survey effort). Outer line indicates approximate boundary of survey area and U.S. EEZ.

POPULATION SIZE

A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 766 (CV=1.05) Longman's beaked whales (Barlow 2003). This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate is 371 Longman's beaked 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 Longman's beaked whales.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (371) 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 3.7 Longman's beaked whales per year.

HUMAN CAUSED MORTALITY AND SERIOUS INJURY

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. 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).

Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nitta and Henderson 1993), but none of these interactions are known to have involved Longman's beaked whales. None were observed hooked or entangled in the Hawaii-based longline fishery between 1994 and 2002, with approximately 4-25% of all effort (measured as the number of sets made) observed by on-board observers (Forney 2004). However, there were two interactions with unidentified whales that may have been Longman's beaked whales (Figure 2). Since 2001, the Hawaii-based longline fishery has undergone a series of regulatory changes, primarily to protect sea turtles (NMFS 2001). Potential impacts of these regulatory changes on the rate of Longman's beaked whale interactions are unknown.

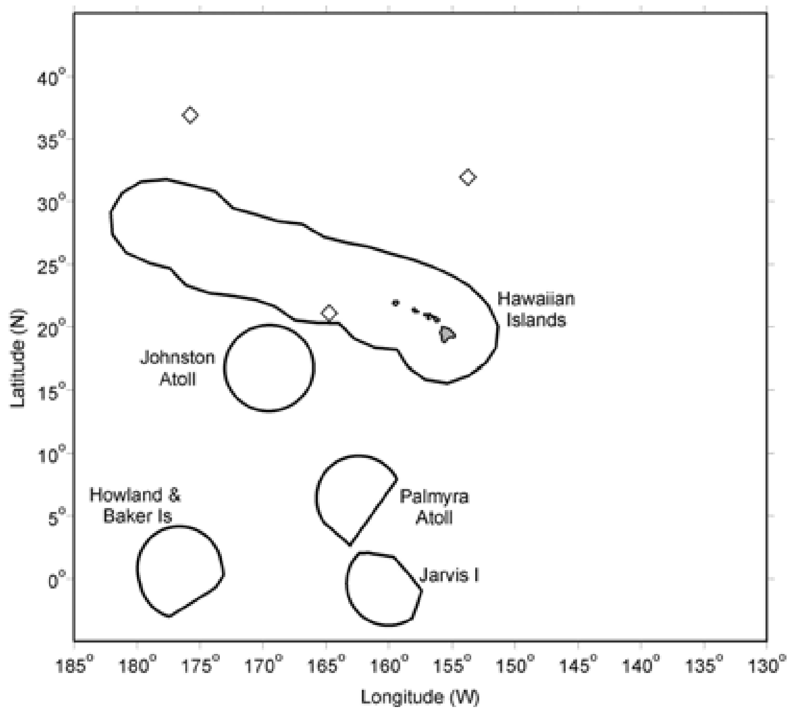

Figure 2. Locations of observed takes of possible Longman's beaked whales (open diamonds) in the Hawaii-based longline fishery 1994-2002. The solid lines represent the U.S. Exclusive Economic Zone (EEZ).

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 (Malakoff 2002). The use of active sonar from military vessels has been implicated in mass strandings of beaked whales in the Mediterranean Sea during 1996 (Frantzis 1998), the Bahamas during 2000 (U.S. Dept. of Commerce and Secretary of the Navy 2001), and the Canary Islands 2002 (Martel, 2002). Similar military active sonar operations occur around the Hawaiian islands. No estimates of potential mortality or serious injury are available for U.S. waters.

STATUS OF STOCK

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. They are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The Hawaiian stock of Longman's beaked whales is not considered strategic under the 1994 amendments to the MMPA, because there has been no reported fisheries related mortality or serious injury within the Hawaiian Islands EEZ. However, the effect of potential interactions of unidentified beaked whales (which may have been Longman's beaked whales) with the Hawaii-based longline fishery in U.S. and international waters is not known. Insufficient information is available to determine whether the total fishery mortality and serious injury for Longman's beaked whales is insignificant and approaching zero mortality and serious injury rate. 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 Longman's beaked whales that feed in the oceans' "sound channel".

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PYGMY SPERM WHALE (*Kogia breviceps*): Hawaiian Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Pygmy sperm whales are found throughout the world in tropical and warm-temperate waters (Caldwell and Caldwell 1989). Between the years 1949 and 2002, at least 22 strandings of this species were reported in the Hawaiian Islands (Tomich 1986; Nitta 1991; Maldini 2005). A stranded calf was held for several days at Sea Life Park (Pryor 1975:94). Shallenberger (1981) reported three sightings off Oahu and Maui. Two sightings of pygmy or dwarf sperm whales were made between Hawaii and Maui during 1993-98 aerial surveys within about 25 nmi of the main Hawaiian Islands (Mobley et al. 2000). 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 2003). Baird (2005) reported one sighting off Ni'ihau and another off the island off Hawaii (R.W. Baird, pers. comm.). 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 discrete, non-contiguous areas: 1) Hawaiian waters (this report), and 2) waters off California, Oregon and Washington.

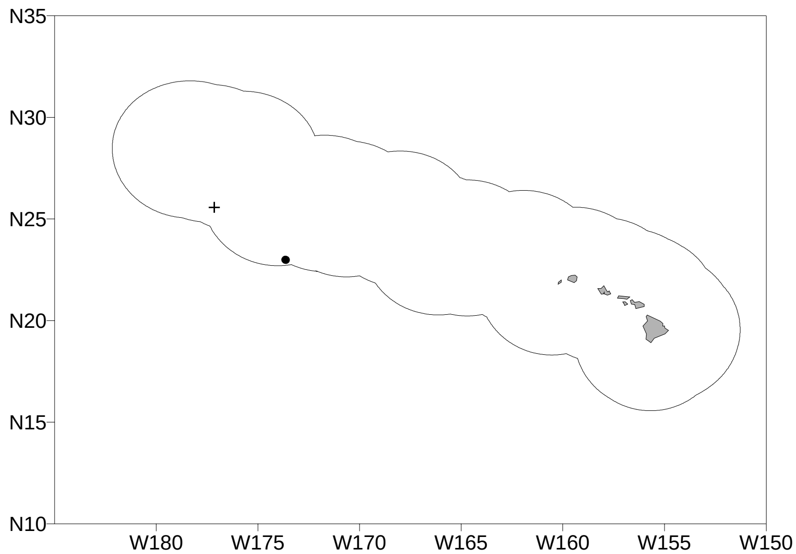

Figure 1. Sighting locations of pygmy sperm whales (filled circle) and unidentified Kogia (cross) during the 2002 shipboard cetacean survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2003; see Appendix 2 for details on timing and location of survey effort). Outer line indicates approximate boundary of survey area and U.S. EEZ.

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 about 25 nmi of the main Hawaiian Islands in 1993, 1995 and 1998. Two sightings of five pygmy or dwarf sperm whales were made; however, these sightings were excluded during abundance analyses (Mobley et al. 2000), because they were made during poor observation conditions. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 7,251 (CV=0.77) pygmy sperm whales (Barlow 2003), including a correction factor for missed diving animals. This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate is 4,082 pygmy sperm 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

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (4,082) <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 known fishery mortality or serious injury within the Hawaiian Islands EEZ; Wade and Angliss 1997), resulting in a PBR of 41 pygmy sperm whales per year.

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 Hawaiian 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). Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nitta and Henderson 1993), but no interactions with pygmy sperm whales have been documented. None were observed hooked in the Hawaii-based longline fishery between 1994 and 2002, with approximately 4-25% of all effort observed (Forney 2004).

STATUS OF STOCK

The status of pygmy sperm whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. They are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The Hawaiian stock of pygmy sperm whales is not considered strategic under the 1994 amendments to the MMPA because there has been no reported fisheries related mortality or serious injury. Insufficient information is available to determine whether the total fishery mortality and serious injury for pygmy sperm whales is insignificant and approaching zero mortality and serious injury rate. 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 pygmy sperm whales that feed in the oceans' "sound channel".

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DWARF SPERM WHALE (*Kogia sima*): Hawaiian Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Dwarf sperm whales are found throughout the world in tropical to warm-temperate waters (Nagorsen 1985). Rice (1998) recently argued that the species name *simus*, was incorrect and should be replaced by *sima* to reflect rules of Latin usage. At least four strandings of dwarf sperm whales have been documented in Hawaii (Tomich 1986; Nitta 1991; Maldini 2005). Two sightings of pygmy or dwarf sperm whales were made between Hawaii and Maui during 1993-98 aerial surveys within about 25 nmi of the main Hawaiian Islands (Mobley et al. 2000). Five sightings of dwarf sperm whale were made during a 2002 shipboard survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands (Figure 1; Barlow 2003). Baird (2005) reports that dwarf sperm whales are the sixth most commonly sighted odontocete around the main Hawaiian islands. This species' small size, tendency to avoid vessels, deep-diving habits, combined with the high proportion of Kogia sightings that are not identified to species, may result in negatively biased relative abundances in this region (R.W. Baird, pers. comm.). 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.

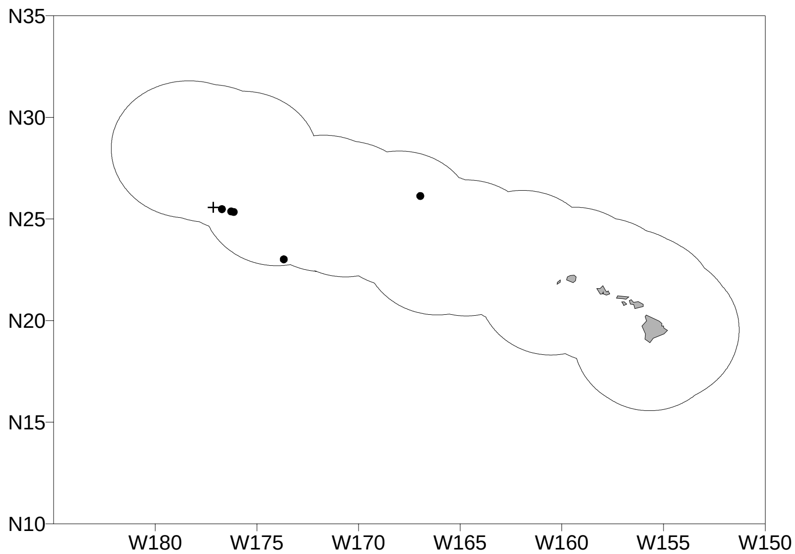

Figure 1. Sighting locations of dwarf sperm whales (filled circle) and unidentified Kogia (cross) during the 2002 shipboard cetacean survey of U.S. waters surrounding the Hawaiian Islands (Barlow 2003; see Appendix 2 for details on timing and location of survey effort). Outer line indicates approximate boundary of survey area and U.S. EEZ.

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. 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 about 25 nmi of the main Hawaiian Islands in 1993, 1995 and 1998. Two sightings of five pygmy or dwarf sperm whales were made; however these sightings were excluded during abundance analyses (Mobley et al. 2000), because they were made during poor observation conditions. Therefore, no abundance was estimated from these surveys for dwarf sperm whales within Hawaiian waters. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 19,172 (CV=0.66) dwarf sperm whales (Barlow 2003), including a correction factor for missed diving animals. This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate is 11,555 dwarf sperm 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

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (11,555) 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 116 dwarf sperm whales per year.

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 Hawaiian 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). Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nitta and Henderson 1993), but no interactions with dwarf sperm whales have been documented. None were observed hooked in the Hawaii-based longline fishery between 1994 and 2002, with approximately 4-25% of all effort observed (Forney 2004).

STATUS OF STOCK

The status of dwarf sperm whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. They are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The Hawaiian stock of dwarf sperm whales is not considered strategic under the 1994 amendments to the MMPA because there has been no reported fisheries related mortality or serious injury. Insufficient information is available to determine whether the total fishery mortality and serious injury for dwarf sperm whales is insignificant and approaching zero mortality and serious injury rate. 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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SPERM WHALE (*Physeter macrocephalus*): Hawaiian 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°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°W at the equator, is 160°W between 40-50°N, and ends up at 180°W north of 50°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°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 18 strandings have been reported from Oahu, Kauai and Kure Atoll (Woodward 1972; Nitta 1991; Maldini 2005). Sperm whales have also been sighted around several of the Northwestern Hawaiian Islands (Rice 1960; Barlow 2003), off the main island of Hawaii (Lee 1993; Mobley et al. 2000) in the Kauai Channel and in the Alenuihaha Channel between Maui and the island of Hawaii (Shallenberger 1981). In addition, the sounds of sperm whales have been recorded throughout the year off Oahu (Thompson and Friedl 1982). A summer/fall 2002 shipboard survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands resulted in 43 sperm whale sightings throughout the study area (Figure 1; Barlow 2003).

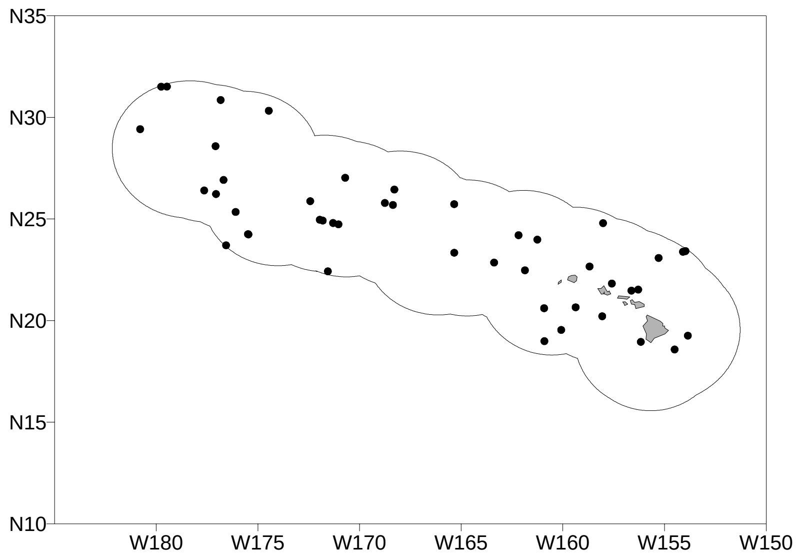

Figure 1. Sperm whale sighting locations during the 2002 shipboard survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2003; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ.

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), but much uncertainty remains. 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 1998). Very preliminary genetic analyses revealed significant differences between sperm whales off the coast of California, Oregon and Washington and those sampled offshore to Hawaii (Mesnick et al., unpubl. data); analyses of additional genetic samples are ongoing at the NMFS, Southwest Fisheries Science Center. 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) waters around Hawaii (this report), 2) California, Oregon and Washington waters, and 3) Alaskan waters.

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 24,000 (CV=0.46) sperm whales based on visual sightings, and 39,200 (CV=0.60) based on acoustic detections and visual group size estimates (Barlow and Taylor 1998). 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. 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 about 25 nmi of the main Hawaiian Islands in 1993, 1995 and 1998. An average abundance estimate of 66 (CV=0.56) sperm whales was calculated from the combined survey data (Mobley et al. 2000). This study underestimated the total number of sperm whales within the U.S. EEZ off Hawaii, because areas around the Northwestern Hawaiian Islands (NWHI) and beyond 25 nautical miles from the main islands were not surveyed. Furthermore, this species is known to spend a large proportion of time diving, causing additional downward bias in the abundance estimate. The data on which this estimate was based are now over 5 years old. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 7,082 (CV=0.30) sperm whales (Barlow 2003), including a correction factor for missed diving animals. This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate is 5,531 sperm whales.

Current Population Trend

No data on current population trend are available.

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 this stock is calculated as the minimum population size (5,531) 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; Wade and Angliss 1997), resulting in a PBR of 11 sperm whales per year.

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 Hawaiian 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).

Interactions with cetaceans are reported for all pelagic fisheries, and large whales have been entangled in longlines off the Hawaiian Islands (Nitta and Henderson 1993; NMFS/PIR, unpublished data). Between 1994 and 2002, one sperm whale was observed entangled within the Hawaiian Islands EEZ in the Hawaii-based longline fishery, with approximately 4-25% of all effort observed (Table 1; Forney 2004). During the 905 observed trips with 11,014 sets, the average interaction rate of sperm whales was one animal per 905 fishing trips, or one animal per 11,014 sets. The

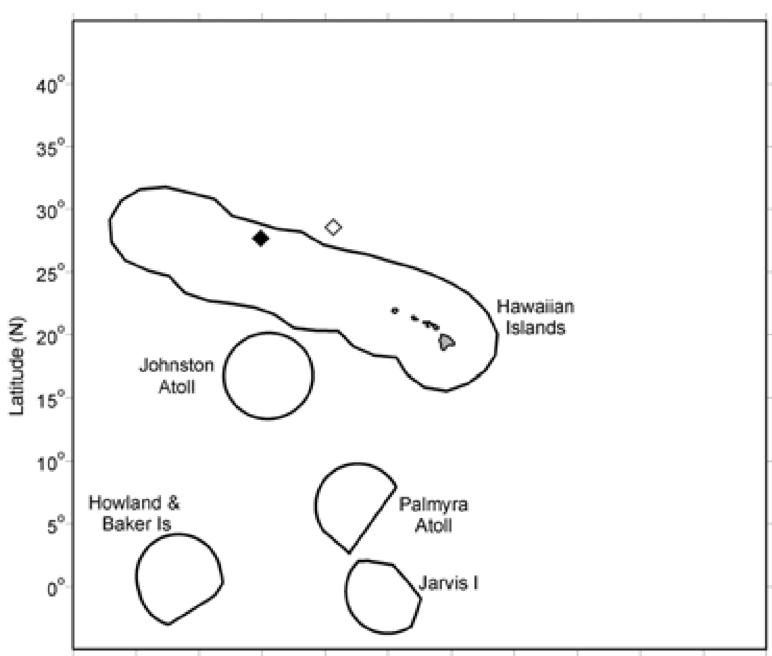

Figure 2. Location of the observed sperm whale take in the Hawaii-based longline fishery, 1998-2002 (filled diamond), and the take observed during an experimental longline set in 2002 (open diamond). Solid lines represent the U.S. Exclusive Economic Zone (EEZ).

caught animal was apparently able to free itself and was not considered seriously injured (Forney 2004), following established guidelines for assessing serious injury in marine mammals (Angliss and DeMaster 1998). The average 5-yr estimate of annual mortality and serious injury within the Hawaiian Islands EEZ during 1998-2002 is zero sperm whales. One additional sperm whale was observed taken in an experimental set outside the U.S. EEZ, but the severity of its injuries could not be determined (Forney 2004). Since 2001, the Hawaii-based longline fishery has undergone a series of regulatory changes, primarily to protect sea turtles (NMFS 2001). Potential impacts of these regulatory changes on the rate of sperm whale interactions are unknown.

Table 1. Summary of available information on incidental mortality and serious injury of sperm whales (Hawaiian stock) in commercial fisheries, within and outside of the Hawaiian Islands EEZ (Forney 2004). Mean annual takes are based on 1998-2002 data unless otherwise indicated; n/a = not available.

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Mortality and Serious Injury outside of U.S. EEZ			Mortality and Serious Injury within Hawaiian Islands EEZ		
				Observed	Estimated (CV in parentheses)	Mean Annual Takes (CV in parentheses)	Observed	Estimated (CV in parentheses)	Mean Annual Takes (CV in parentheses)
Hawaii-based longline fishery	1998 1999 2000 2001 2002	1998-2002 observer data	4.6% 3.5% 11.8% 22.7% 24.9%	0 0 0 0 0	0 (-) 0 (-) 0 (-) 0 (-) 0 (-)	0 (-)	0 0 0 0 0	0 (-) 0 (-) 0 (-) 0 (-) 0 (-)	0 (-)
Experimental longline fishery	2002	observed		1	n/a	0.2 (n/a)			
Minimum total annual takes within U.S. EEZ waters									0 (-)

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) estimate that about 89,000 whales were additionally taken by the Soviet pelagic whaling fleet between 1949 and 1979. The 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. 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. Furthermore, the effect of interactions with the Hawaii-based longline fishery in U.S. and international waters is not known. 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 sperm whales that feed in the oceans' "sound channel".

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Revised 03/15/2005

BLUE WHALE (*Balaenoptera musculus*): Western 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 fed in the eastern Aleutians or Gulf of Alaska and returned to feed in California waters; however, he has 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) support separate population status for blue whales feeding off California and those feeding in Alaskan waters. Whaling catch data indicate that whales feeding along the Aleutian Islands are probably part of a central Pacific stock (Reeves et al. 1998), which may 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); however, blue whale calls have been recorded there between 1995 and 2001 (Stafford et al. 2001, Stafford 2003).

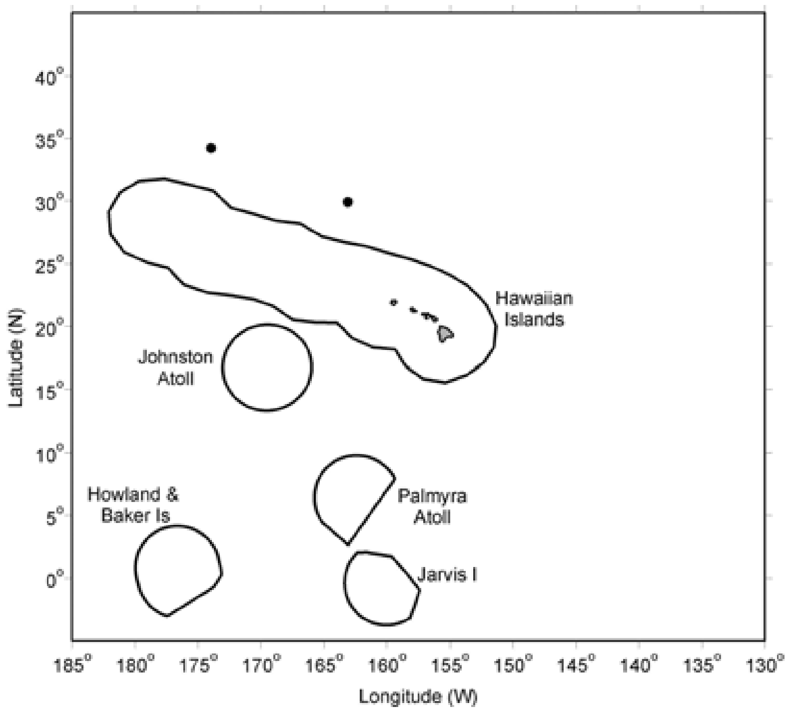

Figure 1. Locations of two blue whale sightings made by observers aboard Hawaii-based longline fishing vessels in July 1994 and February 1997 (NMFS/PIR unpublished data). Solid lines represent the U.S. Exclusive Economic Zone (EEZ).

Recent analyses of acoustic data obtained throughout the North Pacific Ocean (Stafford et al. 2001; Stafford 2003) has revealed two distinct blue whale call types, suggesting two North Pacific stocks: eastern and western. The regional occurrence patterns indicate that blue whales from the eastern North Pacific stock winter off Mexico, central America, and as far south as 8ES (Stafford et al. 1999), and feed during summer off the U. S. West Coast and to a lesser extent in the Gulf of Alaska, and in central North Pacific waters. This stock has previously been documented 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^{o} N) in winter/spring (Mate et al. 1999, Stafford et al. 1999). Blue whales belonging to the western 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 they migrate to lower latitudes in the western Pacific and less frequently in the central Pacific, including Hawaii (Stafford et al. 2001). The only published sighting record of blue whales near Hawaii is that of Berzin and Rovnin (1966). Two 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 included at least some within the U.S. Exclusive Economic Zone (EEZ). The recordings made off Hawaii showed bimodal peaks throughout the year (Stafford et al. 2001), with western 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 western North Pacific stock (this report), which includes whales found around the Hawaiian Islands during winter, 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. A weighted average estimate of 1,744 blue whales is available for California, Oregon and Washington, based on shipboard line-transect surveys in 1996 and 2002(Barlow 2003a) and photographic mark-recapture estimates (Calambokidis et al. 2003). No data are available to estimate population size for any other North Pacific blue whale population, including the putative central stock that apparently summered along the Aleutians and wintered north of Hawaii. No blue whale sightings were made during a summer 1994 shipboard survey south of the Aleutian Islands (Forney and Brownell 1996), during twelve aerial surveys conducted in 1993-98 within about 25 nmi of the main Hawaiian Islands (Mobley et al. 2000), or during a summer/fall 2002 shipboard surveys of the entire Hawaiian Islands EEZ (Barlow 2003b). Therefore, no estimate of abundance is available for the western Pacific blue whale stock.

Minimum Population Estimate

No data are available to provide a minimum population estimate.

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 be calculated for this stock at this time.

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 Hawaiian 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). Large whales have been entangled in longline gear off the Hawaiian Islands (Nitta and Henderson 1993, Forney 2004), but no interactions with blue whales were observed in the Hawaii-based longline fishery between 1994 and 2002, with approximately 4-25% of all effort observed (Forney 2004).

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 Hawaiian stock is automatically considered as a "depleted" and "strategic" stock under the MMPA. Insufficient information is available to determine whether the total fishery mortality and serious injury for blue whales is insignificant and approaching zero mortality and serious injury rate. 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).

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FIN WHALE (*Balaenoptera physalus*): Hawaiian Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Fin whales are found throughout all oceans and seas of the world from tropical to polar latitudes. They have been considered rare in Hawaiian waters. 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 and in the Kauai Channel in February 1979 (Shallenberger 1981). More recently, a single fin whale was observed north of Kauai in February 1994 (Mobley et al. 1996), and five sightings were made during a 2002 survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands (Barlow 2003; Figure 1). A single stranding has been reported on Maui (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.

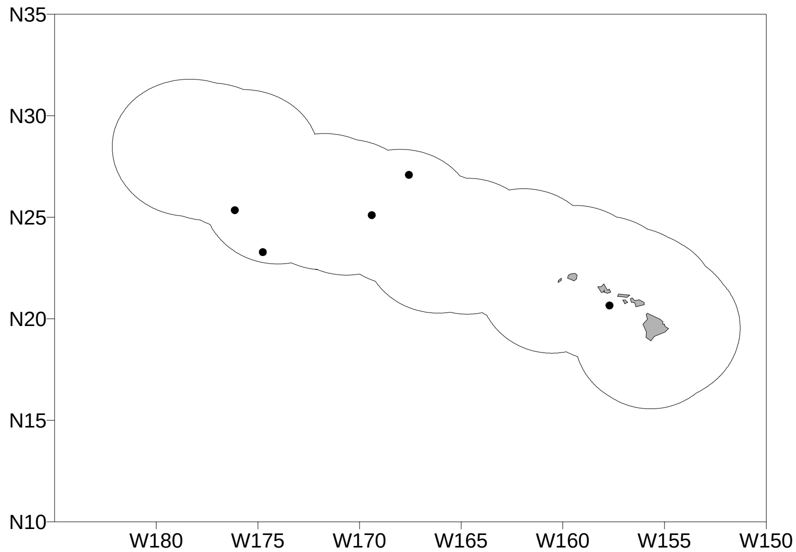

Figure 1. Fin whale sighting locations during the 2002 shipboard survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2003; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ.

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) cites 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.

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 about 25 nmi of the main Hawaiian Islands in 1993-98 (Mobley et al. 2000). Only one sighting of a single fin whale was made (Mobley et al. 1996), and no abundance estimate was calculated. Using passive acoustic detections from a hydrophone north of Oahu, MacDonald and Fox (1999) estimate 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). This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate is 101 fin 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

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (101) 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; Wade and Angliss 1997), resulting in a PBR of 0.2 fin whales per year.

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 Hawaiian 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). Interactions with cetaceans are reported for all pelagic fisheries, and large whales have been entangled in longline gear off the Hawaiian Islands (Nitta and Henderson 1993, Forney 2004). Between 1994 and 2002, no interactions with fin whales were observed in the Hawaii-based longline fishery, with approximately 4-25% of all effort observed (Forney 2004).

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. Insufficient information is available to determine whether the total fishery mortality and serious injury for fin whales is insignificant and approaching zero mortality and serious injury rate. 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).

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BRYDE'S WHALE (*Balaenoptera edeni*): Hawaiian Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bryde's whales occur in tropical and warm temperate waters throughout the world. Shallenberger (1981) reported a sighting of a Bryde's whale southeast of Nihoa in April 1977 (see DeLong and Brownell 1977; Leatherwood et al. 1982: Fig. 39c). 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, but the basis for this statement was not explained. 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). A summer/fall 2002 shipboard survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands resulted in 13 Bryde's whale sightings throughout the study area (Figure 1; Barlow 2003).With presently available evidence, there is no biological basis for defining separate stocks of Bryde's whales in the central North Pacific. Bryde's whales also occasionally occur off southern California (Morejohn and Rice 1973). 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 tropical Pacific (east of 150^{o}W and including the Gulf of California and waters off California).

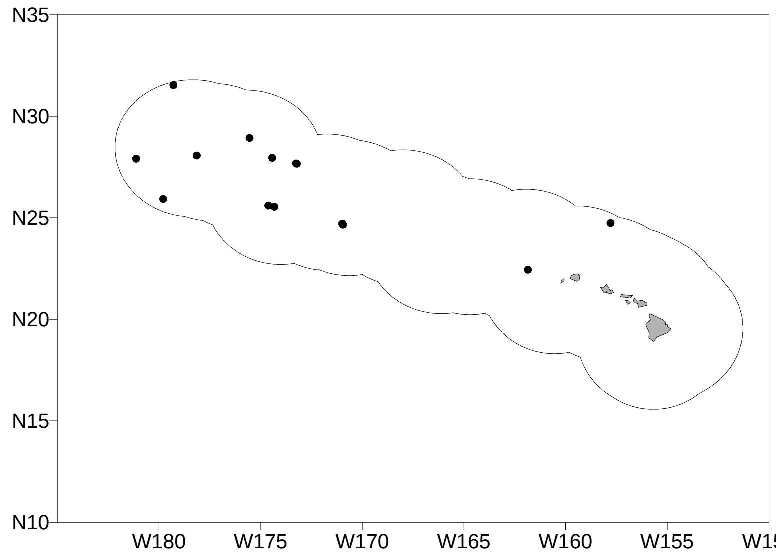

Figure 1. Bryde's whale sighting locations during the 2002 shipboard survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2003; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ.

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=0.202) 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 east and somewhat south of the Hawaiian Islands, and it is not known whether these animals are part of the same population that occurs around the Hawaiian Islands. 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 about 25 nmi of the main Hawaiian Islands in 1993, 1995 and 1998 (Mobley et al. 2000). No sightings of Bryde's whales were made. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 493 (CV=0.34) Bryde's whales (Barlow 2003). This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate is 373 Bryde's 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

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (373) 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 3.7 Bryde's whales per year.

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 Hawaiian 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). Interactions with cetaceans are reported for all pelagic fisheries, and large whales have been entangled in longline gear off the Hawaiian Islands (Nitta and Henderson 1993, Forney 2004). Between 1994 and 2002, no interactions with Bryde's whales were observed in the Hawaii-based longline fishery, with approximately 4-25% of all effort observed (Forney 2004).

Historical Mortality

Small numbers of Bryde's whales were taken near the Northwestern Hawaiian Islands by Japanese and Soviet whaling fleets during 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 status of Bryde's whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. They are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The Hawaiian stock of Bryde's whale is not considered strategic under the 1994 amendments to the MMPA because there has been no reported fisheries related mortality or serious injury. Insufficient information is available to determine whether the total fishery mortality and serious injury for fin whales is insignificant and approaching zero mortality and serious injury rate. 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).

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Revised 03/15/2005

SEI WHALE (*Balaenoptera borealis*): Hawaiian 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 45-55°N (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. 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. Four sightings of sei whales were recently made during a summer/fall 2002 shipboard survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands (Figure 1; Barlow 2003). For the Marine Mammal Protection Act (MMPA) stock assessment reports, sei whales within the Pacific U.S. EEZ are divided into three discrete, non-contiguous areas: 1) waters around Hawaii (this report), 2) California, Oregon and Washington waters, and 3) Alaskan waters.

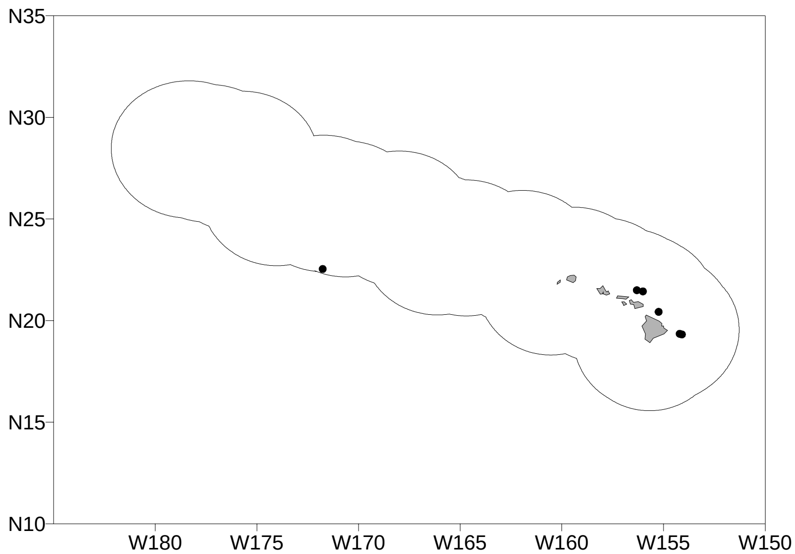

Figure 1. Sei whale sighting locations during the 2002 shipboard cetacean survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2003; see Appendix 2 for details on timing and location of survey effort). Outer line indicates approximate boundary of survey area and U.S. EEZ.

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 North Pacific based on sighting surveys. 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 about 25 nmi of the main Hawaiian Islands in 1993-98 (Mobley et al. 2000), but no sightings of sei whales were made. 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). This is currently the best available abundance estimate for this stock, but the majority of sei whales would be expected to be at higher latitudes in their feeding grounds at this time of year.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate is 37 sei whales.

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.

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 (37) 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; Wade and Angliss 1997), resulting in a PBR of 0.1 sei whales per year.

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 Hawaiian 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). Interactions with cetaceans are reported for all pelagic fisheries, and large whales have been entangled in longline gear off the Hawaiian Islands (Nitta and Henderson 1993; Forney 2004). Between 1994 and 2002, no interactions with sei whales were observed in the Hawaii-based longline fishery, with approximately 4-25% of all effort observed (Forney 2004).

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. Insufficient information is available to determine whether the total fishery mortality and serious injury for sei whales is insignificant and approaching zero mortality and serious injury rate. 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).

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Revised 03/15/2005

MINKE WHALE (*Balaenoptera acutorostrata*): Hawaiian 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).

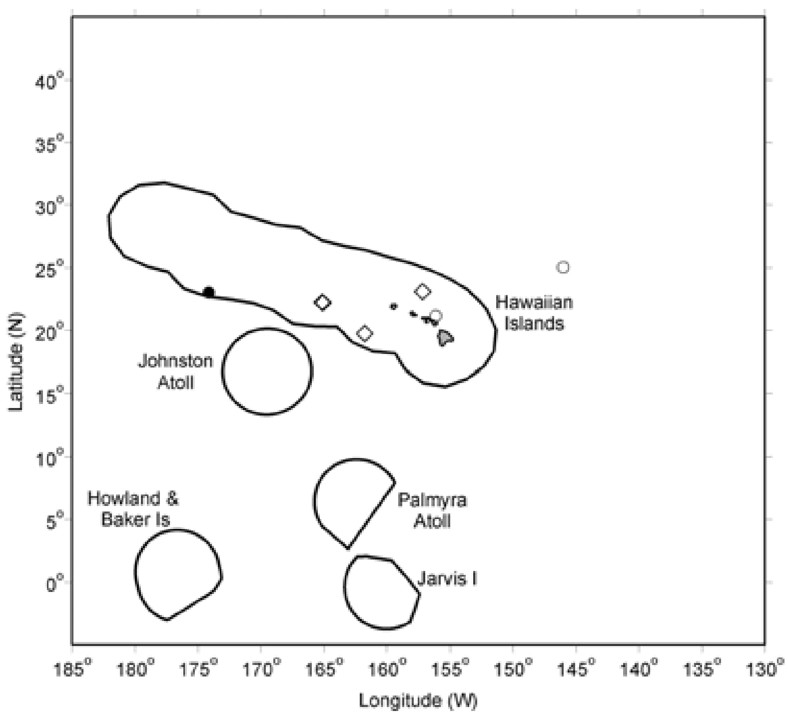

Figure 1. Locations of minke whale sightings from longline observer records (diamonds; NMFS/PIR, unpublished data), and sighting (closed circle) and acoustic detections (open circles) made during the 2002 shipboard survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2003; see Appendix 2 for details on timing and location of survey effort). Solid lines represent the U.S. EEZ.

Minke whales have only been recently confirmed to occur seasonally around the Hawaiian Islands (Barlow 2003, Rankin and Barlow, in prep), and their migration routes or destinations are not known. Four reliable sightings of minke whales were made by observers in the Hawaii-based longline fishery during the months of December-March, 2000-2002 (Figure 1; NMFS/PIR unpublished data). One confirmed sighting of a minke whale was made in November 2002 during a survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands (Barlow 2003), and additional acoustic detections of this species' distinctive call (known as the 'boing') were made that could not be visually verified (Figure 1). There are no known stranding records of this species from the main islands (Nitta 1991; Maldini 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.

POPULATION SIZE

A summer/fall 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in one 'off effort' sighting of a minke whale following the acoustic detection of a so-called 'boing' (Barlow 2003; Rankin and Barlow, in prep). This sighting was not part of regular survey operations and, therefore, could not be used to calculate an estimate of abundance (Barlow 2003). Furthermore, 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 November - March) 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 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

No PBR can be calculated for this stock at this time.

HUMAN CAUSED MORTALITY AND SERIOUS INJURY

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. 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). Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nitta and Henderson 1993), but none of these interactions are known to have involved minke whales. None were observed hooked or entangled in the Hawaii-based longline fishery between 1994 and 2002, with approximately 4-25% of all effort (measured as the number of sets made) observed by on-board observers (Forney 2004).

STATUS OF STOCK

The status of minke whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. They are not listed as “threatened” or “endangered” under the Endangered Species Act (1973), nor as “depleted” under the MMPA. Although information on minke whales in Hawaiian waters is limited, this stock would not be considered strategic under the 1994 amendments to the MMPA because there has been no reported fisheries related mortality or serious injury within the Hawaiian Islands EEZ. Insufficient information is available to determine whether the total fishery mortality and serious injury for minke whales is insignificant and approaching zero mortality and serious injury rate. 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).

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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 mortalities and serious injuries 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 mortalities, 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, vol. 69 no. 231 dated 02 December 2004.

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, and Washington. 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 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 or mortality to 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 1998-2002, there were 115 fisher self-reports of marine mammal interactions in the California swordfish/thresher shark drift gillnet fishery. This compares with 201 observed interactions over the same period, based on only 20% observer coverage. This suggests that fisher self-reports are grossly underreported.

3. NMFS Marine Mammal Stranding Network data

In California, for the years 1998 through 2002 there were 120, 154, 152, 100, and 183 cetacean strandings respectively and 3568, 1066, 1857, 1482, and 2,367 pinniped strandings respectively. In Oregon/Washington from 1998-2002, there were 43, 50, 48, 28, and 17 reported cetacean strandings and 321, 267, 235, 250, 139 pinniped strandings, respectively. Approximately 10% of all cetacean and 7% of all pinniped strandings showed 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. A species summary of all cetacean and pinniped strandings for the period 1998-2002 is given in Table 2 of this Appendix.

4. Fishery Descriptions

Category I, CA/OR thresher shark/swordfish drift gillnet fishery (≥14 inch mesh)

Note: NMFS has proposed reclassifying this fishery to a Category I, based on a revised PBR level for short-finned pilot whales and an observed take of a short-finned pilot whale in this fishery in 2003 (Federal Register vol. 69 no. 231 dated 02 December 2004).

Number of permit holders: The number of eligible permit holders in California for 1998-2002 are 148, 136, 126, 113, and 105, respectively.

Number of active permit holders: The number of vessels active in this fishery from 1998-2002 were 123, 96, 81, 65, and 56, respectively.

Total effort: Both estimated and observed effort for the drift-net fishery during the calendar years 1990 through 2002 are shown in Figure 7. In 2002 there was an estimated 1,630 effort-days, where an effort-day is defined to be one day of effort by one vessel. (In this fishery, 1 effort-day is equivalent to 1 set.). There were 360 (64 trips) observed effort-days in 2002.

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 1-5 show locations of observed sets and Figure 6 shows approximate locations of observed marine mammal entanglements for the period 1998-2002.

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 angel shark/halibut 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^o 17') to N 34^o 27' W 123^o 35', west to W129^o, north to N 45^o, then east to the Oregon coast. The Highly Migratory Species Management Team of the Pacific Fishery Management Council is considering re-opening the area south of Point Sur, California in this fishery. 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, Vol 68, No 241, 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) administered by the Pacific Fishery Management Council.

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 July 1990. Due to bycatch of strategic stock including short-finned pilot whale, beaked whales, sperm whale and humpback whale, a Take Reduction Team was formed February 12, 1996. Since then, the implementation of increased extender lengths and the deployment of pingers has 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 as larger vessels drop out of this fishery.

Category I, CA angel shark/halibut and other species set gillnet fishery (>3.5 inch mesh).

Note: The "**CA angel shark/halibut set gillnet fishery**" and "**CA other species, large mesh (>3.5 in) set gillnet fishery**" were previously listed as separate fisheries. Angel shark and 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 for 1998 through 2002 are, respectively, 255, 245, 232, 223, and 209.

Number of active permit holders: For the period 1998-2001, there were 45, 66, 62, 57, and 52 active permit holders in this fishery.

Total effort: Effort in the angel shark/halibut set-net fishery has historically been as high as 7,000 days in 1991, declined to fewer than 2,000 days following a gillnet closure within 3 nautical miles of the mainland and 1 nmi of the Channel Islands in 1994, and has been steady at about 3,000-4,000 days in the last five years. A summary of estimated fishing effort and observer coverage for the years 1990-2002 is shown in Figure 8. Effort in the white seabass and yellowtail portion of this fishery from 1998 to 2002 were 761, 460, 657, 551, and 733 days, respectively. For the first two quarters of 2003, there were 366 days fished. A portion of the effort in the white seabass and yellowtail fishery utilizes drifting nets (see "CA yellowtail, barracuda, white seabass, and tuna drift gillnet fishery (>3.5 and <14 in mesh)" fishery description below).

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/angel shark set-net fishery is a limited entry fishery with gear restrictions and area closures.

Comments: An observer program for the halibut/angel shark 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, and the stock is currently designated as 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. 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.

Category I, Hawaii swordfish, tuna, billfish, mahi mahi, wahoo, and oceanic shark longline/set line fishery.[1]

Note: 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 mortalities in this fishery (Federal Register Vol. 69 No. 153, dated 10 August 2004).

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 (approximately 126 were renewed in 2003). Most holders of Hawaii longline limited access permits are based in, or operate out of, Hawaii. Longline general permits are not limited by number. Approximately 67 longline general permits were issued in 2003, about 48 of which were active. In 2003 all but two holders of longline general permits were based in, or operated out of, American Samoa. The remaining two, neither of which was active in 2003, were based in the Mariana Islands (Federal Register 2 April 2004, Volume 69 Number 64).

[1] This fishery description was provided in part by Chris Yates (NMFS) and from published fishery regulations in the Federal Register Vol. 69. No. 153, dated 10 August 2004.

Number of active permit holders: From 1998-2002 there were 115, 122, 125, 101, and 102 vessels actively fishing, respectively. There were 126 permits renewed in 2003 (Federal Register 2 April 2004, Volume 69 Number 64). In 2004, there were 125 Hawaii longline limited access permits renewed, with 119 active. In 2004, there were 40 active permits in American Samoa.

Total effort: For the years 1998-2002, there were 1,181, 1,165, 1,135, 1,075, and 1,193 trips made respectively. The number of hooks set has steadily increased since 1997 (15.5 million) and peaked in 2002 with 27 million hooks set. In 2002, most effort occurred within the U.S. EEZ (approximately 15 million hooks set), while 12 million hooks were set outside the U.S. EEZ. At Kingman Reef and Palmyra Atoll there were 2.1 million hooks set in 2002. In 2003, there were 1,214 trips recorded (with tuna as the target species). There were a total of 29.8 million hooks set in 2003, of these, 15 million occurred outside the U.S. EEZ, 11 million within the Main Hawaiian Islands EEZ, 2.7 million within the Northwest Hawaiian Islands EEZ, and the remaining 0.9 million within other U.S. possession EEZs. The preliminary estimate of hooks fished in 2004 is 32 million hooks. 2003 logbook data for American Samoa consisted of 932 trips by 51 vessels, which made 6,220 sets, with 14.2 million hooks fished. Preliminary logbook data from 2004 in American Samoa consists of 623 trips by 40 vessels, which made 4,804 sets, with 11.6 million hooks fished.

Geographic range: This fishery encompasses a huge geographic range extending North-South from 40° N to the equator and East-West from Kure Atoll to as far as 135° W. Fishing for swordfish generally occurs north of Hawaii, (as much as 2,000 miles from Honolulu), whereas fishing for tunas occurs around the Main Hawaiian Islands (MHI) and south of the Hawaiian Islands. New regulations published in 2004 lift previous area closures north of the equator.

Seasons: This fishery operates year-round. Effort is generally lower in the third quarter of the year.

Gear type: The basic unit of gear is the main line which is made of monofilament and stored on a large hydraulic reel. Eight hundred to 1000 hooks are attached to 30 to 40 miles of main line on a typical fishing day. Shallow sets for swordfish and deep sets for tuna are fished with a requirement that the fishermen must declare prior to departure which set type will be employed. (There was no Hawaii-based shallow set swordfish fishery from 2001-2003). All shallow swordfish sets are required to utilize size 18/0 circle hooks with a 10 degree offset and mackerel bait (the use of squid bait is prohibited). Deployment and retrieval of gear must occur at night. For deep sets, all float lines must be at least 20 meters in length; with a minimum of 15 branch lines between any two floats (except basket-style longline gear which may have as few as 10 branch lines between any two floats); without the use of light sticks; and resulting in the possession or landing of no more than 10 swordfish (Xiphias gladius) at any time during a given trip. As used in this definition ``float line" means a line used to suspend the main longline beneath a float and ``light stick" means any type of light emitting device, including any fluorescent ``glow bead", chemical, or electrically powered light that is affixed underwater to the longline gear (Federal Register 2 April 2004 Volume 69 Number 64). There are currently no Hawaii longline vessels deploying basket gear.

While similar, swordfish and tuna gear differ in the depth at which it is deployed, the number of hooks deployed, and the time of day at which it is set. Both styles use a monofilament mainline that is generally 3.2- 4.0 mm in diameter that is stored, deployed, and retrieved using a large hydraulic reel (some vessels may have two). In general, swordfish gear is deployed at an average depth (deepest) of 70m, with 600-1000 hooks deployed per day (3-6 hooks between floats), and the line is set at night and hauled during daylight hours. Additionally, float lines are usually less than the required twenty meters (~10m) for tuna fishing. Because some swordfish vessels carry two reels of mainline, it is not uncommon for swordfish vessels to set as much as 60 miles of line in a day. In contrast, tuna gear is set much deeper (~200m), with 1500-2200 hooks deployed per day (20-35 hooks between floats), the line is set in the morning and hauled in the evening. In addition, tuna mainline is deployed using a hydraulic line shooter. Regulations permit a minimum of 15 hooks between floats. There is no minimum for trips targeting swordfish. The line shooter sends the line off the vessel faster than the vessel is moving creating deep arcing caternaries in the line. This allows them to target deep dwelling tunas. Swordfish mainline is set at the same speed as the vessel to keep the line in shallower depths. Finally, lightsticks are prohibited during tuna (deep set) fishing operations. These are allowed in the swordfish fishery.

The leaders attached to the mainline also differ between the two fisheries. A tuna leader is usually comprised of a hook immediately followed by a length of wire (1-2 mm thick) which is attached to a weighted swivel. The rest of the tuna leader in comprised of ~2mm thick monofilament and a snap for attachment to the mainline. The swordfish gear is comprised of a 18/0 or larger circle hook attached to a ~ 10m length of ~2mm monofilament line to a weighted swivel followed by another ~10m length of ~2mm monofilament. All attachments are made using loops secured by crimps.

Vessel operators are required to call NMFS for possible observer placement 72 hours prior to departure. At that time they must declare if they intend to go on a shallow-set or deep-set fishing trip. Regulations prohibiting the presence of lightsticks and float lines shorter than 20m aboard vessels on declared deep-set trips preclude fishermen from fishing trip types while at sea - additionally a vessel returning from a deep-set trip cannot land more than 10 swordfish (50 CFR 660.22).

Additional requirements for sea birds go into effect for vessels fishing above 23 degrees north latitude. New seabird regulations will take effect in 2005. Fishermen will be given a choice between side setting and employing a suite of seabird mitigation measures. Currently, regulations require deep-setting vessels to dye their bait blue, thoroughly thaw the bait, and throw all offal on the opposite side of the vessel from which fishing operations are taking place. (There have been no observations of marine mammals feeding on offal discarded from Hawaii-based longline vessels.) Additionally, these vessels are required to use a line shooter – which they would have anyway – and at least forty-five gram weights on the line.

Regulations: Effort is required to be outside of 50 nautical miles from the entire Northwestern Hawaiian islands (NWHI) because of possible protected species (monk seal) interactions. Several 25-75 mile closed areas also exist around the MHI to prevent gear conflicts with smaller fishing vessels. Current regulations require 100% observer coverage for shallow swordfish sets and 20% observer coverage for deep tuna sets. There are fleet-wide annual limits on the number of allowable sea turtle interactions in this fishery (16 leatherbacks or 17 loggerheads). The shallow set component of the fishery is closed if either threshold is reached Federal Register: April 2, 2004 (Volume 69, Number 64). There is an annual limit of 2,120 shallow sets north of the equator. Vessel operators must obtain single shallow set certificates from NMFS, which are transferable, and valid for one calendar year. Hawaii-based longline vessels are prohibited from making more shallow-sets north of the equator during a trip than the number of valid shallow-set certificates on board the vessel. Within 72 hours of landing a pelagic management unit species, vessel operators are required to submit one valid shallow-set certificate to the Regional Adminstrator for every shallow set fished north of the equator during a fishing trip.

Management type: Federal limited access program. This fishery is managed under a Fishery Management Plan (FMP), by the Western Pacific Fishery Management Council.

Comments: This Hawaii longline fishery is active year-round and targets swordfish and tuna, other species are caught incidentally. Interactions with bottlenose dolphins, false killer whales, humpback whales, short-finned pilot whales, spinner dolphins, short-beaked common dolphins, pantropical spotted dolphins, Blainville's beaked whale, sperm whales, and Risso's dolphins have been documented[2]. Longline hooks have also been recovered from Hawaiian monk seals, but these were not observed during longline fishing operations. 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 has exceeded 20% in 2001 and 2002. In 2003, observer coverage was 22.2% (based on vessel departures), with 6.4 million hooks observed from 3,204 sets. Observed injuries of marine mammals in this fishery in 2003 included 2 false killer whales, 1 unidentified cetacean and 1 unidentified whale. Additionally, there was one observed mortality of a bottlenose dolphin (Pacific Islands Regional Office preliminary report dated 9 February 2004). In 2004, observer coverage was 24.6% (based on vessel departures), with 7.9 million hooks observed from 3,958 sets. Observed injuries of marine mammals in this fishery

[2] K.A. Forney 2004. Estimates of cetacean mortality and injury in two U.S. Pacific longline fisheries, 1994-2002. Southwest Fisheries Science Center Administrative Report LJ-04-07, available from Southwest Fisheries Science Center, 8604 La Jolla Shores Drive, La Jolla, CA 92037. 17 pp.

in 2004 included 5 false killer whales, 1 humpback whale and 1 short-finned pilot whale. Additionally, there was one observed mortality of a false killer whale. In the shallow set component of this fishery, observer coverage in 2004 was 100% (88 sets and 76,750 hooks observed). No marine mammal interactions were observed in the shallow set component of the fishery (Pacific Islands Regional Office preliminary report dated 25 January 2005).

Category II, CA yellowtail, barracuda, white seabass, and tuna drift gillnet fishery (>3.5 and <14 in mesh)

Note: This fishery has developed recently as an offshoot of the "**CA other species, large mesh (>3.5 in) set gillnet fishery**" (see above). Fishermen use the same gear as in the set gillnet fishery (typically 6.5 inch mesh nets, 100-200 fathoms in length, except that they instead utilize drifting nets to target white seabass and yellowtail. Albacore tuna and barracuda are also targeted in this fishery.

Number of permit holders: There are approximately 24 active permit holders in this fishery.

Total effort: In the first two quarters of 2003, there were 366 days fished in the white seabass - yellowtail fishery. Of these 366 effort days, 69 days (19%) were drift sets, 267 (73%) were set gillnets, and 30 days (8%) were unspecified set type. In 2002, there were a total of 733 days fished in the white seabass - yellowtail fishery. Of these 733 effort days, 195 days (27 %) were drift sets, 447 days (61%) were set gillnets, and 91 days (12%) were unspecified set type.

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 150-200 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. For the period May 2001 through July 2003, there were 42 sets observed from 11 vessel trips. Observed mortality included one short-beaked common dolphin and 2 California sea lions. Also, 4 California sea lions were entangled and released alive during this period.

Category II, CA swordfish longline fishery

Number of permit holders: About 20-30 vessels based in California participate in the longline fishery.

Number of active permit holders: As of 2002, approximately 20-30 vessels participated in this fishery.

Total Effort: An estimated 1 - 1.5 million hooks are fished annually by 20-30 California-based vessels.

Geographic range: This fishery operates in west coast waters outside the 200 nm EEZ and unload their catch in California ports.

Seasons: The fishery operates year-round.

Gear type: Typically, vessels fish 24_72 km of mainline, rigged with 22 m gangions at approximately 60 m intervals. Anywhere from 800 to 1,300 hooks are deployed in a set, with large squid (Illex sp.) used for bait. Variously colored lightsticks are used, for fishing takes place primarily during the night, when more swordfish are available in surface waters. The mainline is deployed in 4_7 hours and left to drift unattached for 7_10 hours. Retrieval typically takes about 7_10 hours.

Regulations: Longline vessels are prohibited from operating within the 200 nmi limit, but may unload their catch in California ports and are required to have a California state commercial fishing license.

Management type: The California longline fishery is currently covered by a fishery management plan (FMP) that was submitted for Secretarial review in November 2003. The FMP was partially approved by NMFS on February 4, 2004. NMFS published a final rule on March 11, 2004 which prohibits shallow longline sets of the type normally targeting swordfish on the high seas in the Pacific Ocean east of 150^{o} W. longitude. The Pacific Fishery Management Council's Highly Migratory Species (HMS) Management Team is currently investigating scenarios under which swordfish may once again be targeted in this region with the adoption of gear modification measures (circle hooks and mackerel baits) used in the Atlantic that have been shown to significantly reduce takes of loggerhead and leatherback sea turtles. The HMS Management Team is also investigating options to create a limited-entry program for this fishery. A mandatory observer program became effective for this fishery in August 2002.

Comments: Many of the vessels in this fishery previously landed in Hawaii, but closures around the Hawaiian Islands have moved fishing effort farther east, and as a result some longline vessels now land in California. Preliminary catch data has been compiled for the California longline fishery from skipper logbooks, dated between August 1, 1995 and December 31, 1999. The logbooks do not report any whale or dolphin interactions, but do show interactions with California sea lions. Other documented bycatch in this fishery includes striped marlin, blue shark, seabirds, and sea turtles (Vojkovich and Barsky, 1998). Since 1993, the number of vessels in this fishery has increased, from 3 to the current estimate of 40-50. This increase in vessels initially resulted from the movement of vessels based in the Gulf of Mexico into southern California in the summer of 1993, and more recently from increased effort eastward by vessels originating in Hawaii, responding to a court injunction closing fishing areas around the Hawaiian islands. Approximately 40-50 longline vessels unload in California, and of these, 40 boats originated from Hawaii (and which also have Hawaii longline limited entry permits); these have unloaded their catch in California ports since December, 1999 (D. Petersen, NMFS, personal communication, April, 2000). Between October 2001 and November 2003, 19 trips were observed by California-based longline observers, with 391 sets observed (<15% observer coverage). Between October 2001 and November 2003, observed cetacean interactions have included one injured Risso's dolphin and one mortality of an unidentified dolphin.

Category II, California Round Haul Fisheries.

Note: This category includes purse seine, drum seine and lampara net fisheries for wetfish (anchovy, mackerel, and sardine), and tuna. Choice of targeted species is primarily driven by availability and varying market demand.

Number of permit holders: Number of permit holders is estimated at 150 for the wetfish fisheries (currently, tuna does not require a specific permit to operate other than a general commercial fishing permit). Starting January 1, 2000 under a new Coastal Pelagic Species Fishery Management Plan (CPS-FMP), a limited entry program was initiated for the area south of 39^{o} North latitude. Eligibility required a minimum of 100 metric tons of CPS finfish landed between January 1, 1993 through November 5, 1997.

Number of active permit holders: For the wetfish fishery, there are an estimated 65 vessels/persons actively fishing; for tuna, there are approximately 15 vessels/persons fishing.

Total effort: An estimated 70 vessels are eligible to fish under the limited entry permit requirements.

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: Starting on January 1, 2000 the wetfish fishery will be managed by PFMC in accordance with a CPS (coastal pelagic species) /FMP (fishery management plan) under federal laws.

Management type: The mackerel and sardine fisheries are quota fisheries. Several closures for both mackerel and sardine have been required by NMFS in recent years (mackerel 2001, 2002; sardine 2002, subarea closure) (pers. comm., Dale Sweetnam, California Department of Fish and Game).

Comments: Beginning in 1999 the sardine population is considered fully recovered since its collapse during the middle of the century. Typically, anchovy is targeted for bait or reduction while mackerel and sardine are destined for fresh fish, aquaculture or canning overseas.

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. In 1999, the U.S. and Canada reached an agreement that significantly reduced the U.S. share of sockeye salmon. In order to compensate the non-treaty U.S. fishermen for the impact of this reduction, a federally funded buyback program was established. By the 2001 fishing season, the number of available drift gillnet permits had been reduced from 675 (1999) to 216. The intent of the buyback program was to reduce the number of drift gillnet permits to 200 (pers. comm., David Cantillon, NMFS, Northwest Region).

Number of active permit holders: Under the cooperative program that integrates issuance of Marine Mammal Authorization Certificates into the existing State license process, NMFS receives data on vessels that have completed the licensing process and are eligible to fish. These vessels are a subset of the total permits extant (725 in 2001), and the remainder of the permits are inactive and do not participate in the fishery during a given year. The number of "active" permits is assumed to be equal to or less than the number of permits that are eligible to fish. From 1997-2001, the number of active permits was 633, 559, 199, 248, and 182, respectively.

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. Since 1994, the number of active vessels in the Puget Sound drift gillnet fishery has declined. In addition, at least one major portion of the fishery, the previously observed sockeye fishery in areas 7 and 7A, has experienced reductions in available fishing time (openings). The number of days and total number of hours that the sockeye fishery remained open, approached the 1994 level only once (1997) in the period from 1995 through 1998. In the remaining years the available sockeye fishing time was less than half of the 1994 level. In recent years, poor sockeye returns and market conditions have combined to reduce participation in the fishery beyond the reductions created originally by the federal buyback program. In 2001, drift gillnets fished for only one opening and 182 gear units were fished in all areas as compared to the 559 cited for 1998. Owing to the buyback program and reduced salmon runs, it is expected that the number of active permits will remain low.

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: In 1993, observers were placed onboard vessels in a pilot program to monitor seabird and marine mammal interactions with fishing effort for several target salmon species in a number of areas throughout the Puget Sound region. In 1994 observer effort was concentrated in the sockeye fishery in areas 7 and 7A, where interactions with seabirds and marine mammals were most likely to occur. Incidental takes of harbor porpoise, Dall’s porpoise and harbor seals have been documented in the fishery. The overall take of marine mammals for the salmon drift gillnet fisheries in Puget Sound is unlikely to have increased since the fisheries were last observed, owing to reductions in the number of participating vessels and available fishing time.

Category II, OR swordfish surface longline fishery.

Number of permit holders: The number of Oregon Developmental Fishery Permits for fishing swordfish using a floating longline is limited to 20. The number of permits issued for the period 1998-2002 (through May 2002) were 3, 4, 7, 2, and 3, respectively (pers. comm., Jane McCrae, Oregon Department of Fish and Wildlife, Marine Resources Program).

Number of active permit holders: Based on landings of swordfish with this gear type, there were no active permit holders in this fishery from 1997-2002.

Total effort: From 1997-2002, there were no reported swordfish landings using longline gear.

Geographic range: This fishery occurs off the coast of Oregon. Swordfish longlines may not be fished within 25 nautical miles of the mainland.

Seasons: This fishery could occur year-round, however, effort would generally terminate by late fall.

Gear type: Fishing gear consists of a buoyed mainline fitted with leaders and baited hooks. The mainline is fished near the surface suspended from buoys (rather than anchored to the bottom as in groundfish longline fisheries). Swordfish longlines may not exceed 1000 fathoms in length and must be attached at one end to the vessel when fishing. The gear is typically set in the evening and retrieved in the morning.

Regulations: The fishery is a limited entry fishery with gear and bycatch restrictions.

Management type: This fishery is managed by the Oregon Department of Fish and Wildlife, Developmental Fisheries Program.

Comments: The Developmental Fisheries Permit requires permit holders to take observers aboard if requested to do so, however, to date no observer placements have been made. No marine mammal interactions have been documented.

Category II, OR blue shark surface longline fishery.

Number of permit holders: The number of Oregon Developmental Fishery Permits for fishing blue shark using a floating longline is limited to 10. From 1997-2002, there were 4,0,0,4,1, and 3 permits issued for this fishery (pers. comm., Jane McCrae, Oregon Department of Fish and Wildlife, Marine Resources Program).

Number of active permit holders: There were no active permits in the blue shark longline fishery off Oregon from 1997 through mid-2002. The effort in this fishery prior to 1998 was estimated to be low based on the number of permits issued and very limited landings.

Total effort: Actual catch by the few developmental permit holders is unknown. Landings of blue shark by all vessels using longline gear totaled 3,628 pounds for the period 1995 through 1998 (477 lbs - '95, 871 lbs - '96, 542 lbs - '97, and 1,738 lbs - '98). Note that these landing totals are for all longline including blue shark landed incidental to the groundfish sunken longline fishery.

Geographic range: This fishery occurs off the coast of Oregon. There are no area restrictions for shark longline gear.

Seasons: This fishery occurs year-round, however, effort in this fishery generally terminates by late fall.

Gear type: Fishing gear consists of a buoyed mainline fitted with leaders and baited hooks. The mainline is fished near the surface suspended from buoys (rather than anchored to the bottom as in groundfish longline fisheries). Shark longlines must be marked at each terminal surface end with a pole and flag, an operating light, a radar reflector, and a buoy showing clear identification and gear owner. The gear is typically set in the evening and retrieved in the morning.

Regulations: The fishery is a limited entry fishery with gear and bycatch restrictions.

Management type: This fishery is managed by the Oregon Department of Fish and Wildlife, Developmental Fisheries Program.

Comments: The Developmental Fisheries Permit requires permit holders to take observers aboard if requested to do so, however, to date no observer placements have been made. No marine mammal interactions have been documented.

Category III, CA herring purse seine fishery.[3]

This fishery is composed of a roe herring fishery and a fresh herring fishery. The sac-roe fishery occurs in California's four largest herring spawning regions: San Francisco Bay, Tomales Bay, Humboldt Bay, and Crescent City Harbor. The largest spawning aggregations occur in San Francisco Bay and produces more than 90% of the herring catch. The four spawning areas 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 roe herring component has recently undergone some changes. During the early 1990's, there were 26 permits fishing for roe herring using round hauls (either purse seine or lampara nets). Between 1993 and 1998, all roe herring fishers converted their gear to gillnets with stretched mesh size less than 2.5 inches (which are not known to

[3] Pers. Comm. Diana Watters, biologist at CDFG Menlo Park.

take mammals) as part of CDFG efforts to protect herring resources. The sac-roe fishery is managed through a limited-entry program. Since 1983, only five new permits have been issued, and the number of annual permits has remained at about 450. 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. There are 10 permits available for the fresh herring round haul fishery (purse seine or lampara nets). This fishery is restricted to the non-spawning season, or approximately mid-March through the end of November. Fishing may take place in open ocean areas (e.g. Monterey Bay) or inside bays (e.g. San Francisco Bay).

Category II, CA squid purse seine fishery.[4]

Number of permit holders: A permit to participate in the squid fishery has been required since April 1998. There are two types of permits. Market squid vessel permits allow a light vessel to attract squid with lights and catch squid. Light boat owner permits only allow the use of attracting lights to aggregate market squid. In the 2002/2003 season there were 184 market squid vessel permits and 40 light boat owner permits issued. Landings of two tons or less are considered incidental and no permit is required.

Number of active permit holders: The number of active permits varies by year depending on market conditions and squid availability. During the 2002/2003 season, there were approximately 105 vessels active during some portion of the year. Thirty-four vessels harvested 90% of the total landings greater than two tons. The 1999/2000 season had the highest squid landings to date, with 132 vessels making squid landings greater than two tons.

Total effort: Beginning in May 2000, logbooks were required for the squid fishery. Results for the 2001 calendar year indicate that each hour of fishing required 5.5 hours of search time by light boats. Combined searching and fishing effort resulted in 3.7 mt of catch per hour. In the 2002/2003 season, the fishery made 2,244 landings. This is a 34.0% decrease from the previous season. In addition, the average landing decreased from 28.2 mt to 19.0 mt.

Geographic range: Since the mid-1980s, the majority of the squid fishing harvest has occurred south of Point Conception. However, during the 2002/2003 season, a moderate El Nino condition resulted in nearly 60% of the catch landed in northern California. The northern fishery harvest ranged from Morro Bay to Fort Bragg, although the majority of fishing occurred within a half mile of the Monterey Bay shoreline. The Monterey Bay fishery has been in operation since the mid-1800s and has historical significance for California. Squid catch south of Point Conception accounted for only 41% of the 2002/2003 landings and declined 54% from 84,024 mt in the previous season to 17,387 mt.

Seasons: This fishery occurs year-round, however, effort in this fishery differs north and south of Point Conception. Typically, the fishery north of Point Conception operates from April through September while the southern fishery is most active from October through March. El Niño conditions hamper the fishery and squid landings are minimal during these events, while landings in the northern fishery often increase. The La Niña event in 1999 resulted in the southern fishery landing squid year-round.

Gear type: There are several gears employed in this fishery. From 1997-2001, the vast majority (98%) of vessels uses either purse (77%) or drum (21%) seine nets. Other types of nets used include lampara, dip and brail nets which are used by a few vessels in southern California. Another gear type associated with the market squid fishery is attracting lights that are used to aggregate spawning squid. In 2000, attracting lights were regulated and each vessel is now restricted to no more than 30,000 watts of lights during fishing activities. Further, to reduce light scatter, lights must be shielded and oriented directly downward. The lighting restrictions were enacted to avoid risks to nesting brown pelicans and interactions with other seabird species of concern.

Regulations: All vessels participating in the squid fishery must have a permit. Commercial squid fishing is prohibited between noon on Friday and noon on Sunday of each week to allow a two-day consecutive uninterrupted period of spawning. A mandatory logbook program for fishing and lighting vessels has been in place since May

[4]This fishery description was provided by Dale Sweetnam, Senior Biologist at CDFG La Jolla.

2000. In May 2001, a seasonal harvest guideline of 125,000 short tons for market squid was established to limit further expansion of the fishery.

Management type: This fishery was largely unregulated until 1998 when it came under more strict regulatory control by the Department of Fish and Game. The fishery is considered a monitored fishery in the Pacific Fishery Management Council's Coastal Pelagic Species Fishery Management Plan. A state fishery management plan is to be adopted by the Fish and Game Commission by December 2004. The plan considers seasonal and daily catch limitations; weekend closures, research and monitoring programs, harvest replenishment areas, live bait and incidental market squid catch, restricted access programs including transferability, gear restrictions, area and time closures to address seabird issues, and permit fees.

Comments: The squid fishery operates primarily at night and targets spawning aggregations with the use of lights. Encounters between the fishery and pilot whales, pinnipeds, and birds have been documented. Seal bombs are used regularly. Lethal and nonlethal interaction rates are unknown. During the 1980s, California's squid fishery grew rapidly in fleet size and landings when international demand for squid increased due to declining squid fisheries in other parts of the world. In 1997, the rapid growth of fleet size was halted by a moratorium on new permits. Landing records were set several times during the 1990s, but have been curtailed with the establishment of the 125,000 short ton seasonal harvest guideline.

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.

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 mortalities were observed during 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 seal and California sea lion were documented, but only during the winter seasons (which have been reduced dramatically in recent years to protect ESA listed salmon) . No mortalities were 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 whiting (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 whiting. The annual whiting 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. Whiting 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 whiting deliveries landed at shore-based processors were monitored. The following is a description of the commercial whiting 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. 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 whiting, 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 whiting during the regular season. In addition, 6 unpermitted mothership processors received unsorted whiting catch.

Total effort: The whiting 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 whiting in 17 days, catcher/processors took 70,365 mt of whiting in 54 days and shore-based processors received 87,862 mt of whiting 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 whiting 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 whiting 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 dolphin, Dall's porpoise, California sea lion, harbor seal, northern fur seal, and northern elephant seal have been documented in the whiting 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, Hawaii gillnet fishery.[5]

Number of active permit holders: In 1997 there were 129 active commercial fishers. In 1995 there were approximately 115.

Total effort: In 1997 there were 2,109 trips for a total catch of 864,194 pounds with 792,210 pounds sold. 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 of stretched mesh greater than 2 inches and stretched mesh size greater than 2.75 inches for stationary gillnets. Stationary nets must be inspected every 2 hours and total soak time cannot exceed four hours in the same location. New restrictions implemented in 2002 include that nets may not: 1) be used more than once in a 24-hour period; 2) exceed a 12 ft stretched height limit; 3) exceed a single-panel; 4) be used at night; 5) be set within 100 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 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. In addition to these gear restrictions, non-commercial users of lay nets may not use a net longer than 500 ft, while commercial users may use nets up to 1200 ft in length. Additional mesh restrictions are in place for taking the big-eyed scad.

Regulations: Gear and season restrictions (see above).

[5]Descriptions of Hawaii State managed fisheries provided by William Devick, State of Hawaii, Department of Land and Natural Resources, Division of Aquatic Resources, Honolulu Hawaii.

Management type: Managed by the State of Hawaii Division of Aquatic Resources.

Comments: The principle catches include reef fishes and big-eyed scad (akule) and mackerel scad (opelu). Interactions have been documented with bottlenose dolphin and spinner dolphin.

Category III, Hawaii lobster trap fishery.[6 7]
Note: The portion of this fishery managed by the State of Hawaii and operating in the MHI is about 1% of the size (total pounds of lobster caught) of the federally managed fishery operating primarily in the NWHI. The description that follows refers to the NWHI fishery unless stated otherwise.

Number of permit holders: There are 15 permit holders under a (1991) federal limited access program.

Number of active permit holders: In 1998 and 1999 there were 5 and 6 vessels that participated respectively. In the MHI there were 5 active fishers in 1997.

Total effort: The number of trap hauls for 1999 is not available at this time. However, the majority of the effort took place in the 4 harvest guideline areas; Necker Bank, Gardner Pinnacles and Maro Reef, with the remaining effort spread out over 10 unique areas. In 1998 171,000 trap hauls were made by the 5 vessels during 9 trips and in 1997 a total of 177,700 hauls were made. In the MHI 19 trips were made in 1997.

Geographic range: Lobster permits allow fishing operations in the US EEZ from 3 to 200 nmi offshore American Samoa, Guam and Hawaii (including the EEZ areas of the NWHI and MHI). However, no vessels have operated in the EEZ's of American Samoa or Guam since 1983.

Seasons: This fishery operates under a seasonal harvest guideline system opening on July 1. The season ends once the harvest guideline is met, but no later than December 31. In 1998, the harvest guideline was divided into the 4 areas mentioned above with total lobster catch set at (in thousands) 70, 20, 80, and 116, respectively. Area closure occurs once an area's harvest guideline is met. 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: Season, gear and quota restrictions (see above) for the NWHI were formulated by the Western Pacific Regional Fishery Management Council and implemented by NMFS. The MHI fishery is managed by the State of Hawaii, Division of Aquatic Resources with season and gear restrictions (see above).

Management type: Limited access program with bank specific quotas and closures. In the MHI, open access.

Comments: The NWHI fishery targets the red spiny lobster and the common slipper lobster. The ridgeback slipper lobster is also taken. Protected species of concern include monk seals (mentioned above) and turtles. There have been no interactions with these species since 1995 but they have been seen in the vicinity of the fishing gear.

Category III, Hawaii inshore handline fishery.

In 1997 a total 750 fishers made 8,526 fishing trips in the main Hawaiian Islands and caught 531,449 pounds and sold 475,562 pounds for an ex-vessel landing value of $1,010,758. This fishery occurs in nearshore and coastal

[6]Kawamoto, K. and Samuel G. Pooley. 1999. Draft Annual report of the 1998 western pacific lobster fishery.
[7]Kawamoto, K. 1999. Summary of the 1999 NWHI Lobster Fishing Season. NMFS Honolulu Laboratory.

pelagic regions. The principal catches include reef fishes and big-eyed scad (akule) and mackerel scad (opelu). In 1995 approximately 650 fishers were active. Interactions have been documented for bottlenose dolphin.

Category III, Hawaii deep sea bottomfish handline and jig fishery.

Note: There are two commercial bottomfish fisheries in Hawaii: a distant water Northwestern Hawaiian Islands (NWHI) limited entry fishery under federal jurisdiction and the main Hawaiian Islands bottomfish fishery primarily under the State of Hawaii jurisdiction.

Number of permit holders: The main Hawaiian Islands fishery is open access with close to 2,000 bottomfish vessels registered with the State of Hawaii, whereas the NWHI is restricted to a maximum of 17 vessels.

Number of active permit holders: In 1997 in the MHI a total of 750 fishers were active. The NWHI are divided into the Mau Zone (closer to MHI) and the Hoomalu Zone. The Hoomalu Zone is a limited entry zone with 6 vessels participating in 1998, 7 vessels fished the Mau Zone in the same year. Restrictions on new entry into the Mau Zone were implemented in 1998.

Total effort: In 1998 in the MHI approximately 8,500 trips were made with a total catch of 424,000 pounds for an ex-vessel landing value of $1,336,000. This fishery occurs primarily in offshore banks and pinnacles. In the NWHI 332,000 pounds ($894,000) were caught in 1998, below average since 1990.

Seasons: Year round.
Gear type: This fishery is a hook-and-line fishery that takes place in deep water. In the NWHI fishery, vessels are 30 ft or greater and conduct trips of about 10 days. 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.

Management type: The MHI is managed by the HDAR with catch, gear and area restrictions (see above) but no permit limits. The NWHI is a limited access federal program.

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. NMFS is considering the possibility of re-categorizing the NWHI bottomfish fishery from Category III to Category II due to concerns for potential interactions between bottomfish fishing vessels and Hawaiian monk seals, although there were none observed during 26 NWHI bottomfish trips during 1990-1993, and none reported. On 12 of the 26 trips, bottlenose dolphins have been observed stealing fish from the lines, but not hookings or entanglements occurred. Effort in this fishery increases significantly around the Christmas season because a target species, a true snapper, is typically sought for cultural festivities.[11] No data is collected for recreational or subsistence fishermen, but their MHI catch is estimated to be about equal to the MHI commercial catch.

Category III, Hawaii tuna handline and jig fishery.

In 1997 a total of 543 fishers made 6,627 trips in the MHI and caught 2,014,656 pounds and sold 1,958,759 pounds for an ex-vessel value of $3,788,391. 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. Interactions have been documented for rough-toothed dolphin, bottlenose dolphin, and Hawaiian monk seal.

Table 1. The number of animals injured (I) and killed (K) reported to the Marine Mammal Authorization Program (MMAP) compared with data reported from the NMFS Observer Program for two California gillnet fisheries for the years 1998-2002.

	1998				1999				2000				2001				2002			
	MMAP		NMFS		MMAP		NMFS		MMAP		NMFS		MMAP		NMFS		MMAP		NMFS	
Species	I	K	I	K	I	K	I	K	I	K	I	K	I	K	I	K	I	K	I	K
Minke whale	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Sperm whale	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray whale	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Humpback whale	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pacific white-sided dolphin	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	2	0	0	0	1
Common dolphin spp.	2	5	0	9	8	29	0	35	3	15	0	25	1	6	0	7	0	3	1	10
Risso's dolphin	0	0	0	0	0	0	0	0	0	2	0	3	0	0	0	0	0	0	0	0
Northern right whale dolphin	0	0	0	0	0	1	0	3	0	6	0	11	0	1	0	5	0	2	0	2
Dall's porpoise	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified small cetacean	0	0	0	0	0	3	0	0	4	1	0	0	2	2	0	0	0	2	0	0
California sea lion	3	19	0	23	0	5	0	6	0	14	0	13	1	2	0	2	0	7	0	18
Steller's sea lion	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Northern elephant seal	0	0	0	4	2	1	0	2	1	1	0	6	0	0	0	1	0	0	0	1
Harbor seal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified seal	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0
Unidentified baleen whale	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified toothed whale	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Total Occurrences Reported	5	27	0	38	10	41	1	46	9	41	0	60	5	11	0	17	1	15	1	32

Table 2. Strandings reported to the NMFS Marine Mammal Stranding Network 1998-2002. hr = human-related strandings.

Species	1998				1999				2000				2001				2002			
	CA	hr	OR/WA	hr	CA	hr	OR/WA	hr	CA	hr	OR/WA	hr	CA	hr	OR/WA	hr	CA	hr	OR/WA	hr
Harbor Porpoise	37	4	25	0	31	2	7	0	20	2	6	1	12	4	15	1	19	5	0	0
Dall's Porpoise	2	0	2	0	4	0	3	0	3	0	9	1	2	1	6	0	3	0	0	0
Pac. White-sided Dolphin	5	0	1	0	4	1	1	0	3	0	0	0	6	2	0	0	2	0	1	0
Risso's Dolphin	3	0	0	0	2	4	1	0	6	0	1	0	3	0	0	0	4	2	0	0
Bottlenose Dolphin	4	0	0	0	3	0	0	0	12	0	0	0	14	0	0	0	13	0	0	0
Common Dolphin	35	1	0	0	37	0	0	0	30	1	0	0	33	4	0	0	88	4	0	0
Striped Dolphin	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N. Right Whale Dolphin	1	0	0	0	2	0	0	0	0	0	0	0	5	0	0	0	1	0	0	0
Rough-toothed Dolphin	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Killer Whale	0	0	1	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
Short-finned Pilot Whale	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0
Baird's Beaked Whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stejneger's Beaked Whale	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Cuvier's Beaked Whale	2	0	1	0	0	0	0	0	1	0	0	0	0	0	1	1	3	0	0	0
Peruvian Beaked Whale	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Unident. Beaked Whale	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pygmy Sperm Whale	6	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	3	1	0	0
Dwarf Sperm Whale	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Sperm Whale	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0
Gray Whale	3	3	4	1	47	6	31	2	58	8	25	0	5	1	1	0	7	3	1	1
Minke Whale	1	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0
Blue Whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0
Fin Whale	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	4	4
Sei Whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Humpback Whale	2	0	2	0	0	0	0	0	4	3	0	0	2	1	0	0	1	0	0	0
Unidentified Cetacean	0	0	0	0	0	0	3	0	1	0	4	1	0	0	0	0	1	0	1	0
Unidentified Porpoise	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified Dolphin	12	0	5	0	13	2	2	0	11	0	2	0	9	0	2	0	30	1	0	0
Unidentified Whale	2	0	0	0	3	1	0	0	1	0	0	0	4	4	0	0	2	2	0	0
Unident. Balaenopterid	0	0	1	0	0	0	1	0	0	0	0	0	2	0	0	0	3	1	0	0
Northern Fur Seal	21	0	1	0	7	1	3	0	3	0	6	0	2	0	1	1	9	0	0	0
Guadalupe Fur Seal	3	0	0	0	5	0	0	0	1	0	0	0	3	1	0	0	1	0	0	0
Steller (Nthn) Sea Lion	10	2	7	0	11	1	3	0	10	2	5	0	9	0	4	0	5	0	3	0
California Sea Lion	2576	199	75	9	596	52	35	3	1268	67	32	5	990	98	27	1	1821	195	8	0
Unidentified Sea Lion	0	0	0	0	0	0	9	1	1	0	8	0	0	0	17	0	1	0	0	0
Harbor Seal	313	21	121	7	135	7	176	4	230	13	148	8	152	8	170	8	160	18	121	6
Northern Elephant Seal	409	6	24	0	200	1	2	0	211	3	11	0	216	4	11	0	174	7	0	0
Unidentified Seal	0	0	5	0	0	0	26	1	0	0	17	1	0	0	11	1	1	0	0	0
Unidentified Pinniped	236	0	88	0	112	0	13	0	133	0	8	0	110	0	9	0	195	0	4	0
Totals for Cetaceans	120	9	43	1	154	16	50	2	152	14	48	3	101	18	28	2	183	20	10	5
Totals for Pinnipeds	3568	228	321	16	1066	62	267	9	1857	85	235	14	1482	111	250	11	2367	220	136	6

1998-2002 human-related fraction (Cetaceans)	0.10
1998-2002 human-related fraction (Pinnipeds)	0.07

Table 3. 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/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 angel shark/halibut and other species set gillnet fishery (>3.5 inch mesh)	Halibut/angel shark	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	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.

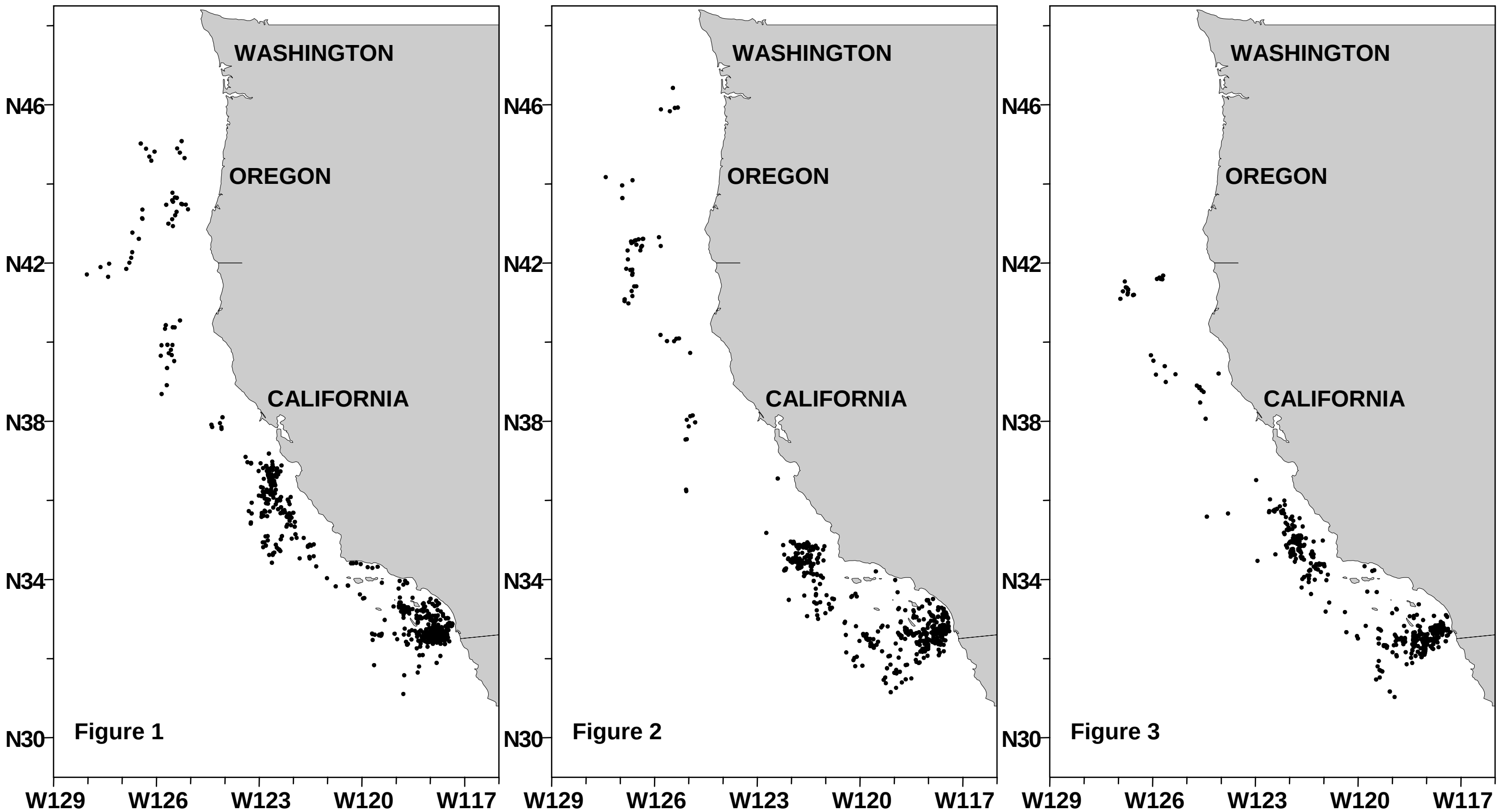
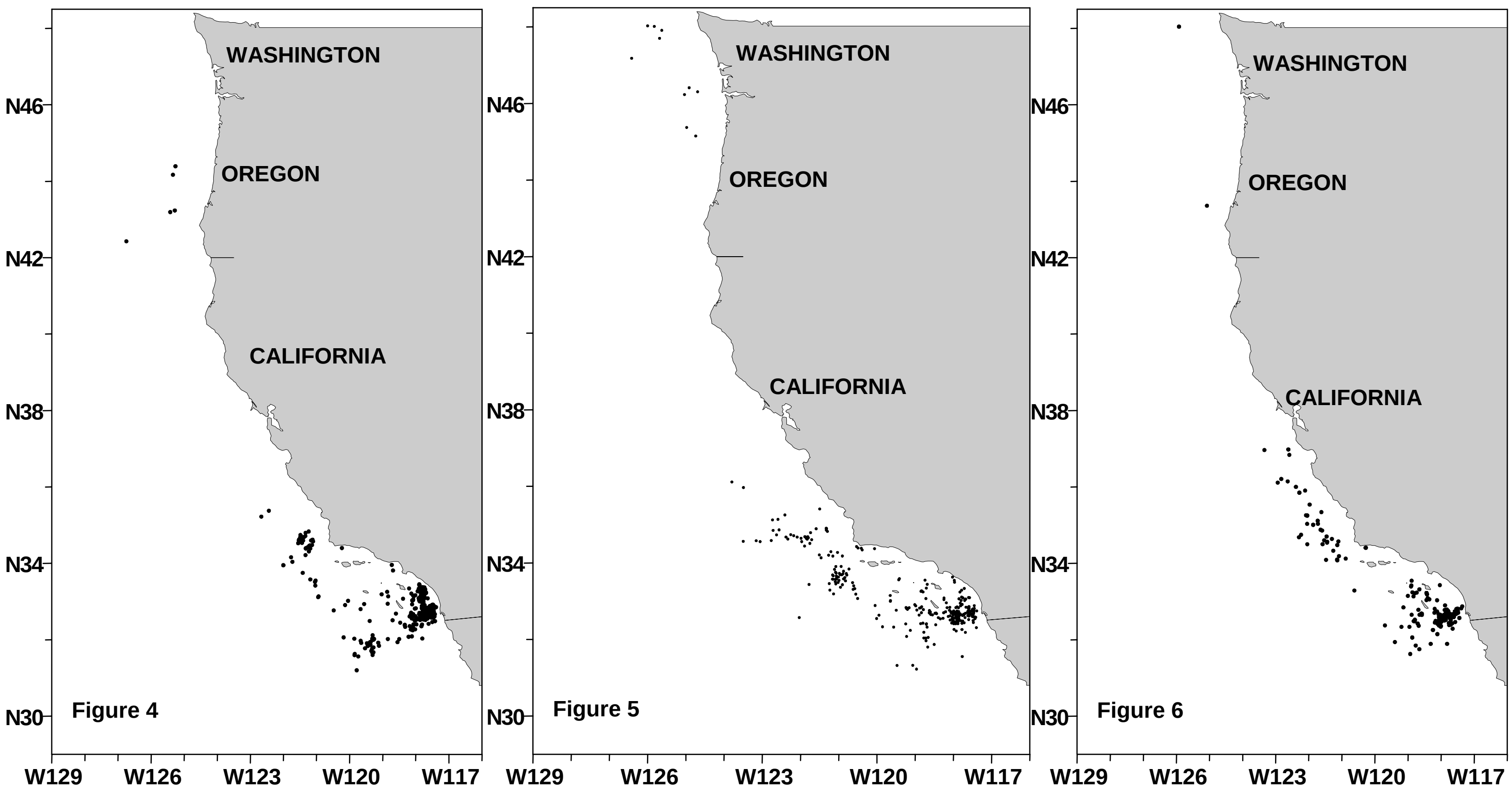


Figure 1 – 3. Locations of 587, 526, and 444 observed sets in the swordfish/thresher shark drift gillnet fishery in 1998, 1999, and 2000, respectively. An estimated 3353, 2634, and 1936 sets were fished in 1998, 1999, and 2000, respectively.



Figures 4-6. Locations of 339 and 360 observed sets in the swordfish/thresher shark drift gillnet fishery in 2001 and 2002, respectively. Figure 6 shows the locations of 199 observed marine mammal entanglements resulting in injury or death over the period 1998-2002. There were approximately 11,000 sets fished during this period.

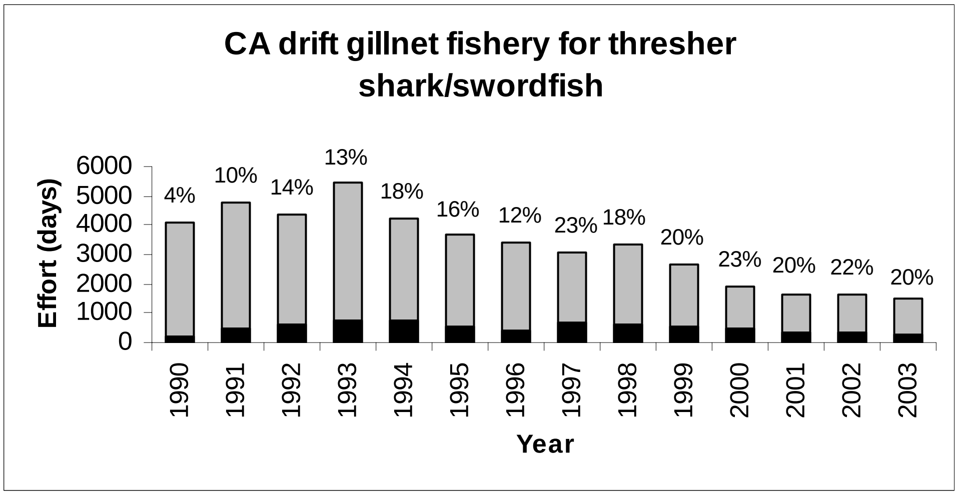


Figure 7. Estimated (gray) and observed (black) days of fishing effort for 1990-2003 in the California/Oregon thresher shark/swordfish drift gillnet fishery (≥ 14 inch mesh). Percent observer coverage for each year is shown above the bars.

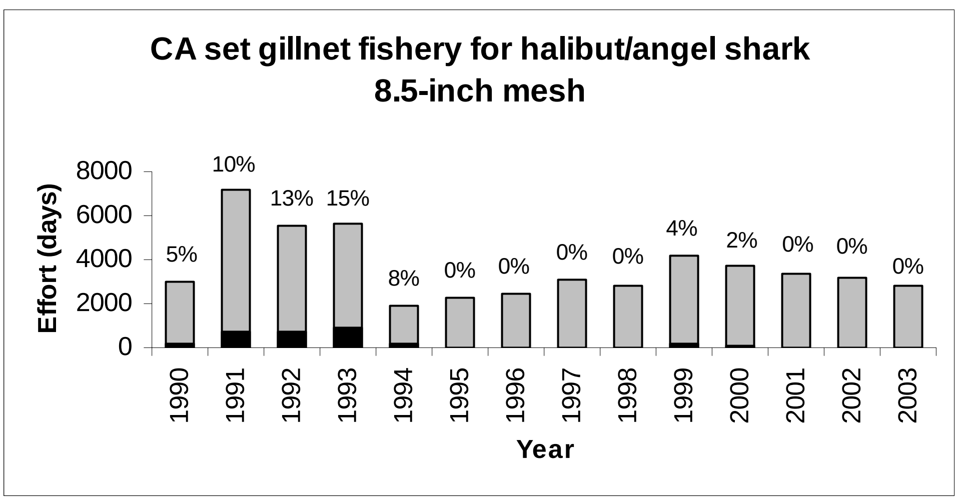


Figure 8. Estimated (gray) and observed (black) days of fishing effort for 1990-2003 in the California angel shark/halibut set gillnet fishery (> 3.5 inch mesh). The fishery was observed only from 1990-94 and again in 1999 and 2000 in Monterey Bay. Percent observer coverage for each year is shown above the bars.

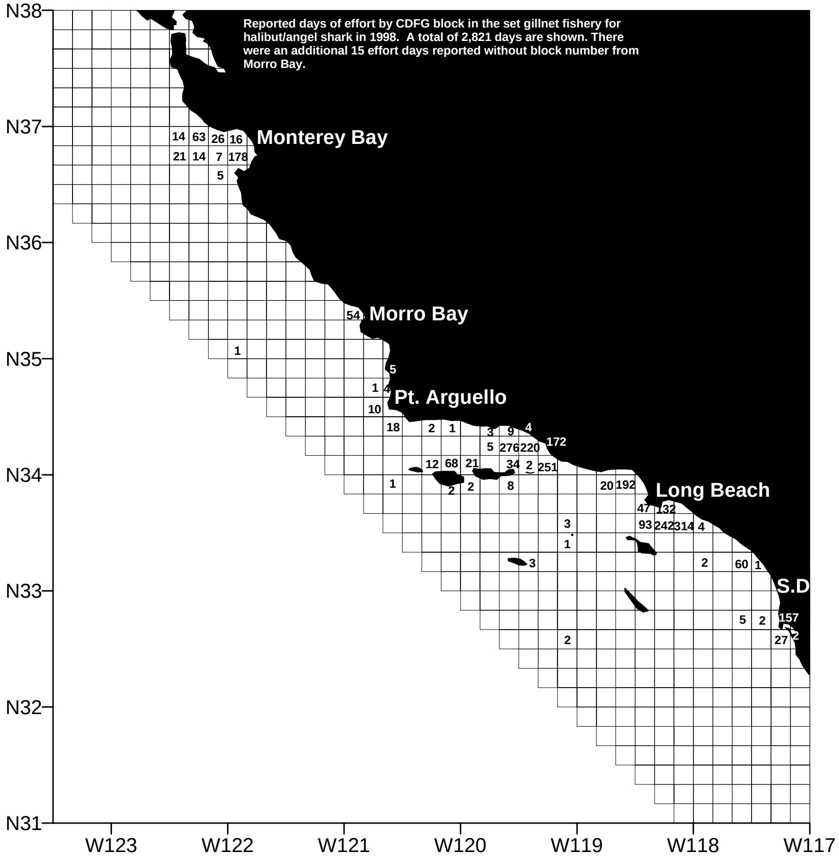


Figure 9. Reported fishing effort in days in the halibut/angel shark set gillnet fishery for 1998.

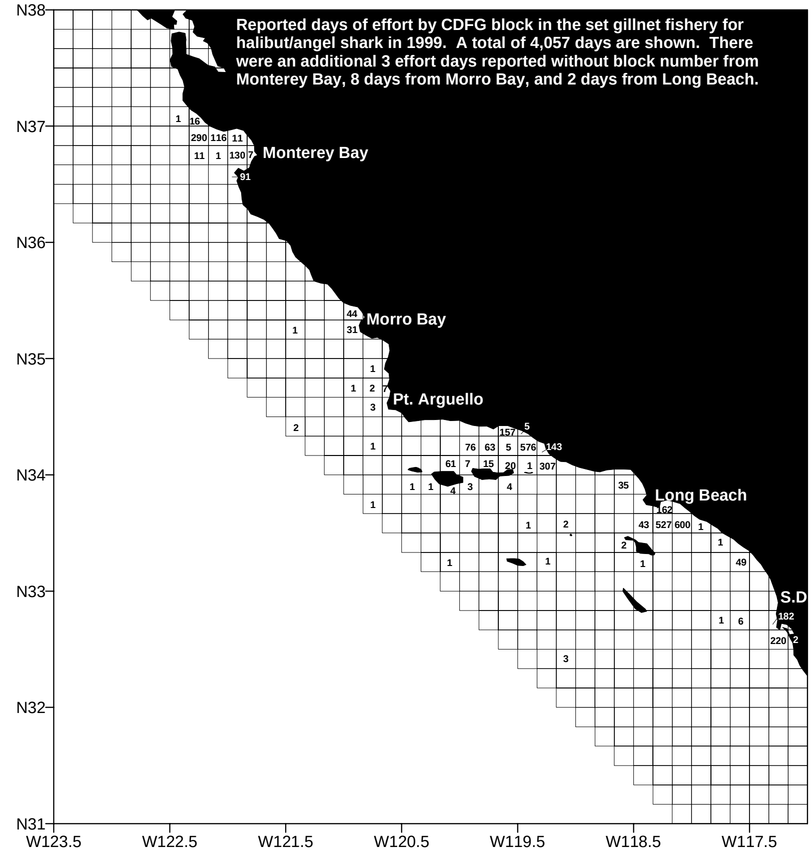


Figure 10. Reported fishing effort in days in the halibut/angel shark set gillnet fishery for 1999.

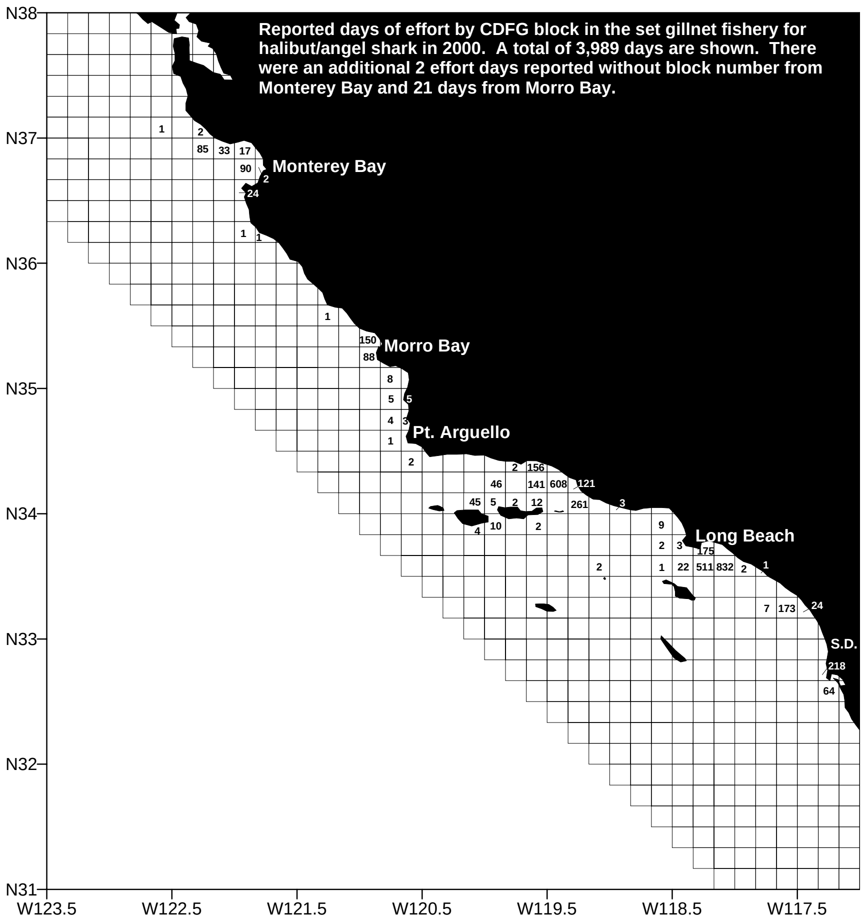


Figure 11. Reported fishing effort in days in the halibut/angel shark set gillnet fishery for 2000.

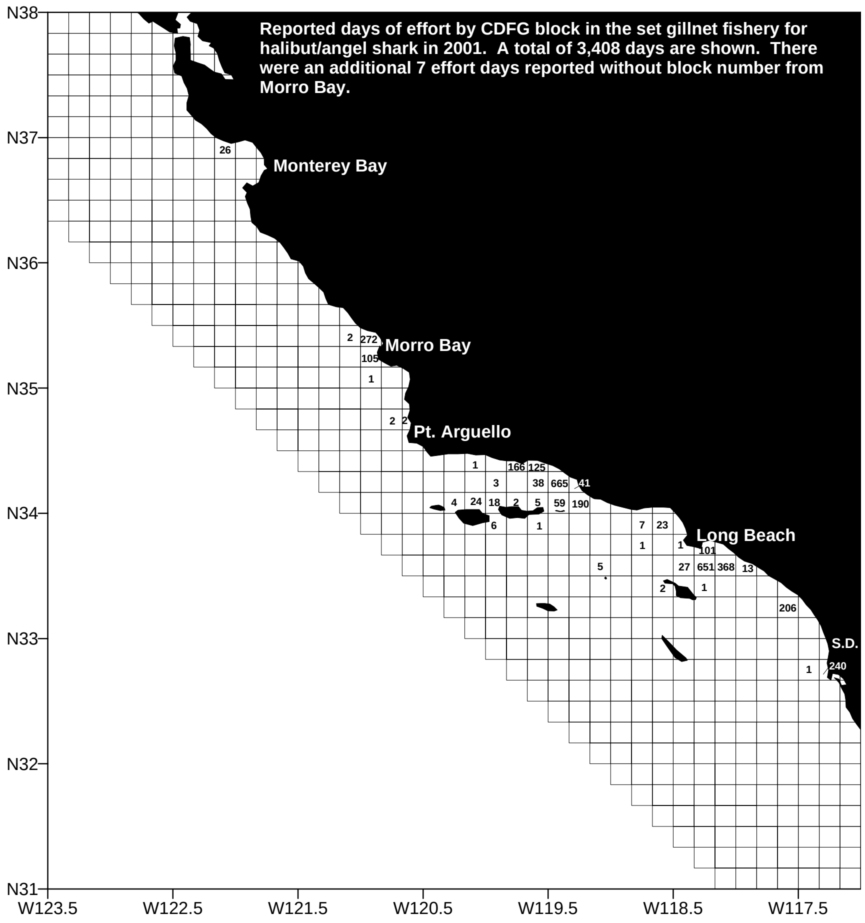


Figure 12. Reported fishing effort in days in the halibut/angel shark set gillnet fishery for 2001.

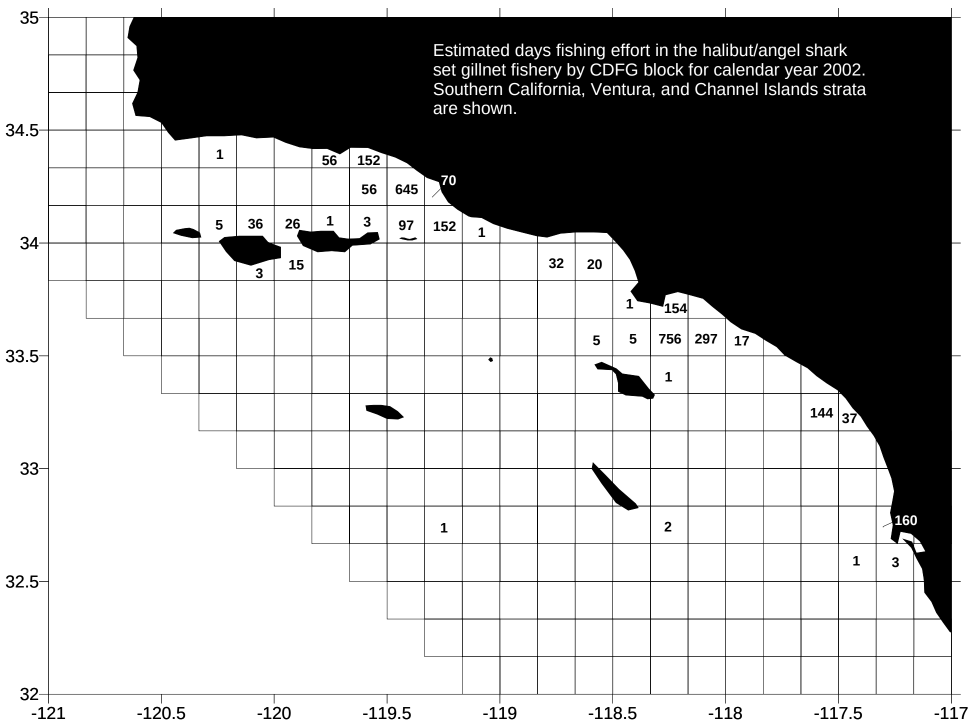


Figure 13. Reported fishing effort in days in the halibut/angel shark set gillnet fishery for 2002 (southern California).

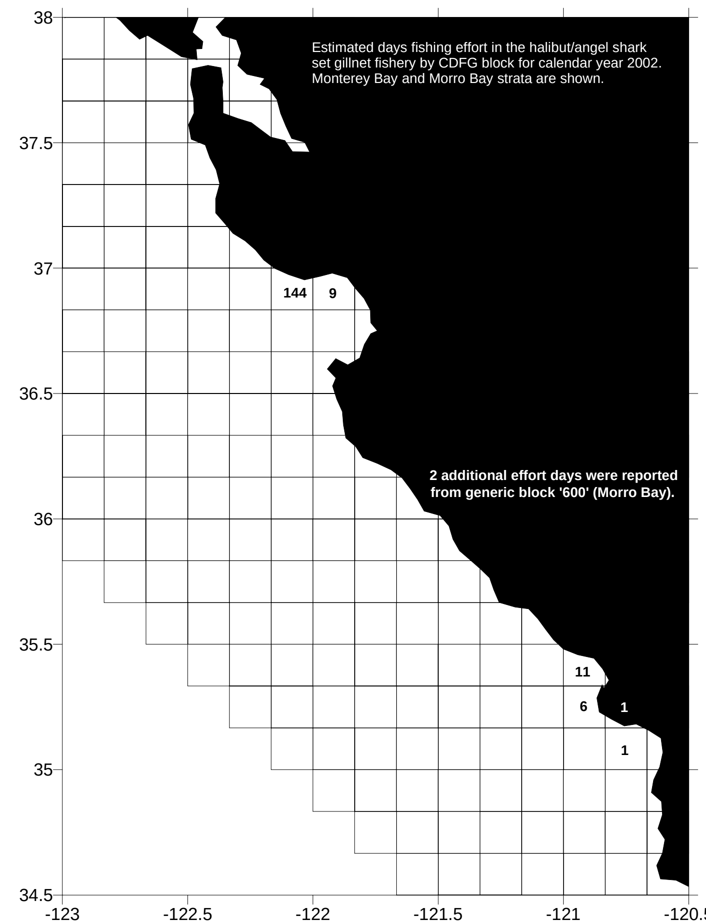


Figure 14. Reported fishing effort in days in the halibut/angel shark set gillnet fishery for 2002 (central California).

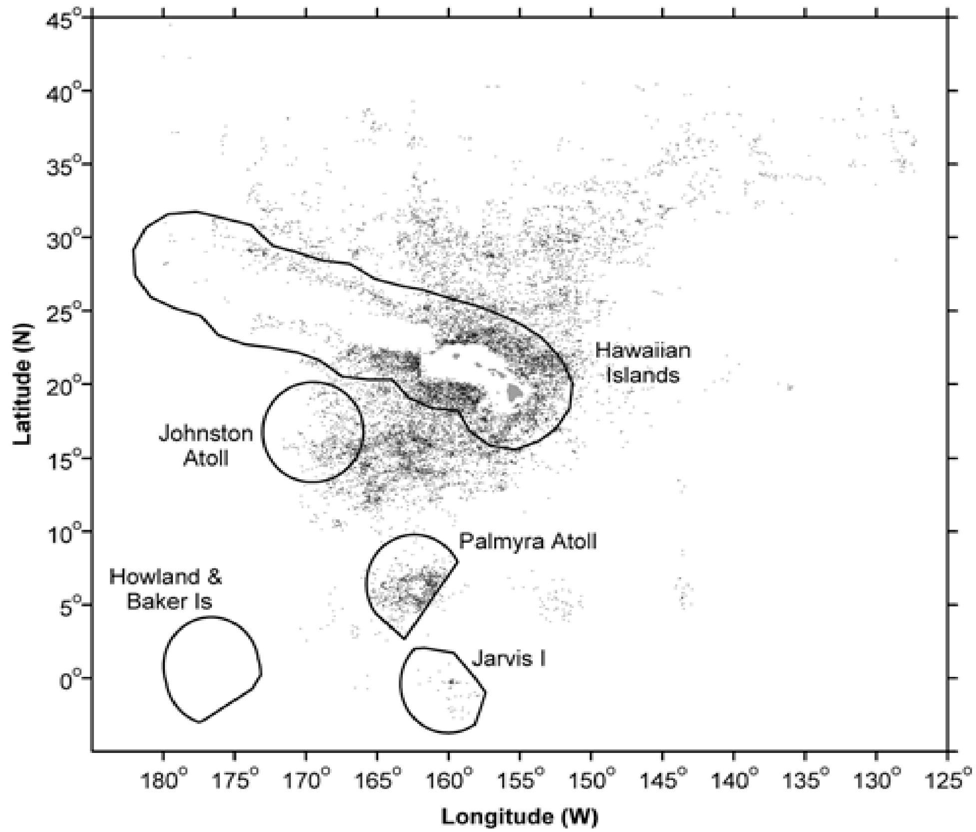


Figure 15. Observed set locations in the Hawaii-based longline fishery, 1994-2002.

Appendix 2. Cetacean Survey Effort

This Appendix presents a summary of survey effort from which cetacean sighting locations were plotted in the stock assessment reports. In Figures 1-6, the thick solid line represents the outer boundary of all surveys and the thin dashed line represents the U.S. EEZ.

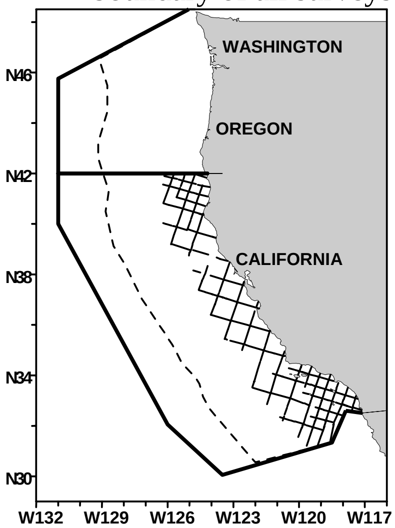


Figure 1. Transect lines completed during a 1991 winter/spring aerial survey of California waters (Forney et al. 1995).

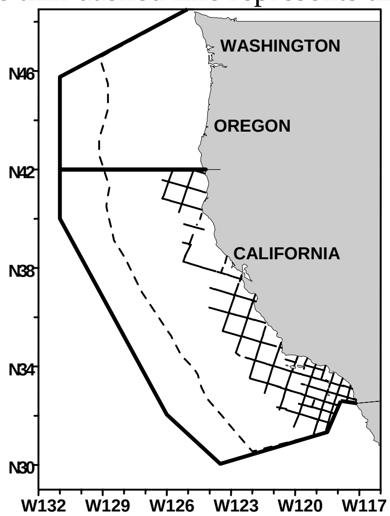


Figure 2. Transect lines completed during a 1992 winter/spring aerial survey of California waters (Forney et al. 1995).

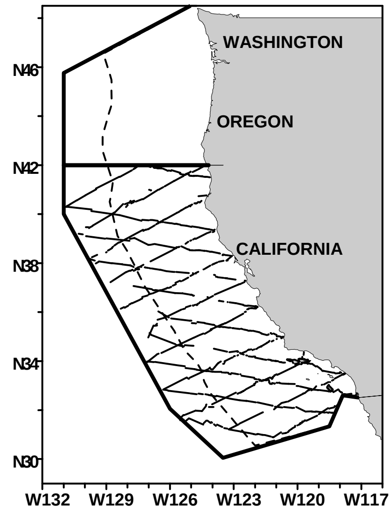


Figure 3. Transect lines completed during a 1991 summer/autumn vessel survey of California waters (Barlow 1995).

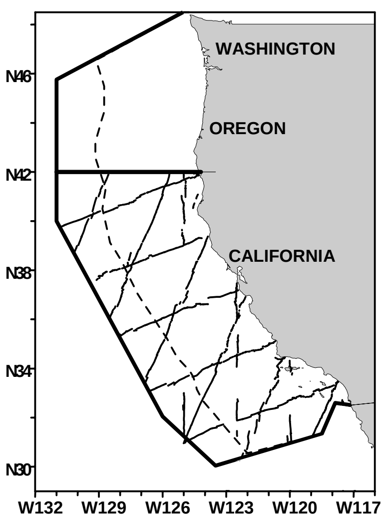


Figure 4. Transect lines completed during a 1993 summer/autumn vessel survey of California waters (Mangels and Gerrodette 1994).

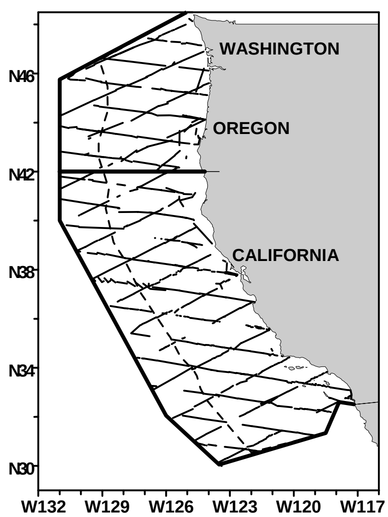


Figure 5. Transect lines completed during a 1996 summer/autumn vessel survey of California, Oregon, and Washington waters (Barlow 1997; Von Saunder and Barlow 1999).

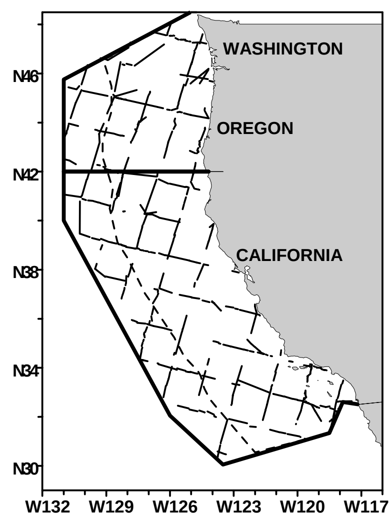


Figure 6. Transect lines completed during a 2001 summer/autumn vessel survey of California, Oregon, and Washington waters (Appler et al. 2004).

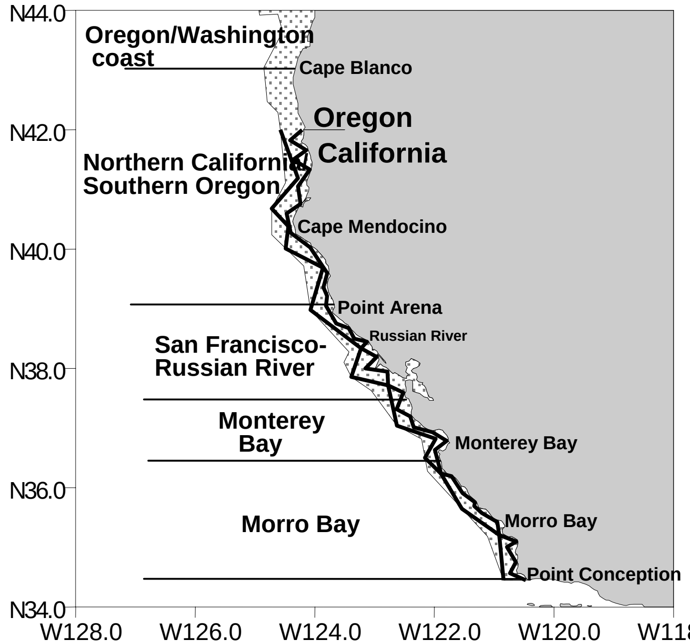


Figure 7. Harbor porpoise stock boundaries in California and southern Oregon. Stippled area shows approximate harbor porpoise habitat between 0-200 meters. Thick solid line represent survey transects flown during 1989-2002 aerial surveys (Forney et al. 1991; Forney 1995; Carretta and Forney 2004). Survey coverage north of the California/Oregon border has been completed by the National Marine Mammal Laboratory (Laake et al. 1998).

Figure 8. Coastline section (in bold) surveyed during 1990-2000 coastal bottlenose dolphin aerial surveys in southern and central California (Carretta et al. 1998, NMFS unpublished data).

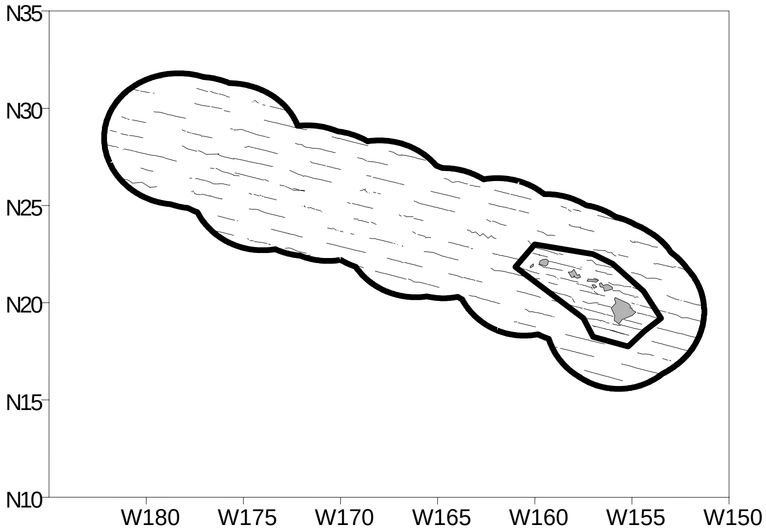


Figure 9. Transect lines completed during a 2002 summer/autumn vessel survey of Hawaiian waters (Barlow et al. 2004). Thick outer survey boundary line represents the U.S. EEZ and the inner thick line represents a separate 'Main Hawaiian Islands' stratum. Thin lines represent completed transect lines.

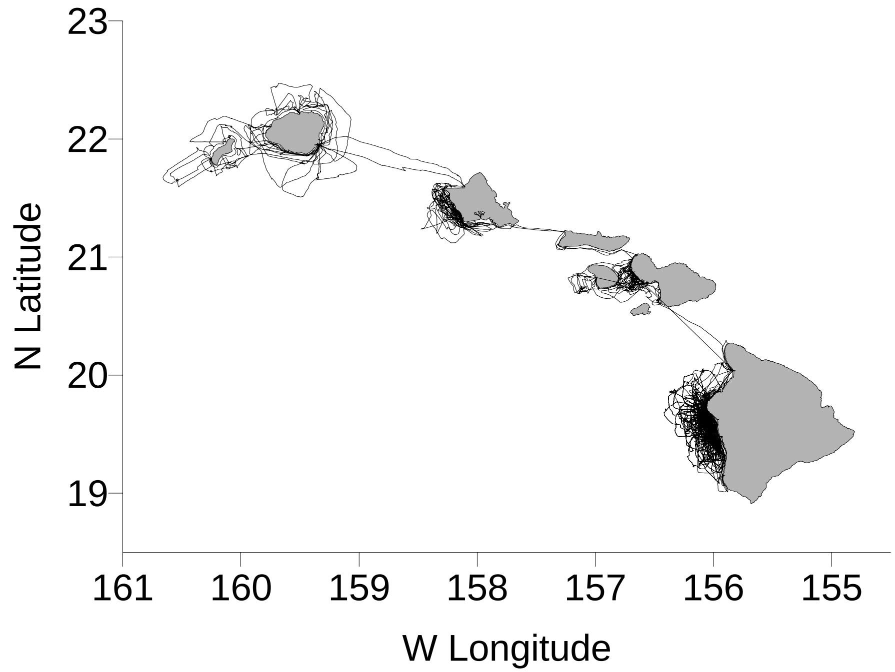


Figure 10. Small research vessel survey lines completed around the Main Hawaiian Islands between 2000-2004 (Baird et al. 2005). Approximately 25,000 km of survey tracks are shown.

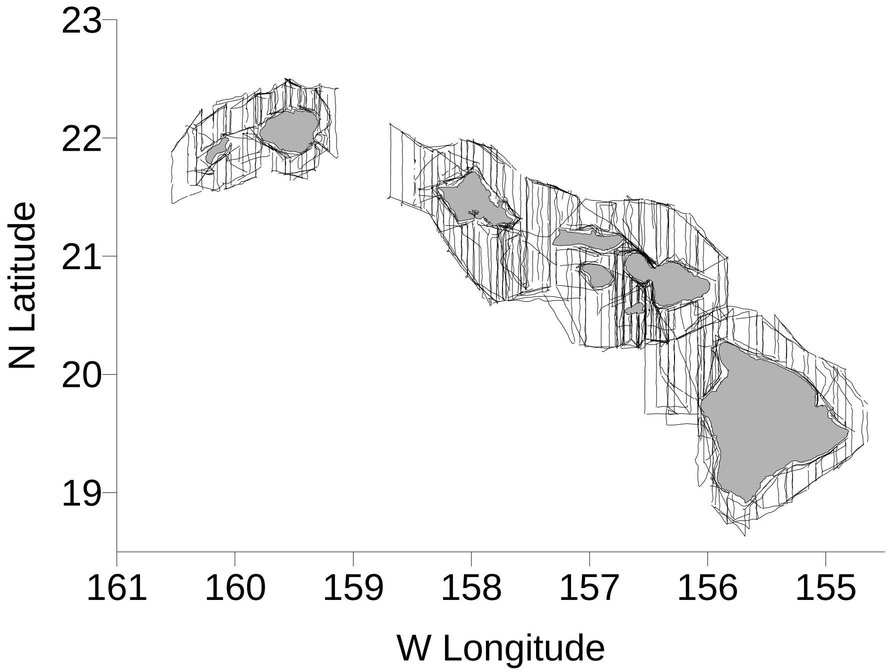


Figure 11. Aerial survey effort conducted around the Main Hawaiian Islands from 1993-2003 (Mobley et al. 2000, Mobley 2001, 2002, 2003, 2004).

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Information for stocks which were revised in 2005 appears shaded.

SUMMARY OF 2005 PACIFIC MARINE MAMMAL STOCK ASSESSMENT REPORTS

Species	Stock Area	Region	NMFS Center	N_{min}	R_{max}	F_r	PBR	Total Annual Mortality + Serious Injury	Annual Fishery Mortality + Serious Injury	Strategic Status
California sea lion	U.S.	PAC	SWC	138,881	0.12	1.0	8,333	1,562	1,476	N
Harbor seal	California	PAC	SWC	31,600	0.12	1.0	1,896	≥ 389	389	N
Harbor seal	Oregon/Washington Coast	PAC	AKC	22,380	0.12	1.0	1,343	≥17	≥15	N
Harbor seal	Washington Inland Waters	PAC	AKC	12,844	0.12	1.0	771	≥34	≥30	N
Northern Elephant Seal	California breeding	PAC	SWC	60,547	0.083	1.0	2,513	≥88	≥86	N
Guadalupe Fur Seal	Mexico to California	PAC	SWC	3,028	0.12	0.5	91	0	0	Y
Northern Fur Seal	San Miguel Island	PAC	AKC	4,190	0.086	1.0	180	0.8	≥0.6	N
Monk Seal	Hawaii	PAC	PIC	1,224	0.07	0.1	n/a	n/a	n/a	Y
Harbor porpoise	Morro Bay	PAC	SWC	1,206	0.04	0.4	10	4.5	4.5	N
Harbor porpoise	Monterey Bay	PAC	SWC	1,149	0.04	0.45	10	9.5	9.5	N
Harbor porpoise	San Francisco – Russian River	PAC	SWC	6,254	0.04	0.5	63	≥ 0.8	≥ 0.8	N
Harbor porpoise	Northern CA/Southern OR	PAC	SWC	12,940	0.04	1.0	259	≥ 0	≥ 0	N
Harbor porpoise	Oregon/Washington Coast	PAC	AKC	28,967	0.04	0.5	290	3.2	3.2	N
Harbor porpoise	Washington Inland Waters	PAC	AKC	2,545	0.04	0.4	20	15.2	15.2	N
Dall’s porpoise	California/Oregon/Washington	PAC	SWC	75,915	0.04	0.48	729	7	7	N
Pacific white-sided dolphin	California/Oregon/Washington	PAC	SWC	39,822	0.04	0.48	382	≥ 5.4	≥ 5.4	N
Risso’s dolphin	California/Oregon/Washington	PAC	SWC	12,748	0.04	0.4	115	3.6	3.6	N
Bottlenose dolphin	California Coastal	PAC	SWC	186	0.04	0.5	1.9	0	0	N
Bottlenose dolphin	California/Oregon/Washington Offshore	PAC	SWC	3,053	0.04	0.5	31	0	0	N
Striped dolphin	California/Oregon/Washington	PAC	SWC	9,165	0.04	0.5	92	0	0	N

Information for stocks which were revised in 2005 appears shaded.

SUMMARY OF 2005 PACIFIC MARINE MAMMAL STOCK ASSESSMENT REPORTS

Species	Stock Area	Region	NMFS Center	N_{min}	R_{max}	F_r	PBR	Total Annual Mortality + Serious Injury	Annual Fishery Mortality + Serious Injury	Strategic Status
Common dolphin, short-beaked	California/Oregon/Washington	PAC	SWC	365,617	0.04	0.5	3,656	93	93	N
Common dolphin, long-beaked	California/Oregon/Washington	PAC	SWC	25,163	0.04	0.48	242	11	11	N
Northern right whale dolphin	California/Oregon/Washington	PAC	SWC	16,417	0.04	0.5	164	23	23	N
Killer whale	Eastern North Pacific Offshore	PAC	SWC	361	0.04	0.5	3.6	0	0	N
Killer whale	Eastern North Pacific Southern Resident	PAC	AKC	84	0.04	0.5	0.8	0	0	Y
Short-finned pilot whale	California/Oregon/Washington	PAC	SWC	149	0.04	0.4	1.2	1.0	1.0	N
Baird's beaked whale	California/Oregon/Washington	PAC	SWC	152	0.04	0.5	1.5	0	0	N
Mesoplodont beaked whales	California/Oregon/Washington	PAC	SWC	645	0.04	0.5	6.5	0	0	N
Cuvier's beaked whale	California/Oregon/Washington	PAC	SWC	1,121	0.04	0.5	11	0	0	N
Pygmy Sperm whale	California/Oregon/Washington	PAC	SWC	119	0.04	0.5	1.2	0	0	N
Sperm whale	California/Oregon/Washington	PAC	SWC	885	0.04	0.1	1.8	1.0	1.0	Y
Humpback whale	Eastern North Pacific	PAC	SWC	1,158	0.08	0.1	2.3	≥1.6	≥1.2	Y
Blue whale	Eastern North Pacific	PAC	SWC	1,384	0.04	0.1	1.4	0.2	0	Y
Fin whale	California/Oregon/Washington	PAC	SWC	2,541	0.04	0.3	15	1.4	1.0	Y
Bryde's whale	California/Oregon/Washington	PAC	SWC	11,163	0.04	0.5	n/a	0	0	N
Sei whale	Eastern North Pacific	PAC	SWC	35	0.04	0.1	0.1	0	0	Y
Minke whale	California/Oregon/Washington	PAC	SWC	585	0.04	0.45	5.9	0	0	N
Rough-toothed dolphin	Hawaii	PAC	SWC	13,184	0.04	0.5	132	n/a	n/a	N
Risso's dolphin	Hawaii	PAC	SWC	1,426	0.04	0.5	14	n/a	n/a	N
Bottlenose dolphin	Hawaii	PAC	SWC	2,046	0.04	0.5	20	≥ 0.2	≥ 0.2	N

Information for stocks which were revised in 2005 appears shaded.

SUMMARY OF 2005 PACIFIC MARINE MAMMAL STOCK ASSESSMENT REPORTS

Species	Stock Area	Region	NMFS Center	N_{min}	R_{max}	F_r	PBR	Total Annual Mortality + Serious Injury	Annual Fishery Mortality + Serious Injury	Strategic Status
Pantropical spotted dolphin	Hawaii	PAC	SWC	7,362	0.04	0.5	74	≥ 0.8	≥ 0.8	N
Spinner dolphin	Hawaii	PAC	SWC	1,691	0.04	0.5	17	0	0	N
Striped dolphin	Hawaii	PAC	SWC	7,078	0.04	0.5	71	n/a	n/a	N
Fraser's dolphin	Hawaii	PAC	SWC	7,917	0.04	0.5	79	n/a	n/a	N
Melon-headed whale	Hawaii	PAC	SWC	1,386	0.04	0.5	14	n/a	n/a	N
Pygmy killer whale	Hawaii	PAC	SWC	382	0.04	0.5	3.8	n/a	n/a	N
False killer whale	Hawaii	PAC	SWC	128	0.04	0.45	1.2	1.6[†]	1.6[†]	Y
Killer whale	Hawaii	PAC	SWC	250	0.04	0.5	2.5	n/a	n/a	N
Pilot whale, short-finned	Hawaii	PAC	SWC	5,986	0.04	0.5	60	0.8	0.8	N
Blainville's beaked whale	Hawaii	PAC	SWC	1,204	0.04	0.5	9.6	0.8	0.8	N
Indopacetus pacificus	Hawaii	PAC	SWC	371	0.04	0.5	3.7	n/a	n/a	N
Cuvier's beaked whale	Hawaii	PAC	SWC	6,919	0.04	0.5	69	n/a	n/a	N
Pygmy sperm whale	Hawaii	PAC	SWC	4,082	0.04	0.5	41	n/a	n/a	N
Dwarf sperm whale	Hawaii	PAC	SWC	11,555	0.04	0.5	116	n/a	n/a	N
Sperm whale	Hawaii	PAC	SWC	5,531	0.04	0.1	11	n/a	n/a	Y
Blue whale	Hawaii	PAC	SWC	n/a	0.04	0.1	n/a	n/a	n/a	Y

Information for stocks which were revised in 2005 appears shaded.

SUMMARY OF 2005 PACIFIC MARINE MAMMAL STOCK ASSESSMENT REPORTS

Species	Stock Area	Region	NMFS Center	N_{min}	R_{max}	F_r	PBR	Total Annual Mortality + Serious Injury	Annual Fishery Mortality + Serious Injury	Strategic Status
Fin whale	Hawaii	PAC	SWC	101	0.04	0.1	0.2	n/a	n/a	Y
Sei whale	Hawaii	PAC	SWC	37	0.04	0.1	0.1	n/a	n/a	Y
Minke whale	Hawaii	PAC	SWC	n/a	0.04	0.5	n/a	n/a	n/a	N
Bryde's whale	Hawaii	PAC	SWC	373	0.04	0.5	3.7	n/a	n/a	N

† Serious injury and mortality values for the Hawaii stock of false killer whale includes only animals taken within the Hawaiian Islands Exclusive Economic Zone.

Appendix 4. Summary of U.S. Pacific marine mammal stock assessment report revisions.

U.S. Pacific Marine Mammal Stock	Year Last Revised
Pinnipeds	
California sea lion (*Zalophus californianus californianus*): U.S. Stock	2003
Harbor seal (*Phoca vitulina richardsi*): California stock	2005
Harbor seal (*Phoca vitulina richardsi*): Oregon & Washington Coastal Waters Stock	2003
Harbor seal (*Phoca vitulina richardsi*): Washington Inland Waters Stock	2003
Northern elephant seal (*Mirounga angustirostris*): California Breeding Stock	2003
Guadalupe fur seal (*Arctocephalus townsendi*)	2000
Northern fur seal (*Callorhinus ursinus*): San Miguel Island Stock	2003
Hawaiian monk seal (*Monachus schauinslandi*)	2005
Cetaceans (Eastern North Pacific & California/Oregon/Washington Stocks)	
Harbor porpoise (*Phocoena phocoena*): Morro Bay Stock	2004
Harbor porpoise (*Phocoena phocoena*): Monterey Bay Stock	2004
Harbor porpoise (*Phocoena phocoena*): San Francisco-Russian River Stock	2004
Harbor porpoise (*Phocoena phocoena*): Northern California/Southern Oregon Stock	2003
Harbor porpoise (*Phocoena phocoena*): Oregon/Washington Coast Stock	2003
Harbor porpoise (*Phocoena phocoena*): Washington Inland Waters Stock	2003
Dall's porpoise (*Phocoenoides dalli*): California/Oregon/Washington Stock	2003
Pacific white-sided dolphin (*Lagenorhynchus obliquidens*): California/Oregon/Washington, Northern and Southern Stocks	2003
Risso's dolphin (*Grampus griseus*): California/Oregon/Washington Stock	2003
Bottlenose dolphin (*Tursiops truncatus*): California Coastal Stock	2003
Bottlenose dolphin (*Tursiops truncatus*): California/Oregon/Washington Offshore Stock	2003
Striped dolphin (*Stenella coeruleoalba*): California/Oregon/Washington Stock	2003
Short-beaked common dolphin (*Delphinus delphis*): California/Oregon/Washington Stock	2003
Long-beaked common dolphin (*Delphinus capensis*): California Stock	2003
Northern right whale dolphin (*Lissodelphis borealis*): California/Oregon/Washington Stock	2003
Killer whale (*Orcinus orca*): Eastern North Pacific Offshore Stock	2003
Killer whale (*Orcinus orca*): Eastern North Pacific Southern Resident Stock	2005
Short-finned pilot whale (*Globicephala macrorhynchus*): California/Oregon/Washington Stock	2005
Baird's beaked whale (*Berardius bairdii*): California/Oregon/Washington Stock	2003
Mesoplodont beaked whales (*Mesoplodon* spp.): California/Oregon/Washington Stocks	2003
Cuvier's beaked whale (*Ziphius cavirostris*): California/Oregon/Washington Stock	2003
Pygmy sperm whale (*Kogia breviceps*): California/Oregon/Washington Stock	2003

Appendix 4. Summary of U.S. Pacific marine mammal stock assessment report revisions.

U.S. Pacific Marine Mammal Stock	**Year Last Revised**
Dwarf sperm whale (*Kogia sima*): California/Oregon/Washington Stock	2003
Sperm whale (*Physeter macrocephalus*): California/Oregon/Washington Stock	2003
Humpback whale (*Megaptera novaeangliae*): Eastern North Pacific Stock	2005
Blue whale (*Balaenoptera musculus*): Eastern North Pacific Stock	2004
Fin whale (*Balaenoptera physalus*): California/Oregon/Washington Stock	2003
Bryde=s whale (*Balaenoptera edeni*): Eastern Tropical Pacific Stock	2000
Sei whale (*Balaenoptera borealis*): Eastern North Pacific Stock	2003
Minke whale (*Balaenoptera acutorostrata*): California/Oregon/Washington Stock	2003
Cetaceans (Hawaii Stocks)	
Rough-toothed dolphin (*Steno bredanensis*): Hawaii Stock	2004
Risso=s dolphin (*Grampus griseus*): Hawaii Stock	2004
Bottlenose dolphin (*Tursiops truncatus*): Hawaii Stock	2004
Pantropical spotted dolphin (*Stenella attenuata*): Hawaii Stock	2004
Spinner dolphin (*Stenella longirostris*): Hawaii Stock	2004
Striped dolphin (*Stenella coeruleoalba*): Hawaii Stock	2004
Fraser=s dolphin (*Lagenodelphis hosei*): Hawaii Stock	2004
Melon-headed whale (*Peponocephala electra*): Hawaii Stock	2004
Pygmy killer whale (*Feresa attenuata*): Hawaii Stock	2004
False killer whale (*Pseudorca crassidens*): Hawaii Stock	2005
Killer whale (*Orcinus orca*): Hawaii Stock	2004
Short-finned pilot whale (*Globicephala macrorhynchus*): Hawaii Stock	2004
Blainville=s beaked whale (*Mesoplodon densirostris*): Hawaii Stock	2004
Longman=s beaked whale (*Indopacetus pacificus*): Hawaii Stock	2004
Cuvier=s beaked whale (*Ziphius cavirostris*): Hawaii Stock	2004
Pygmy sperm whale (*Kogia breviceps*): Hawaii Stock	2004
Dwarf sperm whale (*Kogia sima*): Hawaii Stock	2004
Sperm whale (*Physeter macrocephalus*): Hawaii Stock	2004
Blue whale (*Balaenoptera musculus*): Western North Pacific Stock	2004
Fin whale (*Balaenoptera physalus*): Hawaii Stock	2004
Sei whale (*Balaenoptera borealis*): Hawaii Stock	2004
Minke whale (*Balaenoptera acutorostrata*): Hawaii Stock	2004
Bryde=s whale (*Balaenoptera edeni*): Hawaii Stock	2004

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