

Stranding Trends for Eastern Gray Whales, *Eschrichtius robustus*: 1975-2006

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INTRODUCTION

Dead whales have been of scientific interest on the west coast of North America since Lewis and Clarke arrived on the Pacific coast over 200 years ago (Duncan 1997). They reported the carcass of a large whale that must have been a blue whale, *Balaenoptera musculus* (Brownell 2003). Gray whales, *Eschrichtius robustus*, were depleted by commercial whaling during the latter half of the 19th century and early part of the 20th century but by the mid 1960s the population was increasing. The number and trend of dead gray whales has been of special interest to zoologists and the general public at least since the time of the Santa Barbara, California oil spill in January 1969 (Brownell 1971) and again during the *Exxon Valdez* oil spill in Prince Williams Sound, Alaska in March 1989. In 1999, an unusually high number (283) of stranded gray whales resulted in the National Marine Fisheries Service to formally designate the strandings as an "unusual mortality event" (Gulland *et al.* 2005). In 2000, the number of dead gray whales (368) was even higher. The cause of this die-off was not determined but their emaciated condition supported the idea that starvation could have been a significant factor in the death of these whales. However, the underlying cause of starvation is unknown (Gulland *et al.* 2005).

Since the major die-off in 1999 and 2000, scientists and managers have been interested in enhancing the collection of baseline data and the rapid detection of any future die-offs so as to mobilize response and investigation teams as early in the event as possible. This study examines the annual change in the number of stranded gray whales between 1975 and 2006 to gain a better understanding of any trends in the stranding of gray whales. These strandings data are also examined in relationship to the gray whale population abundance estimates and annual calf production estimates.

METHODS

Data on stranded gray whales was collected from various sources, but most data come from established stranding programs in the six main geographic regions along the western shore of North America. These include: Alaska, USA; British Columbia, Canada; Washington, USA; Oregon, USA; California, USA; and Baja California, Mexico. The length of coastline for these regions is: Alaska without the Arctic, 5,580 miles; British Columbia, including islands 27,200 km; Washington, 157 miles; Oregon, 296 miles; California, 840 miles; and west coast of Baja California, ca 1,000 km. We did not

examine data on total length, sex and condition of individual whales from all six regions and therefore did not examine the data for these variables.

Datasets we examine stranding data from six west coast of North America geographic regions. These are:

1. Alaska – 1990- 1995 and 2003 and 2006, Aleria Jensen NOAA Fisheries
2. British Columbia – 1990- 1994 and 2003 and 2006, John Ford pers. comm., May 2007; and Baird *et al.* 2002
3. Washington – Kristin Wilkinson, NOAA Fisheries and John Calambokidis excel sheet for 1977-2006; and Norman *et al.* 2002
4. Oregon – Kristin Wilkinson, NOAA Fisheries and John Calambokidis excel sheet for 1974-2006; and Norman *et al.* 2002
5. California – Los Angeles Count Museum of Natural History excel sheet and Joe Cordaro, NOAA Fisheries
6. Baja California – Sanchez Pacheco (1998), Lorenzo Rojas-Bracho pers. comm., Urban *et al.* (2003).
7. Overall datasets for North America – Sumich and Harvey (1986), Heyning and Dalheim (1990), and Gulland *et al.* (2005), and Smithsonian Institution

Details on the marine mammal stranding networks for California, the Northwest US (Oregon and Washington), and Alaska can be found in Seagars and Jozwiak (1991), Scordino (1991) and Zimmerman (1991), respectively.

Within geographic areas and between geographic areas, search effort to detect and record dead cetaceans varies by time and percent of the area covered. The largest areas (Alaska and British Columbia) have the least amount of search effort per km of coastline and also the most inconsistent search effort over the period 1975 to 2006. Searching effort in the Baja California lagoons with gray whales varied between years based on research activities on live whales.

RESULTS

All records of dead stranded or dead floating gray whales recorded along the coast of North America between 1975 and 2006 are presented in Table 1 and Figure 1. The total number of reported dead gray whales for the 32 year period was 1,892 individuals. Within the six geographic regions from north to south the total reported dead gray whales were: Alaska (312), British Columbia (124), Washington (175), Oregon (66), California (439) and Baja California (774). Search effort in Alaska had the largest annual variation due to differences in research effort per year (Fay *et al.* 1978, Zimmerman 1989) and significant increases in effort due to responses to anthropogenic events like the Exxon Valdez oil spill in 1989 (Kelly and Sease, 1990; Sease and Rea, 1990; Loughlin, 1994).

Strandings from California, Oregon and Washington were summed and used as the core area to detect mortality patterns over this time period because they had the most consistent carcass detection and reporting rates (Figure 2). The data from Alaska, British

Columbia and Baja California were excluded because of known problems of inconsistent search and reporting effort over the 32 year study period.

The general pattern of mortality in the core area from 1984 to 1998 was a higher number of deaths for one or two years followed by two years of lower numbers of strandings (Figure 2). In 1999 and 2000, there was a major die off followed by the lowest number of deaths in 2001. From the low in 2001, the number of reported mortalities increased from 2002 to 2004. Reported strandings have remained at the same rate over the last three years (2004-2006).

In this study we did not examine the cause of death since full necropsies were rarely conducted during this study period. In most cases, the cause of death was mainly reported when the cause was visibly obvious such as for animals taken incidentally in fishing gear, struck by vessels or attacked by killer whales.

Gray whale southbound published abundance estimates (Figure 3) from the period 1975 to 2002 from Granite Canyon, California were obtained from Rugh *et al* (2007). Published and unpublished calf production abundance estimates (Figure 3) from northbound surveys (1980, 1981 and 1994-2006) from Pt. Piedras Blancas, California were obtained from published reports or from Wayne Perryman.

DISCUSSION

The earliest recorded gray whale we found for each of the six geographic regions are follows: Alaska-1958 (Wilke and Fiscus, 1961); British Columbia-1966 (Pike and MacAskie, 1969; Reeves and Mitchell, 1988); Washington-1956 (Sumich and Harvey, 1986); Oregon-1958 (Gilmore, 1960); California-1960 (Brownell, 1971); Baja California-1953 (Gilmore, 1960; Sumich and Harvey, 1986). However, due to problems with searching or reporting effort, we further examined gray whale strandings in the six geographic regions only after 1975. After we examined these data we found the only regions with consistent and even effort over this period were California, Oregon and Washington.

Numerous factors influence the reporting of stranded gray whales. Reports of strandings are either a function of targeted search effort or passive reportings, both of which can vary substantially from region to region. In addition to actual reporting, there are numerous factors that may affect either actual mortality or the detection of carcasses. These include but are not limited to the following: strandings as a function of increasing population size (Rugh *et al.* 2005), active or passive search effort, increasing numbers of calves born on the southbound migration (Shelden *et al.* 2004), killer whale predation (Goley and Straley, 1994), human causes like bycatch and vessel strikes (Heyning and Lewis 1990), and oceanographic conditions which may alter either mortality rates or carcass deposition on or near shores or detection offshore. We will factors need to be examined in future work.

Since the 1980s, more gray whales calves have been seen on the southbound migration than observed previously and the migration has shifted later by one week (Shelden *et al.* 2004). These factors may result in reduced calf survival or increase calf stranding reports because calves have thinner blubber layers at birth and they would have to expend extra energy to swim with their mother to the lagoons and coastal waters of Baja California, Mexico. This study did not evaluate these and other factors that characterize the historic stranding trends and that will be essential to understand future trends.

After the 1999/2000 die-off, the number of strandings in 2001 was lower than the average number that stranded before the die-off. Also the number of calves sighted during northbound counts in the years during and immediately after the die-off was the lowest of the available time series (1980, 1981 and 1994-2006). The abundance estimates after the die-off were about the same as the estimates in the late 1970s. In 2004, the calf production estimates were the highest ever recorded. During the past three years observed calf production has remained stable at the same level observed in the early 1980s and early 1990s. At this time there is no indication that strandings may increase.

RECOMMENDATIONS FOR FUTURE RESEARCH

In order to enhance our understanding of the factors contributing to gray whale strandings and to enhance a consistent detection, reporting, and sample and data collection, we recommend the following:

Establishment of consistent data and sample collection protocols to be used by stranding networks across the range of this species. This includes the collection of data such as the age class of stranded gray whales and their season of stranding (southbound vs northbound migration);

Development of a central stranding database to better track the trend in gray whale strandings and to enhance communication and monitor effort; and

Proactive effort to develop and maintain more consistent effort in Baja California and Alaska, two or three core areas need to be surveyed on a regular bases in order to provide baseline information for comparison with natural event (red tide) or anthropogenic event (oil spill) that might cause a significant die-off of gray whales in those area.

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Strandings trends EGWs/RLB/22IV2007//24IV2007//27IV2007//28IV2007//3V2007//8V2007//11V2007

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	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Mexico					1	20	0	4	7	9
CA	3	1	2			6	14	9	6	8
OR					1	0	1	1	1	0
WA						0	0	4	2	2
Canada						0	1	0	0	2
Alaska						14	17	0	0	0
Year Total						40	33	18	16	21

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Mexico	53	20	45	26	10	7	6	11	12	21
CA	7	9	7	4	12	16	6	21	8	6
OR	4	2	1	3	5	1	0	4	1	2
WA	3	4	1	6	9	1	2	5	8	4
Canada	1	0	1	5	7	2	1	4	5	9
Alaska	0	0	1	0	1	0	1	6	4	36
Year Total	68	35	58		44	27	16	51	38	78

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Mexico	16	45	22	8	3	13	3	22	17	124
CA	11	17	17	14	15	12	13	10	30	45
OR	2	4	1	0	0	4	3	3	0	3
WA	14	10	3	2	3	8	2	2	3	27
Canada	16	7	8	0	4	5	0	5	2	10
Alaska	30	15	7	13	3	1	0	3	3	73
Year Total	89	98	58	37	30	43	21	45	55	282

	2000	2001	2002	2003	2004	2005	2006
Mexico	207	10	6	6	2	12	5
CA	59	5	7	8	18	7	12
OR	2	0	3	2	4	5	4
WA	23	1	2	3	2	11	8
Canada	22	0	0	2	2	3	2
Alaska	55	5	0	6	2	5	11
Year Total	368	21	18	27	39	43	42

Table 1

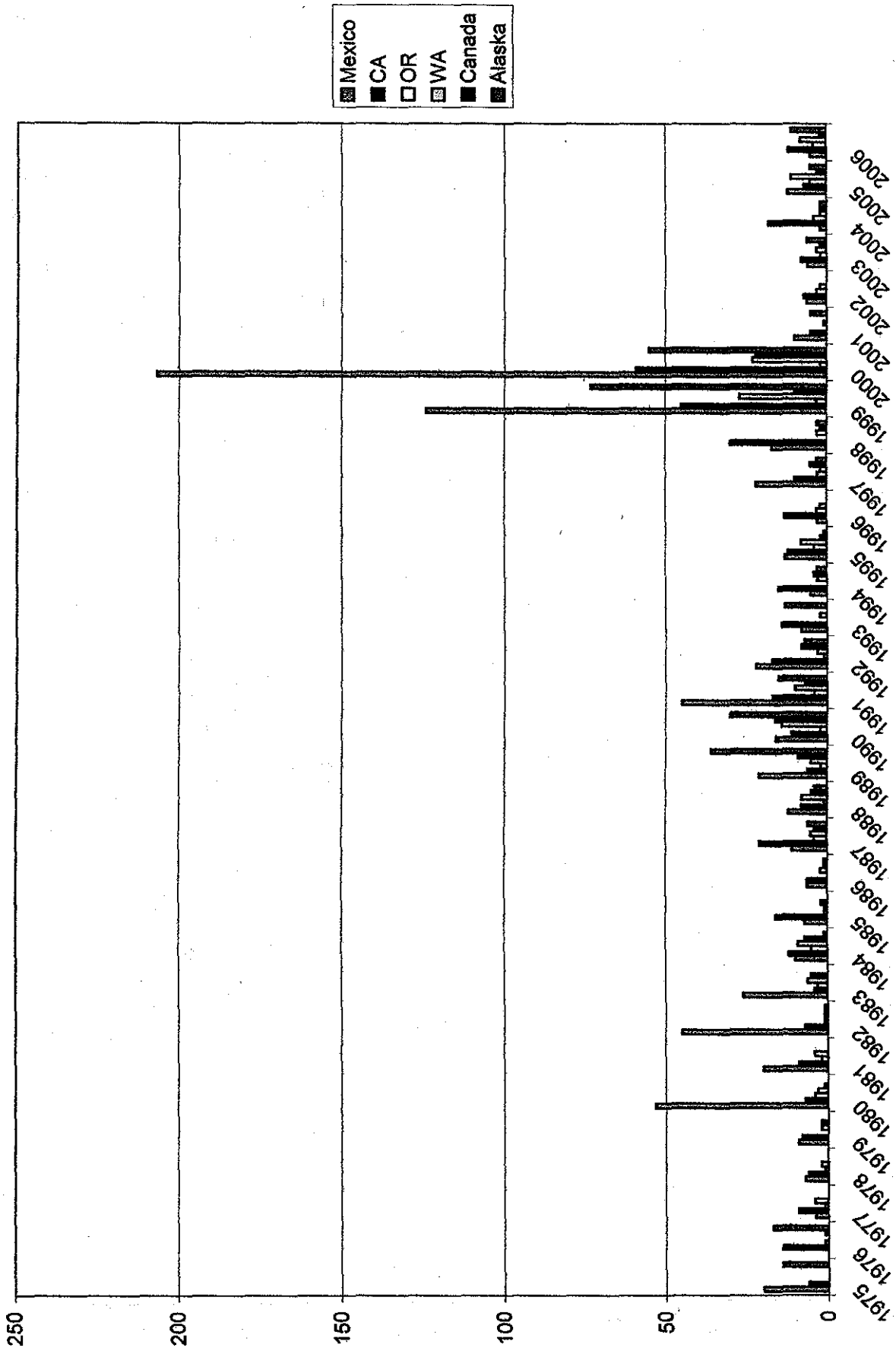


Figure 1

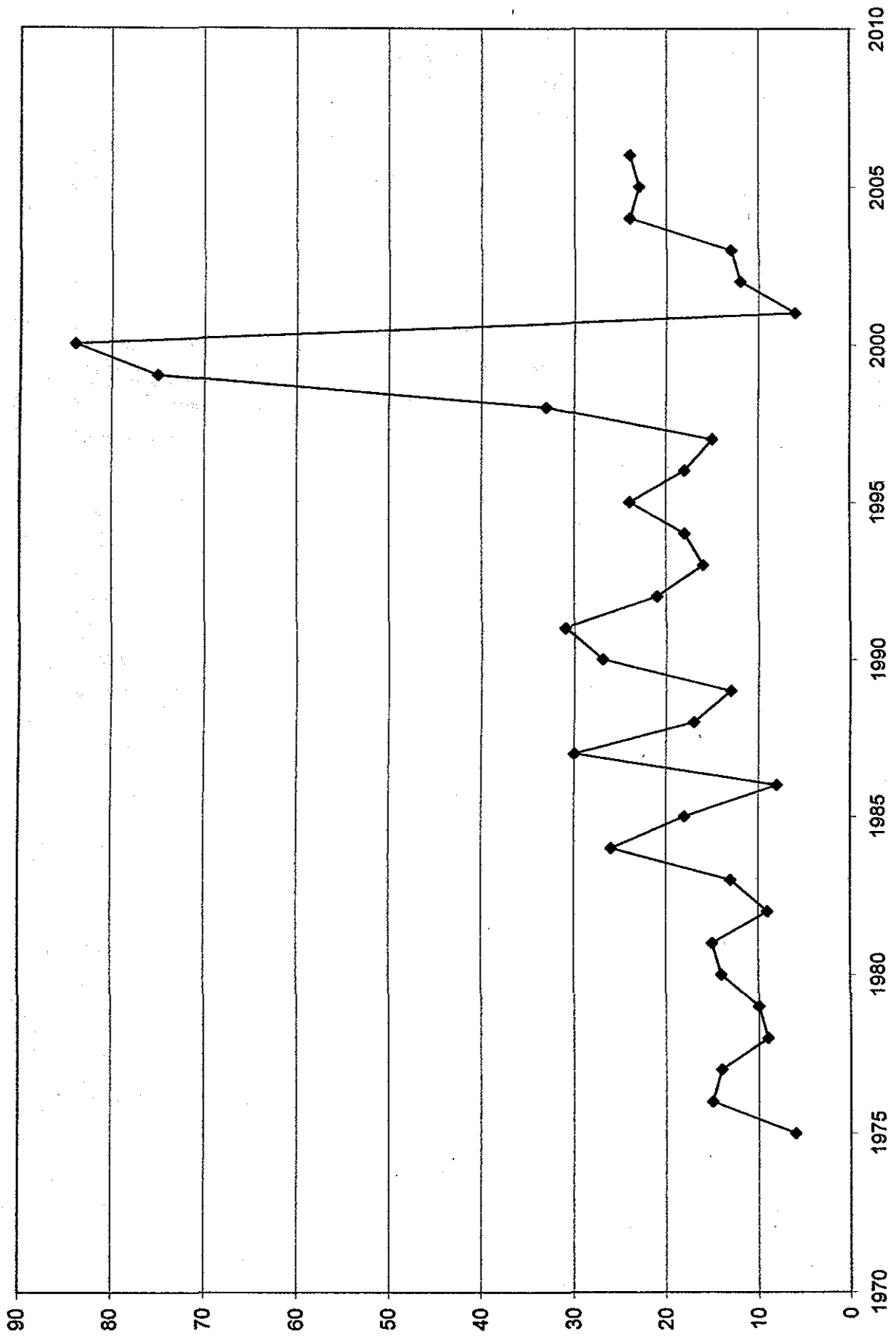
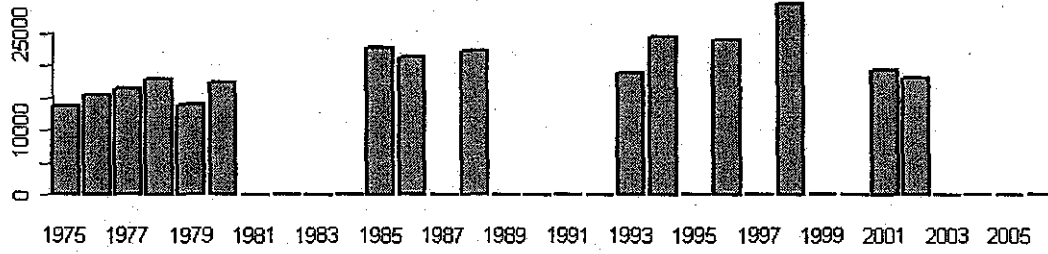
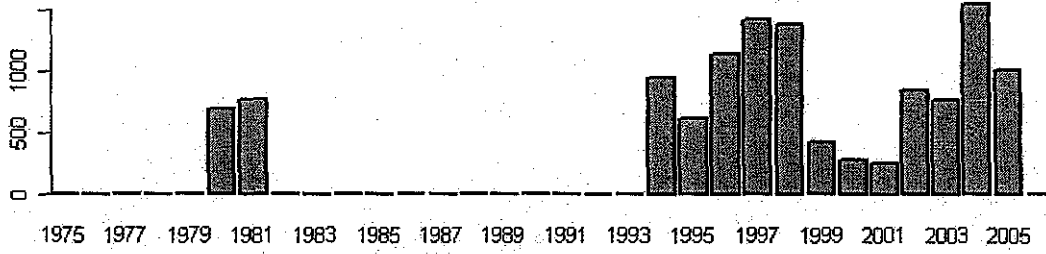


Figure 2

Abundance estimates



Calf estimates



Strandings

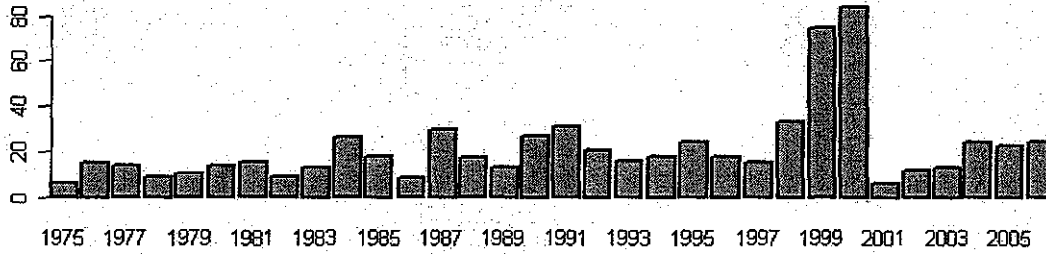


Figure 3

