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DRAFT U.S. PACIFIC MARINE MAMMAL STOCK ASSESSMENTS: 2007

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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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Draft stock assessment reports and appendices revised in 2007 are highlighted; all others will be reprinted as they appear in the 2006 Pacific Region Stock Assessment Reports (Carretta *et al.* 2007).

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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 29 Pacific marine mammal stocks under NMFS jurisdiction, including 9 "strategic" stocks and 20 "non-strategic" stocks (see summary table). Information on the remaining 32 Pacific region stocks is reprinted without revision in this report and also appears in the 2006 reports (Carretta *et al.* 2007). Stock Assessments for Alaskan marine mammals are published by the National Marine Mammal Laboratory (NMML) in a separate report.

The 29 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. Northwest Fisheries Science Center staff prepared the report on the Eastern North Pacific Southern Resident killer whale. National Marine Mammal Laboratory staff prepared the report for the Oregon and Washington coast harbor seal stock. 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 26 stocks, which include 22 U.S. west coast cetacean stocks, two stocks of false killer whales (Hawaii and Palmyra Atoll), the California sea lion, and northern elephant seal.

A new stock of false killer whales (Palmyra Atoll) has been added to this year's reports to reflect the availability of new genetic information for this species in the Pacific Islands Region. Both the 'Hawaii' and 'Palmyra Atoll' false killer whale stocks are included in a single report, labeled the "Pacific Islands Region Stock Complex". The intention of combining stocks into one species report is to consolidate general text about the species and thus reduce the number of printed pages. The status of two U.S. west coast cetacean stocks ('California/Oregon/Washington short-finned pilot whales' and 'California long-beaked common dolphins') has changed from "non-strategic" to "strategic", based on new estimates of abundance and updates of incidental fishery mortality levels. The stock previously referred to as 'East North Pacific Humpback Whale' has undergone a name change to 'California/Oregon/Washington Humpback Whale', to reflect that the stock structure of humpback whales is better defined based on feeding areas rather than breeding grounds.

Draft versions of the stock assessment reports were reviewed by the Pacific Scientific Review Group at the November 2006 Seattle meeting. 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 on marine mammal stocks and fisheries becomes available. Background information and guidelines for preparing stock assessment reports are reviewed in Wade and Angliss (1997). The authors solicit any new information or comments which would improve future stock assessment reports.

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 accessible, the citation should follow the format: [Original source], as cited in [this Stock Assessment Report citation].

Citation for this report: Carretta, J.V., K.A. Forney, M.S. Lowry, J. Barlow, J. Baker, B. Hanson, and M.M. Muto. 2007. Draft U.S. Pacific Marine Mammal Stock Assessments: 2007. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-xxx.

Cover photograph: California sea lion (Zalophus californianus). Photo by Mark S. Lowry

References:

Carretta, J.V., K.A. Forney, M.M. Muto, J. Barlow, J. Baker, Brad Hanson, and M.S. Lowry. 2007. U.S. Pacific Marine Mammal Stock Assessments: 2006. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-398. 312p.

Wade, P.R. and R.P. Angliss. 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS workshop April 3-5, 1996, Seattle, Washington. NOAA Technical Memorandum NMFS-OPR-12. Available from Office of Protected Resources, National Marine Fisheries Service, Silver Spring, MD. 93p.

Revised ~~12/15/2003~~05/03/2007

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.

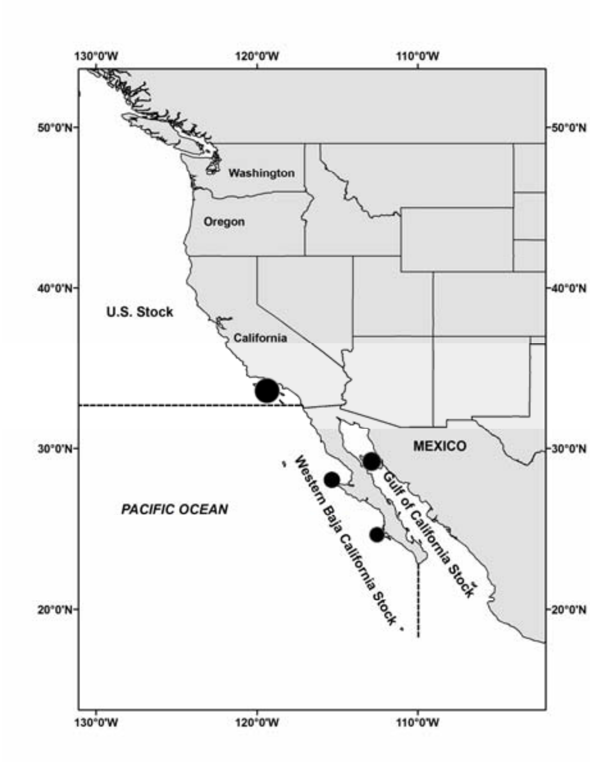


Figure 1. Geographic range of California sea lions showing stock boundaries and locations of major rookeries. The U.S. stock ranges north into Canadian waters.

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)~~ 2005 (48,277) was adjusted for an estimated 15% pre-census mortality (Boveng 1988; Lowry et al. 1992), giving an estimated ~~56,440~~ 55,519 live births in the population. The fraction of newborn pups in the population ~~(23.1% to 23.8%~~ 23.3%) 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,~~ 5.6% yr^{-1}, see below). Multiplying the number of pups born by the inverse of ~~these~~ this fraction~~s~~ (~~4.32 to 4.20~~ 4.28) results in a population estimate~~s ranging from 244,000 to 237,000 (respectively)~~ of 238,000.

Minimum Population Estimate

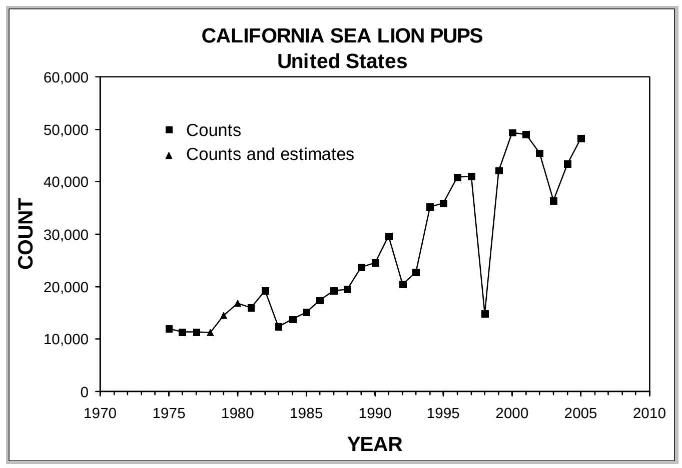
The minimum population size was determined from counts of all age and sex classes that were ashore at all the major rookeries and haulout sites during the ~~2001~~ 2005 breeding season. The minimum population size of the U.S. stock is ~~138,881~~ 141,842 (NMFS unpubl. data). It includes all California sea lions counted during the July ~~2001~~ 2005 census at the ~~four rookeries~~ Channel Islands 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~~ 2005 (Figure 2) were compiled from the literature, NMFS reports, unpublished NMFS data, and Lowry 1999 (the literature up to ~~1992~~ 2000 is listed in ~~Lowry et al. 1992~~ Lowry and Maravilla 2005). Pup counts from 1975 through ~~2001~~ 2005 were examined for four rookeries in southern California and for haulouts in central and northern California. ~~Log-linear interpolation between adjacent counts~~ The number of pups at rookeries not counted were estimated using multiple regressions derived from counts of two neighboring rookeries using data from 1975-2000 (Lowry and Maravilla 2005) ~~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.; and (3) 1978, and 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~~ Four major declines in the number of pups counted occurred during El Niño events in 1983-1984, 1992-93, ~~and~~ 1998, and 2003 (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%~~ 5.6% between 1975 and ~~2001~~ 2005 ~~. When~~ when pup counts for El Niño years (1983, 1984, 1992, 1993, ~~and~~ 1998, and 2003) ~~are~~ were removed from the ~~1975-2001~~ 1975-2005 time series~~, the count of pups increased at an annual rate of 6.1%~~.

The ~~1975-2001~~ 1975-2005 time series of pup counts shows the effect of ~~three~~ four El Niño events on the sea lion population. Pup production decreased by 35 percent in 1983, 27 percent in 1992, 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 1983-1984 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, 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 2002 and 2003 decline can be attributed to (1) reduced number of reproductive adult females being incorporated into the population as a result of the 1992-93 and 1997-98 El Niños, (2) domoic acid poisoning (Scholin et al. 2000, Lefebvre et al. 2000), (3) lower survivorship of pups due to hookworm infestations (Lyons et al. 2001), and (4) the 2003 El Niño. ~~The severity, timing, length, and frequency of future El Niños will govern the growth rate of the sea lion population in the future.~~

Figure 2. U.S. pup count index for California sea lions (1975-~~2001~~2005).



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.~~

A Generalized Logistic growth model indicated that the maximum population growth rate (R_{max}) was 6.52 percent when pup counts from El Niño years (1983, 1984, 1992, 1993, 1998, and 2003) were removed (Figure 3).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (~~138,881~~ 141,842) 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~~ 8,511 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.

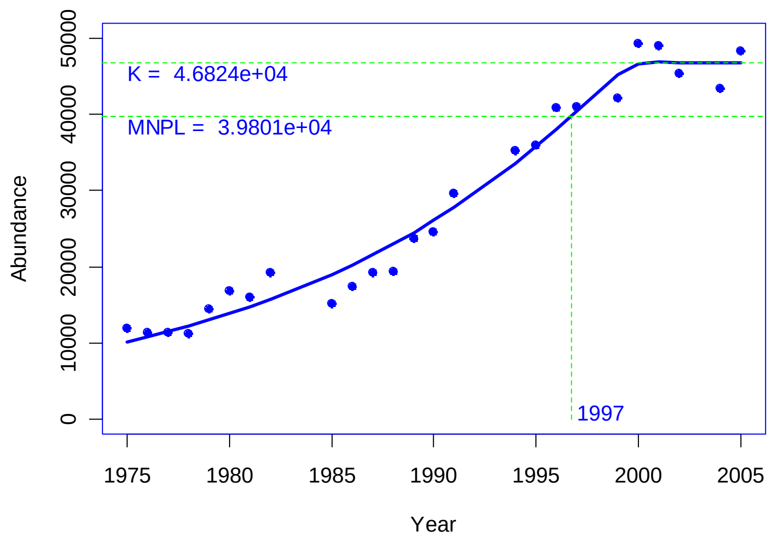


Figure 3. Generalized Logistic growth of California sea lion pup counts obtained during 1975-2005 (excluding El Niño years) indicating when Maximun Net Productivity Level (MNPL) was reached and that the population has reached carrying capacity (K).

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~~ 2000-2004 (~~Julian 1997; Cameron and Forney 1999, 2000; Carretta 2001, 2002~~ Carretta and Chivers 2004, Carretta et al. 2005a, 2005b). 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~~ 2000-2004 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).~~ In past years, the largest source of sea lion mortality has been in the California halibut and angel shark set gillnet fishery, which currently operates south of Point Arguello, California and has not been observed throughout its range since 1994. Limited observer coverage occurred in Monterey Bay in 2000 and 2001, but represented less than 5% of the total fishing effort. Given the lack of recent observer data, it is not possible to estimate sea lion mortality for this fishery. Evidence from fisher self-reports (Table 1) indicates that mortality of sea lions still occurs in this fishery, but it is not possible to extrapolate these self reports to overall mortality because these self reports have been shown to be grossly underreported.

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.) (9) the California small mesh drift gillnet fishery, and (10) the California purse seine fishery for anchovy, mackerel, and tuna. 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.~~ Stranding data from California, Oregon, and Washington between 2000-2004 shows that an additional 66 sea lions died from unknown entangling net fisheries (Table 1). Animals are typically found on the beach or sometimes at sea with portions of gillnet wrapped around the carcass. This represents a minimum number of animals killed, as entanglements are likely to go unreported.

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, Carretta et al. 2005a, 2005b, Perez 2003 ~~M. Perez per. comm~~, Perez 2003; Appendix 1). Mean annual takes are based on ~~1997-2001~~ 2000-2004 data unless noted otherwise. In past years, the set gillnet fishery for halibut and angel shark has been responsible for the majority of fishery-related mortalities. However, this fishery has not been observed recently and thus, current estimates of mortality are unknown. Because current mortality estimates are lacking for this fishery, overall mean annual takes reported in Table 1 are negatively biased by an unknown amount.

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed Mortality	Estimated Mortality (CV in parentheses)	Mean Annual Takes (CV in parentheses)
CA/OR thresher shark/swordfish large mesh drift gillnet fishery	~~1997~~	observer	~~23.0%~~	~~36~~	~~201(0.34)~~	~~81 (0.19)~~ 38 (0.18)
	~~1998~~		~~20.0%~~	~~23~~	~~114 (0.23)~~	
	~~1999~~		~~20.0%~~	~~6~~	~~30 (0.36)~~	
	2000		22.9%	13	50 (0.43)	
	2001		20.4%	2	~~9 (0.69)~~ 10 (0.67)	
	2002		22.1%	18	81 (0.25)	
	2003		20.2%	4	20 (0.50)	
	2004		20.6%	6	29 (0.44)	

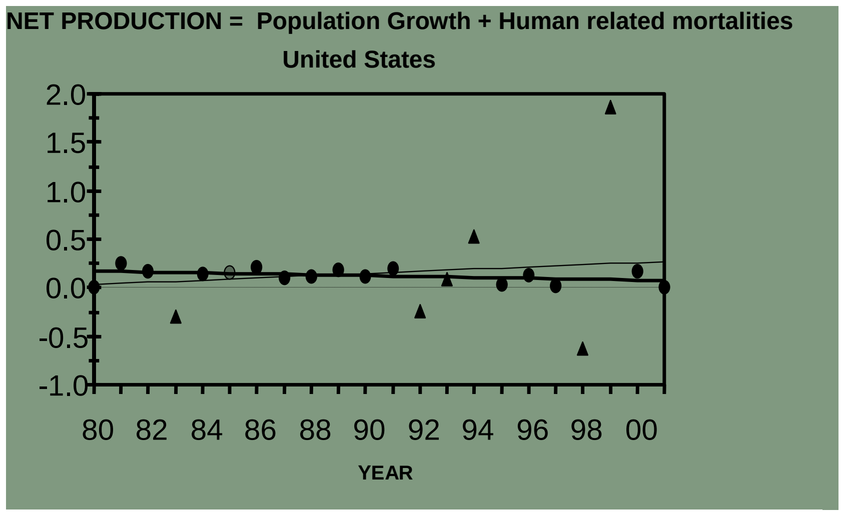
Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed Mortality	Estimated Mortality (CV in parentheses)	Mean Annual Takes (CV in parentheses)
CA angel shark/halibut and other species large mesh (>3.5 in) set gillnet fishery	~~1997~~ ~~1998~~ ~~1999~~ ~~2000~~ 2001 2002 2003 2004 2005 2000-2004	~~extrapolated estimate~~ No fishery-wide observer program since 1994 MMAP self reports	~~0%~~ ~~0%~~ ~~4%~~ ~~1.8%~~ 0% 0% 0% 0% 0% -	- - ~~13~~ ~~28~~ ~~0~~ n/a n/a n/a n/a n/a 57	~~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]~~ n/a n/a n/a n/a n/a n/a	~~1,267 (0.03)[1]~~ n/a ≥11.4
CA small-mesh drift gillnet fishery for white seabass, yellowtail, barracuda, and tuna	2003[1] 2004[1]	observer	11%[1] 11%[1]	2 1	18 (0.71) 9 (0.94)	13.5 (0.57)
CA anchovy, mackerel, and tuna purse seine fishery	2004[2]	Observer	n/a	1	≥ 1 (n/a)	≥ 1 (n/a)
WA, OR, CA domestic groundfish trawl fishery (At-sea processing Pacific whiting fishery only)	~~1997~~ ~~1998~~ ~~1999~~ 2000 2001 2002 2003 2004	observer	~~65.7%~~ ~~77.3%~~ ~~68.6%~~ 80.6% 96.2% 100% 100% 100%	~~0~~ ~~1~~ ~~1~~ 0 0 1 2 2	~~0~~ ~~1 (0.48)~~ ~~3 (0.55)~~ 0 0 1 2 2	~~0.8 (0.43)~~ 1.2 (0)
WA, OR, CA domestic groundfish trawl fishery (bottom trawl)	2000 2001 2002 2003 2004	Observer	n/a	n/a 8 6 24 6	n/a	≥11
WA, OR salmon net pen fishery	~~1997~~ ~~1998~~ ~~1999~~ 2000 2001 2002 2003 2004	~~MMAP~~ n/a		~~9~~ ~~12~~ n/a	~~9~~ ~~12~~ n/a	~~11~~ n/a
Canada: BC salmon pen fishery	~~1997~~ ~~1998~~ ~~1999~~ ~~2000~~ ~~2001~~ 2000 2001 2002 2003 2004	MMAP		~~52~~ ~~88~~ ~~134~~ ~~217~~ ~~88~~ 225 88 19 14 6	~~52~~ ~~88~~ ~~134~~ ~~217~~ ~~88~~ 225 88 19 14 6	~~116~~ ≥70

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed Mortality	Estimated Mortality (CV in parentheses)	Mean Annual Takes (CV in parentheses)
Unknown entangling net fishery	2000-2004	Stranding	n/a	66	n/a	13 (n/a)
Minimum total annual takes						~~1,476 (0.03)~~ ≥159 (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 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.~~ [1] A pilot observer program existed for two years in the small mesh drift gillnet fishery, where observer coverage was estimated to be 11%, based on logbook data from 2002 and 22 observed sets in 2003 and 2004.

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~~ hauled out, with the majority (52%) entangled ~~with~~ in 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 1991-1995 (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.



~~**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.~~

Live strandings and dead beach-cast California sea lions ~~have also been~~ are regularly observed with gunshot wounds in California (Lowry and Folk 1987, Deiter 1991, Barocchi et al. 1993, Goldstein et al. 1999, NMFS unpublished stranding data). A summary of records for ~~2001~~ 2000-2004 from the California Marine Mammal Stranding Network (CMMSN) and the Oregon and Washington stranding databases shows the following non-fishery related mortalities: boat collisions (~~three~~ 17 mortalities), entrainment in power plants (~~21~~ 106 mortalities), ~~and~~ shootings (~~54~~ 237 mortalities ~~and three injuries~~) marine debris (three mortalities), and unknown sources (seven mortalities). Stranding records are a gross under-estimate of injury and mortality because many animals and carcasses are never recorded. ~~However, CMMSN stranding records indicate a higher mortality rate as a result of shootings and hook and line entanglements during the 1997-98 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~~ 2000-2004 was ~~78~~ 370. The average annual non-fishery related mortality of sea lions from 2000-2004 is a minimum of the 370 mortalities listed above, divided by 5 years = 74 sea lions annually.

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

A Generalized Logistic growth model of pup counts obtained during 1975-2005 (excluding El Niño years) indicated that the population reached its Maximum Net Productivity Level (MNPL) of 39,800 pups in 1997 and has reached carrying capacity (K) at 46,800 pups per year (z = 19.09, R_{max} = 0.0652, n0 = 10,100, SE = 1,055) (Figure 3). This determination should be taken with caution until more years of data have been collected to verify whether the flattening of the generalized logistic curve is sustained because it is a recent phenomena. ~~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~~ California sea lions in the U.S. are not listed as "endangered" or "threatened" under the Endangered Species Act or as "depleted" under the MMPA. ~~They~~ Even though current total human-caused mortality is unknown (due a lack of observer coverage in the California set gillnet fishery that historically has been the largest source of human-caused mortalities), California sea lions are not considered a "strategic" stock under the MMPA because (based on historical takes in the set gillnet fishery and current levels of fishing effort) total human-caused mortality ~~(1,483 fishery-related mortalities plus 78 from other sources)~~ is still likely to be less than the PBR (~~8,333~~ 8,511). The total fishery mortality and serious injury rate for this stock ~~is not less than~~ likely remains above 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*): 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).

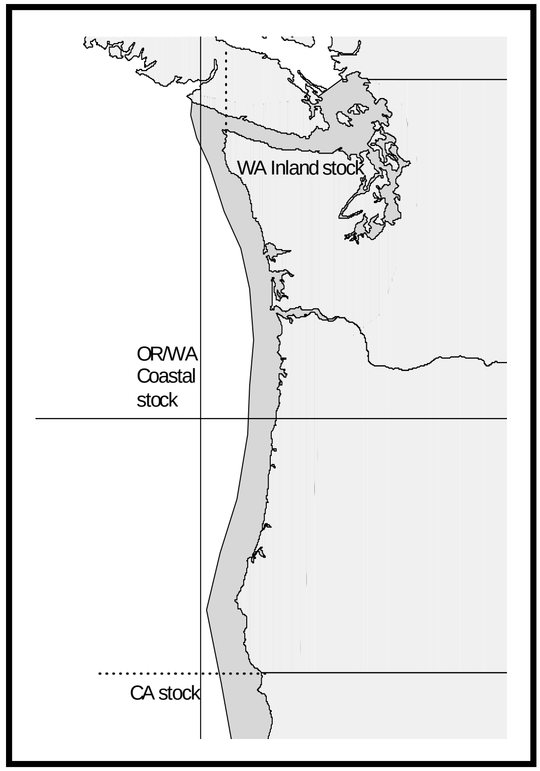


Figure 1. Approximate distribution of harbor seals in the U.S. Pacific Northwest (shaded area). Stock boundaries separating the three stocks are shown.

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 inland 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. Stock assessment reports for Washington Inland Waters and California harbor seals also appear in this volume. Harbor seal stocks that occur in the inland and coastal waters of Alaska are discussed separately in the Alaska Stock Assessment Reports ~~for the Alaska Region~~. Harbor seals occurring in British Columbia are not included in any of the U.S. stock assessment reports.

POPULATION SIZE

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

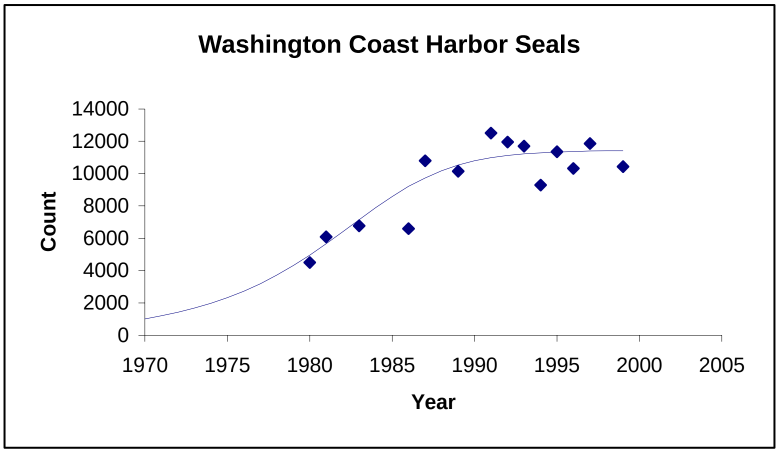
Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock is calculated as the lower ~~The log-normal~~ 20th percentile of the log-normal distribution of the 1999 population estimate ~~for this stock~~ of 24,732, which 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). Based on the analyses of Jeffries et al. (2003) and Brown et al. (2005), both the Washington and Oregon portions of this stock have reached carrying capacity and are no longer increasing (Fig. 2).

~~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).~~



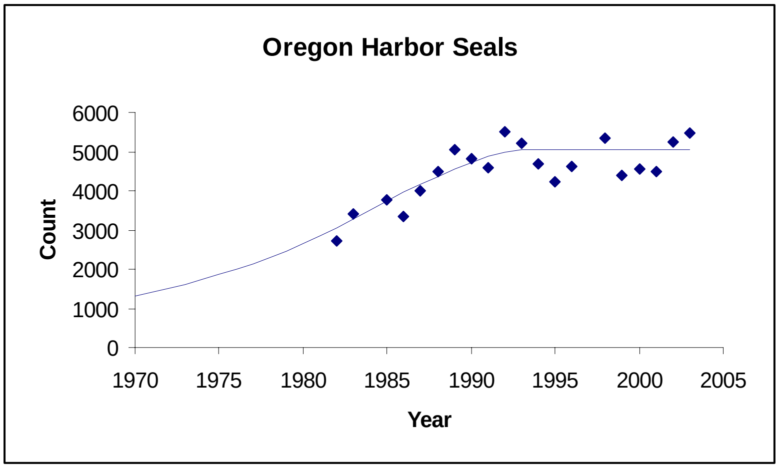


Figure 2. Generalized logistic growth curves of Washington Coast (Jeffries et al. 2003) and Oregon (Brown et al. 2005) harbor seals.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The Oregon/Washington Coast harbor seal stock increased at an annual rate of 7% from 1983 to 1992 and at 4% from 1983 to 1996 (Jeffries et al. 1997). Because the population was not at a very low level by 1983, the observed rates of increase may underestimate the maximum net productivity rate (R_{MAX}). When a logistic model was fit to the Washington portion of the 1975-1999 abundance data, the resulting estimate of R_{MAX} was 18.5% (95% CI = 12.9-26.8%) (Jeffries et al. 2003). When a logistic model was fit to the Oregon portion of the 1977-2003 abundance data, estimates of R_{MAX} ranged from 6.4% (95% CI = 4.6-27%) for the south coast of Oregon to 10.1% (95% CI = 8.6-20%) for the north coast (Brown et al. 2005). ~~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~~ Until a combined analysis for the entire stock is completed ~~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) times one-half the default maximum net growth rate for pinnipeds (½ of 12%) times 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 in the northern Washington marine set gillnet fishery (areas 4, 4A, 4B, and 5) is conducted within the range of both stocks of harbor seals (Oregon/Washington Coast and Washington Inland Waters ~~stocks~~) occurring in Washington State waters. Some movement of animals between Washington's coastal and inland waters is likely, although data from tagging studies have not shown movement of harbor seals between the two locations (Huber et al. 2001). For the purposes of this stock assessment report, the animals taken in ~~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~~ waters south and west of Cape Flattery, WA (areas 4 and 4A), 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,~~ and 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.~~ NMFS observers monitored 100% of the 50 net days (1 net day equals a 100-fathom length net set for 24 hours) of fishing effort in coastal waters in 2000; n~~N~~o fishing effort occurred in the coastal portion of the fishery in ~~1998, 1999, or~~ 2001-2003; and complete records of observer coverage and fishing effort in 2004 are not available, but one vessel fished at least 60 net days in areas 4 and 4A and the vessel operator reported six harbor seal mortalities (Gearin et al. 1994, 2000; P. Gearin, unpubl. data; N. Pamplin, unpubl. data). The mean estimated mortality for this fishery in ~~1997-2001~~ 2000-2004 is ~~3.2 (CV=0.79)~~ 0.8 (CV=0) harbor seals per year from observer data plus 1.2 seals per year from fisher self-reports ~~this stock~~.

The WA/OR/CA groundfish trawl fishery (Pacific ~~whiting~~ hake at-sea processing component) was monitored for incidental take during ~~1997-2001~~ 2000-2004 (Perez 2003; J. Cusick, unpubl. data), and~~. The only~~ harbor seal mortalities occurred in ~~1997 and~~ 2000 and 2004. ~~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, t~~The mean estimated mortality for ~~in~~ this fishery in 2000-2004 is ~~0.8 (CV=1.0)~~ 0.6 (CV=0.35) 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 serious injury of harbor seals (Oregon/Washington Coast stock) in commercial and tribal fisheries that might take this species and calculation of the mean annual mortality rate; n/a indicates that data are not available. ~~All entanglements resulted in the death of the animal.~~ Mean annual takes are based on ~~1997-2001~~ 2000-2004 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~~ 2000 2001 2002 2003 2004	observer data	~~100%~~ ~~no fishery~~ ~~no fishery~~ 100% no fishery no fishery no fishery unknown[2]	~~13~~ ~~0~~ ~~0~~ 3 0 0 0 n/a	~~13~~ ~~0~~ ~~0~~ 3 (0) 0 (0) 0 (0) 0 (0) n/a	~~3.2 (0.79)~~ 0.8 (0)[1]
	2004	fisher self-reports		6		≥1.2 (n/a)
WA/OR/CA groundfish trawl (Pacific ~~whiting~~ hake at-sea processing component)	~~97~~ ~~98~~ ~~99~~ 2000 2001 2002 2003 2004	observer data	~~65.7%~~ ~~77.3%~~ ~~68.6%~~ 80.6%[3] 96.2%[3] 100%[4] 100%[4] 100%[4]	~~0~~ ~~0~~ ~~0~~ 2 0 0 0 1	~~0~~ ~~0~~ ~~0~~ ~~4~~ 2 (0.21) 0 (0) 0 (0) 0 (0) 1 (0)	~~0.8 (1.0)~~ 0.6 (0.35)
	~~97~~	~~unmonitored hauls~~		~~1~~		~~0.2 (n/a)~~
WA Grays Harbor salmon drift gillnet	1991-93	observer data	4-5%	0, 1, 1	0, 10, 10	6.7 (0.50)
WA Willapa Bay drift gillnet	1991-93	observer data	1-3%	0, 0, 0	0, 0, 0	0
WA Willapa Bay drift gillnet	1990-93	fisher self-reports	n/a	0, 0, 6, 8	n/a	≥3.5 (n/a) see text
Unknown west coast fisheries	~~97-01~~ 2000-2004	stranding data	n/a	~~0, 0, 1,~~ 0, 0, 0, 1, 0		≥0.2 (n/a)
Minimum total annual takes						~~≥14.6 (0.4)~~ ≥13 (0.41)

[1]2000-2003 mortality estimates are included in the average.
[2]Complete records of observer coverage in 2004 are not available.
[3]Percent observer coverage equals percent of observed catch; observers were present on 100% of the vessels.
[4]Percent observer coverage equals percent of vessels with observers.

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. Due to high steelhead bycatch in the 2002 fishery, harvest managers used in-season test fishing during the 2003 and 2004 fishing seasons to determine the optimum timing and gear requirements for each subsequent full-fleet commercial fishing period. Both large-mesh (8-9.75") and small-mesh tangle net (≤4.25") fishing periods were adopted in each year, although the 2003 season was severely curtailed to limit the catch of ESA-listed spring chinook stocks. With the focus on greater selectivity in winter/spring commercial salmon fisheries, levels of observer coverage were much higher in 2002-2004 than in previous years. To meet management needs, this increased level of observer coverage in test fisheries and full-fleet commercial fisheries is expected to continue into the foreseeable future (J. North and G. Whisler, pers. comm.). Data on marine mammal interactions (predation, entanglement)~~,~~ recorded by observers during the permit and demonstration commercial fisheries in 2001-2002 and the full-fleet commercial fisheries in 2003-2004~~,~~ 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.

Combining the estimates from the northern Washington marine set gillnet (0.8 from observer data + 1.2 from fisher self-reports), WA/OR/CA groundfish trawl (0.6), Washington Grays Harbor salmon drift gillnet (6.7), and Washington Willapa Bay drift gillnet (3.5 from fisher self-reports) fisheries results in an estimated mean mortality rate of 12.8 harbor seals per year from these fisheries.

The Marine Mammal Authorization Permit (MMAP) fisher self-reports, required of commercial vessel operators by the MMPA, are an ~~An~~ additional source of information on the number of harbor seals killed or seriously 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~~ Between 2000 and 2004, there were no fisher self-reports of ~~any~~ harbor seal mortalities from any MMAP-listed fishery operating in waters off the coasts of Oregon or Washington. Although these reports are considered incomplete (see details in Appendix 1), they represent a minimum mortality. In 2002 one harbor seal from this stock was reported incidentally taken in an in-river gillnet test fishery in southern Oregon, and one harbor seal mortality was reported in a Washington coastal river gillnet fishery in 2003. ~~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 serious injuries caused by interactions with gear are a final source of fishery-related mortality information. One fishery-related stranding was reported in ~~1999~~ 2003

(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~~ 2000-2004 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~~ 11 human-caused harbor seal mortalities or serious injuries were reported from non-fisheries sources in ~~1997-2001~~ 2000-2004. Seven animals were shot (one each in ~~1997, 1999, and~~ 2000 and 2004, ~~and~~ two ~~each~~ in ~~1998 and~~ 2001, and three in 2002), ~~and~~ one animal was struck by ~~an off-road vehicle (in 1997)~~ a boat in 2004, and three pup mortalities were caused by human disturbance in 2004, resulting in an estimated mortality of ~~1.6~~ 2.2 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 may 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~~ 13 + ~~1.6~~ 2.2 ~~+ 5-10~~ = ~~21.2-26.2~~ 15.2) 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~~ 13: based on observer data (~~10.9~~ 8.1) and self-reported fisheries information (~~3.5~~ 4.7) 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~~ The stock ~~relative to~~ is within its Optimum Sustainable Population (OSP) level (Jeffries et al. 2003, Brown et al. 2005).

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Revised ~~10/31/2002~~ 05/03/2007

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^{o}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.

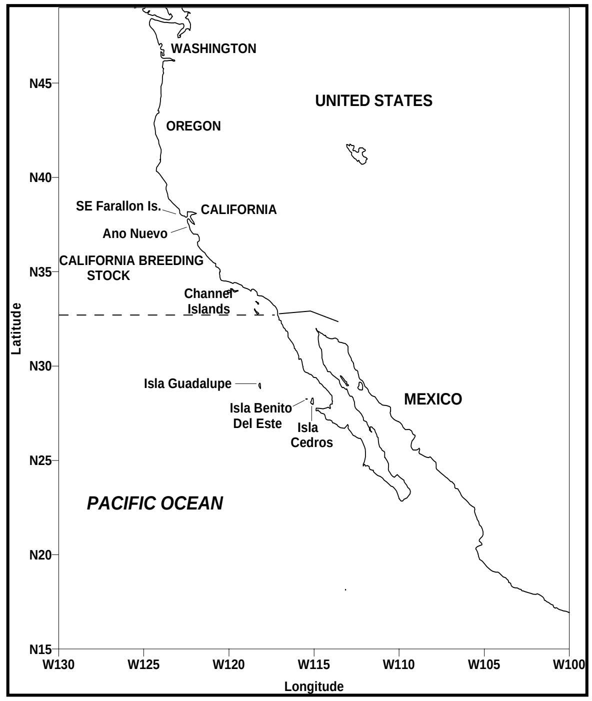


Figure 1. Stock boundary and major rookery areas for northern elephant seals in the U.S. and Mexico.

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~~ 35,549 pups born in California in ~~2001~~ 2005 (Fig. 2) and this 3.5 multiplier, the California stock was approximately ~~101,000 in 2001~~ 124,000 in 2005.

Minimum Population Estimate

The minimum population size for northern elephant seals can be estimated very conservatively as ~~60,547~~ 74,913, which is equal to twice the observed pup count (to account for the pups and their mothers) plus 3,815 ~~2,317~~ males and ~~17~~ juveniles counted at the Channel Islands and central California sites in ~~2001~~ 2005 (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 pup counts, northern elephant seal colonies were continuing to grow in California through ~~2001~~ 2005 (Figure 2), but appear to be stable or slowly decreasing in Mexico (Stewart et al. 1994).

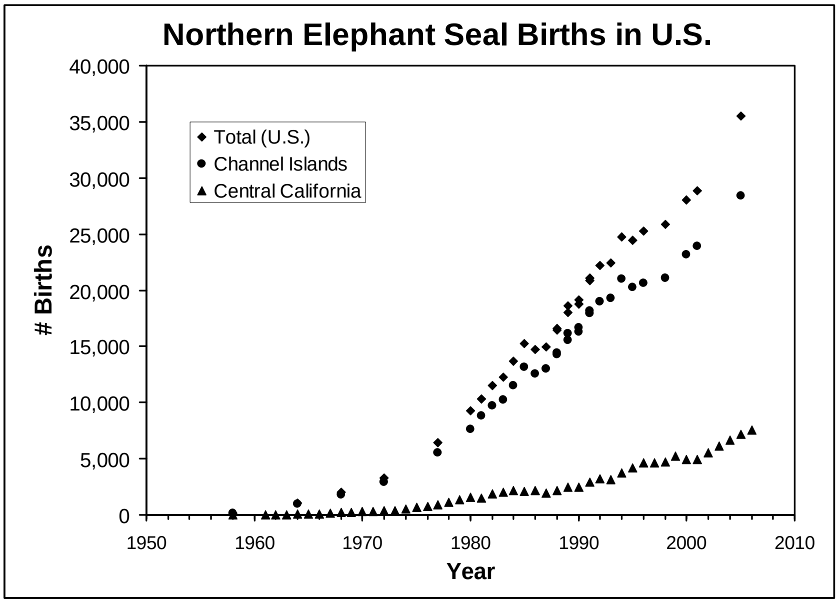
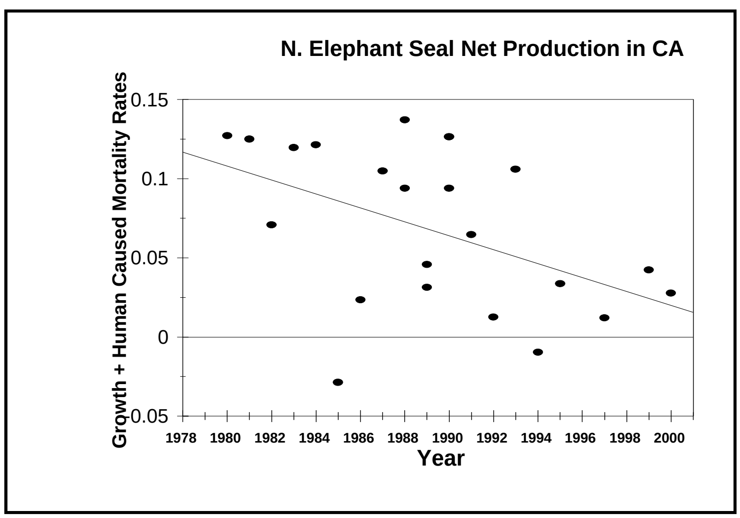


Figure 2. Estimated number of northern elephant seal births in California 1958-2006. Multiple independent estimates are presented for the Channel Islands 1988-91. Estimates are from Stewart et al. (1994), Lowry et al. (1996), Lowry (2002) and unpublished data from Sarah Allen, Dan Crocker, Brian Hatfield, Ron Jameson, Bernie Le Boeuf, Mark Lowry, Pat Morris, Guy Oliver, Derek Lee, and William Sydeman.

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 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*)].~~ A Generalized Logistic growth model indicates that the maximum population growth rate (R_{max}) is 11.7 percent (SE = 2.7) (Figure 3).



~~**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).~~

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (~~60,547~~ 74,913) times one half the observed maximum net growth rate for this stock (½ of ~~8.3~~ 11.7%) 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~~ 4,382.

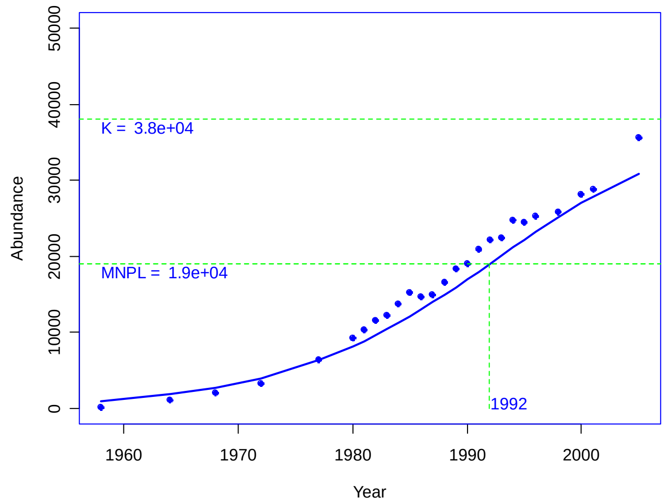


Table 1. Summary of available information on the mortality and serious injury of northern elephant seals (California breeding stock) in commercial fisheries that might take this species (~~Julian 1997; Cameron and Forney 1999, 2000;~~ Carretta ~~2001;~~ and Chivers 2004, Carretta et al. 2005a, 2005b, Perez 2003 ~~M. Perez per. comm~~, Perez 2003; Appendix 1Perez, in prep.; NMFS unpubl. data). n/a indicates information is not available. Mean annual takes are based on ~~1996-2000~~ 2000-2004 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 2001 2002 2003 2004	observer data	~~12.4%~~ ~~22.8%~~ ~~20.2%~~ ~~20.0%~~ 22.9% 20.4% 22.1% 20.2% 20.6%	~~4~~ ~~8~~ ~~4~~ ~~1~~ 6 1 1 1 0	~~37 (0.55)~~ ~~45 (0.33)~~ ~~20 (0.44)~~ ~~10 (0.61)~~ 26 (~~0.41~~0.39) 5 (0.94) 5 (0.92) 5 (1.00) 0	~~25 (0.21) [1]~~ 8 (0.40)
CA angel shark/halibut and other species large mesh (>3.5") set gillnet fishery[1]	~~1996~~ ~~1997~~ ~~1998~~ ~~1999~~ ~~2000~~ 2001[1] 2002[1] 2003[1] 2004[1] 2005[1]	observer data ~~extrapolated Estimate~~	~~0.0%~~ ~~0.0%~~ ~~0.0%~~ ~~23.1% [3]~~ ~~26.9% [3]~~ 0% 0% 0% 0% 0%	- - - ~~10 [1]~~ ~~4 [1]~~ n/a n/a n/a n/a n/a	~~46 (0.23) [2]~~ ~~60 (0.24) [2]~~ ~~70 (0.26) [2]~~ ~~76 (0.19) [2]~~ ~~48 (0.23) [2]~~ n/a n/a n/a n/a n/a	~~60 (0.10)~~ n/a
WA, OR, CA domestic groundfish trawl (At-sea processing Pacific whiting fishery only)	~~1998~~ 2000 2001 2002 2003 2004	observer data	~~77%~~ 80.6% 96.2% 100% 100% 100%	~~1~~ 1 0 0 0 3	~~1 (n/a)~~ 1 (n/a) 0 (n/a) 0 (n/a) 0 (n/a) 3 (n/a)	~~1 (n/a)~~ 0.8 (n/a)

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed Mortality	Estimated Mortality (CV in parentheses)	Mean Annual Takes (CV in parentheses)
WA, OR, CA domestic groundfish trawl fishery (bottom trawl)	2000-2004	observer	n/a	0	0	0 (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)~~ > 8.8 (0.40)

~~[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.~~
~~[3] Observer coverage and observed mortality in 1999-2000 only includes the portion of the fishery in Monterey Bay.~~
[1] The most recent observer data for the halibut set gillnet fishery is from 2000 in Monterey Bay only and there has not been a fishery-wide observer program since 1990-94. There are no current estimates of mortality for this fishery, as this would require assuming that current kill rates are comparable to kill rates observed between 1990-94 and extrapolation of mortality estimates using current estimates of fishing effort.

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, Oregon, and Washington Marine Mammal Stranding Networks in ~~1996-2000~~ 2000-2004 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 databases for California, Oregon, and Washington state maintained by the National Marine Fisheries Service~~, Southwest Region,~~ contain~~s~~ the following records of human-related elephant seal mortalities and injuries in ~~1996-2000~~ 2000-2004: (1) boat collision (~~2~~ three mortalities~~, 1 injury~~), (2) ~~automobile collision (5 mortalities)~~ power plant entrainment (1 mortality), (3) shootings (~~three~~ four mortalities) and (4) entanglement in marine debris (~~1~~ 10 injuries~~y~~). ~~Protective measures were taken to prevent future automobile collisions in the vicinity of Piedras Blancas/San Simeon (Hatfield and Rathbun 1999).~~ This results in a minimum annual average of 1.6 non-fishery related mortalities for 2000-2004.

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).~~ A Generalized Logistic growth model of pup counts indicated that the population reached its Maximum Net Productivity Level (MNPL) of 19,000 pups in 1992, but has not reached carrying capacity (K) at 38,200 pups per year ($z = 1$, $R_{max} = 0.117$, $n0 = 1,000$, SE = 3,376, AICc = 500.3) (Figure 3). 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~~ 4,382), they would not be considered a "strategic" stock under the MMPA. The average rate of incidental fishery mortality for this stock over the last five years (~~86~~ >8.8) 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. This annual rate of fishery mortality is negatively biased because it excludes mortalities that likely occur in the unobserved set gillnet fishery for halibut and angel shark, where average annual mortality was estimated at approximately 60 animals annually during the period 1996-2000. 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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HAWAIIAN MONK SEAL (*Monachus schauinslandi*)

STOCK DEFINITION AND GEOGRAPHIC RANGE

Hawaiian monk seals are distributed 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 1,247~~1,302~~. This estimate is the sum of estimated abundance at the six main Northwest Hawaiian Islands subpopulations, an extrapolation of counts at Necker and Nihoa Islands, and an estimate of minimum abundance in ~~counts at~~ the main Hawaiian Islands. ~~In this report, a new method is used to estimate abundance of the main reproductive subpopulations. Formerly, the number of seals identified (using flipper tags, applied bleach marks and natural markings) at each site was tallied, but there was little evaluation of how many seals may have been overlooked. Baker, Harting and Johanos (in review), developed a procedure to determine whether total enumeration had been achieved at a given subpopulation. In such cases, the total number of seals identified was used as the population estimate.~~ The number of individual seals identified was used as the population estimate at NWHI sites where total enumeration was achieved according to the criteria established by Baker et al. (2006). ~~At sites w~~Where total enumeration was not achieved, capture-recapture estimates from Program CAPTURE were used (Baker 2004; Otis et al. 1978, Rexstad & Burnham 1991, White et al. 1982). When no reliable estimator was obtainable in Program CAPTURE (i.e., the model selection criterion was < 0.75, following Otis et al. 1978), the total number of seals identified was the best available estimate. Finally, sometimes capture-recapture estimates are less than the known minimum abundance (Baker 2004), and in these cases the total number of seals identified was used. In 2005, identification efforts were conducted during two- to six-month studies at all main reproductive sites. Total enumeration was achieved at Midway Atoll, and capture-recapture estimates were obtained at the remaining sites. At Pearl and Hermes Reef and Kure Atoll, this estimate was lower than the known minimum abundance, so that the latter was considered the best estimate. ~~all sites except French Frigate Shoals and Pearl and Hermes Reef. Reliable capture-recapture estimates at the latter two sites were not obtained, so minimum abundance estimates were used~~. The total abundance estimate ~~of 1,150 seals (including 207 pups) were observed~~ at the six main ~~reproductive~~ subpopulations in 2005 was 1,072 seals (including 163 pups) ~~(Johanos and Baker, in press)~~. 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 ~~2000-2004~~ 2001 and 2005 was 14.4 (±4.3) ~~15.4 (±4.2)~~ at Necker Island and 17.7 (±8.3) ~~17.3 (±8.1)~~ at Nihoa Island (Johanos and Baker ~~2002,~~ 2004, 2005, in press, in prep.). 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 of 2.89 (NMFS unpubl. data). Resulting estimates (plus the average number of pups known to have been born during ~~2000-2004~~ 2001-2005) are 43.3 (±12.5) 45.8 (±12.2) at Necker Island and 54.9 (±24.0) ~~52.9 (±23.5)~~ at Nihoa Island.

The only complete and systematic surveys for monk seals in the MHI were conducted in 2000 and 2001 ~~A 2001 aerial survey determined a minimum abundance of 52 seals in the MHI; this remains the most recent available estimate~~ (Baker and Johanos 2004). The NMFS collects information on seal sightings reported by a variety of sources. Recently, the number of such reports has increased and related database improvement efforts have been underway. The total number of individually identifiable seals documented in this way in 2005 was 77, the current best minimum abundance estimate. ~~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 (1,065) identified at the six main NWHI reproductive sites is the best estimate of minimum population size at those sites ~~(i.e., 1,150 seals)~~. Minimum population sizes for Necker and Nihoa Islands (based on the formula provided by Wade and Angliss (1997)) are 34 and 39, respectively ~~37 at both islands~~. The minimum abundance estimate for the main Hawaiian Islands ~~based upon the 2001 aerial survey~~ in 2005 is ~~52~~ 77 seals. The minimum population size for the entire stock (species) is the sum of these estimates, or ~~1,276~~ 1,214 seals.

Current Population Trend

The total of mean non-pup beach counts at the six main reproductive NWHI subpopulations in 2004 is ~~approximately 60%~~ 67% lower than in 1958. ~~In previous Stock Assessment Reports, average non-pup beach counts were used to characterize the population trend (Fig. 1a). A better representation is achieved using t~~The trend in total abundance at the six main NWHI subpopulations estimated as described above is shown in Fig. 1.~~(Fig. 1b)~~. A log-linear regression of estimated abundance on year from 1998 (the first year for which a reliable total abundance estimate has been obtained) to 2005 ~~2004~~ estimates that abundance declined ~~on average~~ -3.8% yr^{-1} (95% CI = -5.0% to -2.6% yr^{-1} ~~-5.5% to -2.1% yr^{-1}~~).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Trends in abundance vary considerably among the six main subpopulations. Mean non-pup beach counts are used as a long-term index of abundance for years when data are insufficient to estimate total abundance as described above). Beach counts at French Frigate Shoals declined 73% ~~70%~~ from 1989-2005 ~~2004~~. 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.

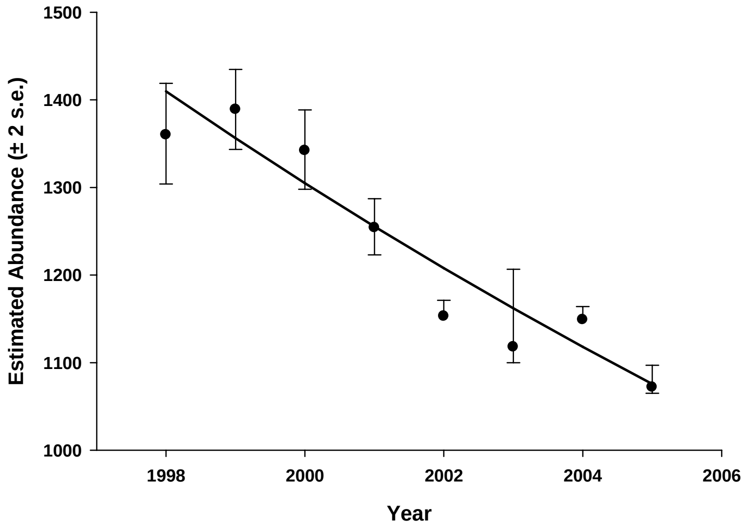

Figure 1~~A) Previous trend analysis using a broken-line regression of log non-pup beach counts (index of abundance) on year (from Carrette et al. 2005 SAR). B)~~ Trend in abundance of monk seals at the six main Northwestern Hawaiian Islands subpopulations, based on a combination of total enumeration and capture–recapture estimates. Error bars indicate ±2 s.e. (from variances of capture-recapture estimates). Fitted log-linear regression line is shown.

Until recently, the three westernmost subpopulations, Kure, Midway and Pearl and Hermes Reef exhibited substantial growth. The subpopulation at Pearl and Hermes Reef increased after the mid-1970s. Prior to 1999, beach count increases 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. ~~Since 2000, there has been a general decline in both abundance and juvenile survival at Pearl and Hermes, Midway and Kure. 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.~~ Since 2000, low juvenile survival, thought to be due largely to food limitation, has been widespread with rare exception in the NWHI, resulting in the population decline (Fig. 1). 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 depleted stock will naturally grow toward OSP (Optimum Sustainable Population), and that some surplus growth could be removed while still allowing recovery. The Hawaiian monk seal population is far below historical levels and has declined 3.8% yr^{-1} on average since 1998. Thus, for unknown reasons, the stock's dynamics do not conform to the underlying model for calculating PBR such that 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, but human-seal interactions have become an important issue in the MHI.

Fishery Information

Fishery interactions with monk seals can include direct interaction with gear (hooking or entanglement), seal consumption of discarded catch, and competition for prey. Entanglement of monk seals in derelict fishing gear, which is believed to originate outside the Hawaiian archipelago, is described in a separate section below.

In the past, monk seal interactions with fisheries in the NWHI were documented, but direct interactions have since become rare or non-existent, and issues related to competition have also somewhat abated. For example, in 1986 a seal died from entanglement in the bridle rope of lobster trap set in the NWHI lobster fishery. Possible reduction of monk seal prey by that fishery (through removal of both target and bycatch species) has also been raised as a concern, though whether the fishery indirectly impacted monk seals remains unresolved. However, the NWHI lobster fishery closed in 2000 and on June 15, 2006, President Bush signed a proclamation that created the Northwestern Hawaiian Islands Marine National Monument. Subsequent regulations prohibit commercial fishing in the Monument except for the bottomfish fishery (and associated pelagic species catch), which may continue for no more than 5 years (U.S. Department of Commerce and Department of the Interior, 2006). 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 landed between 95 and 201 metric tons per year from 1989-2005 (Kawamoto 1995; Kawamoto, pers. comm.) and the number of vessels is currently capped at 9 (8 made NWHI trips in 2005, Kawamoto, pers. comm.). 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 and no monk seal interactions have been observed to date. 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. An EIS for the bottomfish fishery management plan has also been prepared. 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 revealed some evidence that monk seals fed on families of bottomfish which contain commercial species (many prey items recovered from scats and spews were identified only to the level of family; Goodman-Lowe 1998, Longenecker et al. 2006, Parrish et al. 2000). Recent efforts have expanded bottomfish species representation in a fatty acid library to help clarify their potential importance in the monk seal diet using quantitative fatty acid signature analysis. Results of this research effort are expected to be available in 2007. As noted above, this fishery is slated to be closed by 2011.

In contrast to the NWHI, fishery interactions are a serious concern in the MHI, especially involving State of Hawaii managed nearshore fisheries. 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 32 seals have been observed with embedded hooks in the MHI during 1990-2005. 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 three seals have been observed entangled in nearshore gillnets since

2002 (NMFS unpubl. data). The 2005 nearshore fishery serious injury, reported in Table 1, involved a seal observed entangled and struggling in a nearshore gillnet off Oahu. By the time a NMFS contract veterinarian arrived on the scene, the seal was gone and fishermen were retrieving the net, which had a large hole presumably where the seal had been caught. Because it was not possible to determine whether the seal escaped uninjured, entangled, or whether it had died, this case was judged as a serious injury. 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).

~~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 4336 seals have been seen with embedded fish hooks from 1982 to 20052004. 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 seen incidental to land-based research or reported by a variety of sources. 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 1989-20052004 (Kawamoto 1995; Kawamoto, pers. comm.). The number of vessels peaked at 28 in 1987, then varied from 89 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 has also been 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 and no monk seal interactions have been observed to date. 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 revealed some evidence that monk seals fed on families of bottomfish which contain commercial species (many prey items recovered from scats and spews were identified only to the level of family; Goodman-Lowe 1998, Longenecker et al. 2006, Parrish et al. 2000). Recent efforts have expanded bottomfish species representation in a fatty acid library to help clarify their potential importance in the monk seal diet using quantitative fatty acid signature analysis. Results of this research effort are expected to be available in 2007. 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 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 3225 seals have been observed with embedded hooks in the MHI during 1990-20052004. 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 three a seals have been observed was entangled in an actively fished nearshore gillnets off~~

~~Oahu in since 2002 (NMFS unpubl. data). The 2005 nearshore fishery serious injury reported in Table 1, involved a seal observed entangled and struggling in a nearshore gillnet off Oahu. By the time a NMFS contract veterinarian arrived on the scene, the seal was gone and fishermen were retrieving the net, which had a large hole presumably where the seal had been caught. Because it was not possible to determine whether the seal escaped uninjured, entangled, or whether it had died, this case was conservatively judged as a serious injury. 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).~~

~~On June 15, 2006, President Bush signed a proclamation that created the Northwestern Hawaiian Islands Marine National Monument. Subsequent regulations prohibit commercial fishing in the Monument except for the bottomfish fishery (and associated pelagic species catch), which may continue for no more than 5 years (U.S. Department of Commerce and Department of the Interior, 2006).~~

~~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/Reported Mortality/Serious Injury	Estimated Mortality/ Serious Injury	Mean Takes (CV)
NWHI Lobster	2000-present	fishery closed				
Pelagic Longline~~[1]~~	~~2000~~ 2001 2002 2003 2004 2005	~~observer~~ observer observer observer observer observer	~~10.4%~~ 22.5% 24.6% 22.2% 24.6% 26.1% & 100%[1]	~~0~~ 0 0 0 0 0	~~0~~ 0 0 0 0 0	0 (0)
NWHI Bottomfish	2001-2002 2003[2] 2004 2005	Logbook observer observer observer	n/a 33% 18.3% 25.0%	n/a 0 0 0	n/a 0 0 0	0 (0)
MHI Bottomfish[3]	~~2000~~ 2001 2002 2003 2004 2005	n/a	none	0 0 0 0 0 0	n/a	n/a
Nearshore[3]	~~2000~~ 2001 2002 2003 2004 2005	n/a	none	0 1 1 1 2 1	n/a	n/a

Fishery Mortality Rate

~~Data are unavailable to fully assess interaction with some fisheries in Hawaii, therefore, t~~ Total fishery mortality and serious injury cannot be considered to be insignificant and approaching a rate of zero. Monk seals are being hooked and entangled in the MHI at a rate which has not been reliably assessed. The information above represents only reported direct interactions and without purpose-designed observation effort the true interaction rate

[1] Observer coverage for deep and shallow-set components of the fishery, respectively. ~~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.~~

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

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

cannot be estimated. Monk seals also die from entanglement in fishing gear and other debris throughout their range (likely originating from various countries), and NMFS along with partner agencies, is pursuing a program to mitigate entanglement (see below). Indirect interactions (i.e., involving competition for prey or consumption of discards) remain the topic of ongoing investigation.

~~Direct fishery interactions with monk seals remain to be thoroughly evaluated and the information above represents only reported interactions. Without further study, an accurate estimate cannot be determined.~~

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 261~~253~~ cases of seals entangled in fishing gear or other debris have been observed through 2005~~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.

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. Since 1996, annual debris survey and removal efforts in the NWHI coral reef habitat have been ongoing (Donohue et al. 2000, Donohue et al. 2001).

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 2005, a weaned pup died while in NMFS care at a captive facility on Oahu for testing and potential treatment for leptospirosis. Post-mortem examination did not reveal a cause of death.

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 a Hawaiian monk seal occurred when a resident of Kauai killed an adult female in 1989.

Other sources of mortality that ~~may~~ impede recovery include food limitation (see Habitat Issues below), 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 (1995-2005).

Attacks by single adult males have resulted in several monk seal mortalities, ~~. This was~~ most notably at French Frigate Shoals in 1997, where at least 8 pups died from this cause ~~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 has 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 U. S. Fish and Wildlife Service (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 et al. 2006~~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~~ are reported in ~~(~~Littnan et al. (~~in press~~ 2006).

Tern Island is the site of a USFWS 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 wildlife. 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.

Another habitat issue involves loss of terrestrial habitat at French Frigate Shoals, where pupping and resting islets have shrunk or virtually disappeared (Antonelis et al. 2006 ~~in press~~). ~~Predicted Also, a paper evaluating the potential effect~~ Projected increases in ~~of~~ global average sea level (Church et al. 2001) ~~rise~~ may further significantly reduce ~~on NWHI~~ terrestrial habitat for monk seals in the NWHI ~~has been submitted for publication~~ (Baker, Littnan and Johnston, 2006~~in review~~).

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 fewer 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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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.

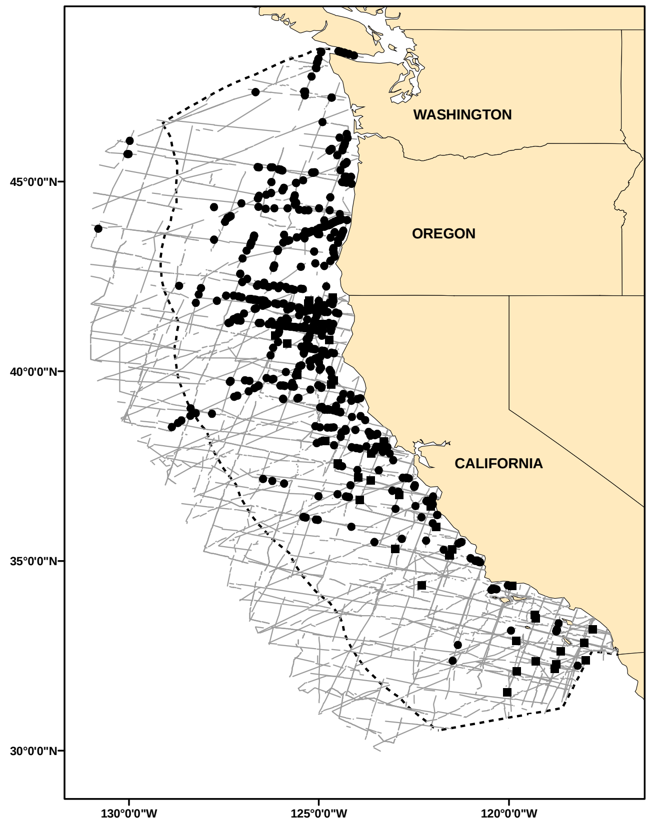

Figure 1. Dall's porpoise sightings based on aerial and shipboard surveys off California, Oregon, and Washington, 1991-~~2001~~ 2005 (see Appendix 2 for data sources and information on timing and location of survey effort). Dashed line represents the U.S. EEZ, thin lines represent completed transect effort ~~thick line indicates the outer boundary~~ of all surveys combined. Key: ● = summer/autumn ship-based sightings; ■ = 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) and 2005 (Forney 2007). 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~~ geometric mean ~~weighted average~~ abundance estimate for California, Oregon and Washington waters based on ~~two~~ 2001 and 2005 ship surveys is ~~98,617~~ 57,549 (CV = ~~0.33~~ 0.34) Dall's porpoise (Barlow 2003; Forney 2007). ~~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.~~ Additional numbers of Dall's porpoise occur in the inland waters of Washington state, but the most recent abundance estimate obtained in 1996 (900 animals, CV = 0.40) is over 8 years old (Calambokidis et al. 1997) and is not included in the overall estimate of abundance for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the ~~1996-~~2001-2005 ~~weighted~~ average abundance estimate for ~~both~~ the outer coast of California, Oregon and Washington ~~and inland Washington~~ waters is ~~75,915~~ 43,425 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~~ 43,425) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of ~~0.48~~ 0.40 (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~~ 347 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~~2000-2004 (~~Cameron and Forney 1999, 2000;~~ ~~Carretta 2001, 2002~~ Carretta and Chivers 2004, Carretta et al. 2005a, 2005b). 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 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~~ 2000-2004 data. This results in an average estimate of ~~four (CV = 0.95)~~ 1.2 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~~ 2003). Between 2000 and 2004 ~~1997 and 2001,~~ with ~~66%-96%~~ 80%-100% of the fishing effort observed, ~~six~~ one Dall's porpoise ~~were~~ was reported killed in the at-sea processing portion of the Pacific whiting trawl fishery. In addition, one Dall's porpoise was reported killed in 2004 under the MMAP self-reporting program. ~~, 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.~~ Currently, there are no estimates of Dall's porpoise mortality available from this fishery.

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~~ 2000-2004 data unless noted otherwise. MMAP refers to fisher self-reports of incidental takes under the Marine Mammal Authorization Program.

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 2002 2003 2004	~~23.0%~~ ~~20.0%~~ ~~20.0%~~ 22.9% 20.4% 22.1% 20.2% 20.6%	~~4~~ ~~0~~ ~~0~~ 0 0 0 0 0	~~20 (0.95)~~ ~~0~~ ~~0~~ 0 0 0 0 0	~~4 (0.95)~~ 0 (n/a)
WA/OR/CA domestic groundfish trawl	Observer data	~~1997~~ ~~1998~~ ~~1999~~ 2000 2001 2002 2003 2004	~~65.7%~~ ~~77.3%~~ ~~68.6%~~ 80.6% 96.2% 100% 100% 100%	~~3~~ ~~2~~ ~~1~~ 0 0 1 0 0	~~10 (0.69)~~ ~~3 (0.40)~~ ~~1 (n/a)~~ 0 0 1 (0) 0 0	~~2.8 (0.50)~~ 0.2 (n/a)
	MMAP	2004	n/a	1	1	≥1 (n/a)
Puget Sound salmon drift gillnet (tribal fishery, Area 5, Strait of Juan de Fuca)	MMAP	2000-2004	n/a	1	1	≥0.2 (n/a)

Minimum total annual takes	~~7 (0.58)~~ 1.4 (n/a)

Other Mortality

Two Dall's porpoise strandings between 2000-2004 showed evidence of a vessel collision as the cause of death. This results in an average annual mortality of 0.4 Dall's porpoise caused by vessel collisions.

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), t~~ The average annual human-caused mortality in ~~1997-2001 (7 animals)~~ 2000-2004 (fishery mortality + vessel collisions = 1.8 animals) is estimated to be less than the PBR (~~729~~ 347), 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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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).

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°N, (Southern California to Alaska), and southern specimens were obtained from about 36°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).

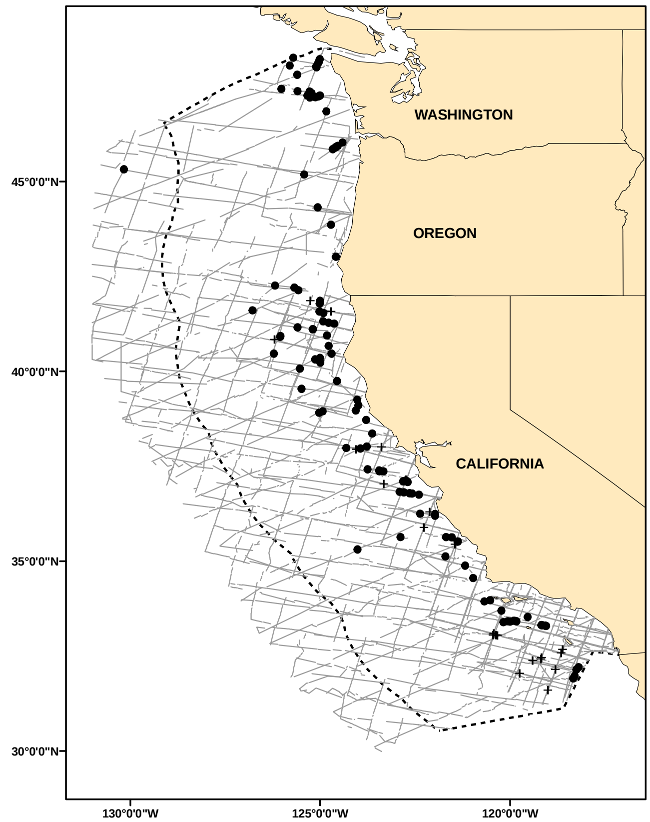

Figure 1. Pacific white-sided dolphin sightings based on aerial and shipboard surveys off California, Oregon, and Washington, 1991-~~2001~~ 2005 (see Appendix 2 for data sources and information on timing and location of survey effort). Dashed line represents the U.S. EEZ, ~~thick~~ thin lines indicates ~~the outer boundary~~ completed transect effort of all surveys combined. Key: • = summer/autumn ship-based sightings; + = winter/spring aerial-based sightings.

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~~ most recent estimates of abundance for Pacific white-sided dolphins ~~were~~ are based on ~~three~~ two summer/autumn shipboard surveys conducted within 300 nmi of the coasts of California, Oregon, and Washington in ~~1991~~ 2001 and ~~1993~~ 2005 (Barlow ~~and Gerrodette 1996~~ 2003; Forney 2007) ~~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~~ 2001-2005 ~~weighted average~~ geometric mean abundance estimate for California, Oregon and Washington waters based on the two most recent ship surveys is ~~59,274~~ 25,233 (CV =~~0.50~~ 0.25) Pacific white-sided dolphins (~~Barlow 2003~~ Forney 2007).

Minimum Population Estimate

The log-normal 20th percentile of the ~~1996-2001~~ 2001-2005 ~~weighted~~ average abundance estimate is ~~39,822~~ 20,441 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~~ 20,441) <u>times</u> one half the default maximum net growth rate for cetaceans (½ of 4%) <u>times</u> a recovery factor of ~~0.48~~ 0.45 (for a species of unknown status with a mortality rate CV >~~0.30~~ 0.60 and ≤~~0.60~~ 0.80; Wade and Angliss 1997), resulting in a PBR of ~~382~~ 184 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~~ 2000-2004 (~~Cameron and Forney 1999, 2000; Carretta 2001, 2002~~ Carretta and Chivers 2004, Carretta et al. 2005a, 2005b). 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~~ 2000-2004 data. ~~This results in an average estimate of 5.9 (CV = 0.42) Pacific white-sided dolphins taken annually.~~ Including mortality from drift gillnet, groundfish trawl, and unknown fisheries, the average annual fishery-related mortality of Pacific white-sided dolphins in 2000-2004 is 5.6 (CV = 0.72) animals.

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~~ 2000-2004 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 2002 2003 2004	~~23.0%~~ ~~20.0%~~ ~~20.0%~~ 22.9% 20.4% 22.1% 20.2% 20.6%	~~3~~ ~~0~~ ~~0~~ 2 2 1 0 0	~~12 (0.68)~~ ~~0~~ ~~0~~ ~~5~~ 9 (~~1.02~~ 0.68) ~~9~~ 10(~~0.69~~ 0.71) 5 (0.86) 0 0	~~5.2 (0.44)~~ 4.8 (0.72)
WA/OR/CA domestic groundfish trawl fisheries (At-sea processing Pacific whiting fishery only).	observer data	~~1997~~ ~~1998~~ ~~1999~~ 2000 2001 2002 2003 2004	~~65.7%~~ ~~77.3%~~ ~~68.6%~~ 80.6% 96.2% 100% 100% 100%	~~0~~ ~~1~~ ~~0~~ 0 0 0 1 0	~~0~~ ~~1 (0.48)~~ ~~0~~ 0 0 0 1 (n/a) 0	0.2 ~~(0.48~~ n/a)
Unknown fishery	Stranding	2000 2001 2002 2003 2004		0 0 2 0 1	n/a	≥0.6

Fishery Name	Data Type	Year(s)	Percent Observer Coverage	Observed Mortality	Estimated Annual Mortality	Mean Annual Takes (CV in parentheses)
Minimum total annual takes						~~5.4 (0.42)~~ 5.6 (0.72)

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~~ 2000-2004, with ~~66%-96%~~ 80-100% 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 (NMFS, unpublished data).~~, 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.~~ Fishery-related strandings of Pacific white-sided dolphins in California/Oregon/Washington between 2000-2004 totalled 3 animals. In 2001, two white-sided dolphins stranded in southern Californa within a week, one animal had its flukes cut off, the second animal had yellow nylon line around the caudal peduncle and apparent bullet holes on each side of the head. A third animal stranded in 2004 with net-like markings.

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~~ The average annual human-caused mortality in ~~1997-2001~~ 2000-2004 (~~5.4~~ 5.6 animals) is estimated to be less than the PBR (~~382~~ 184), 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.

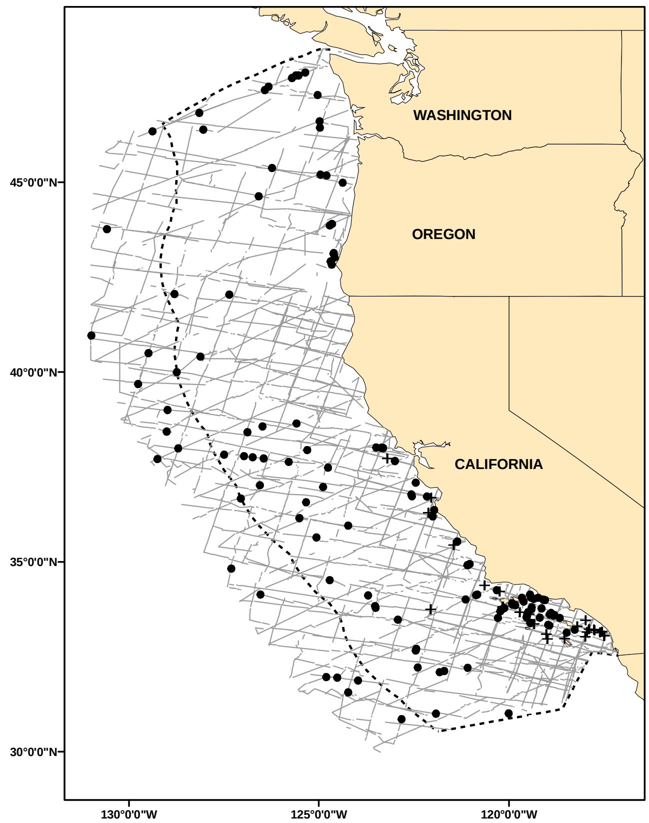

Figure 1. Risso's dolphin sightings based on aerial and shipboard surveys off California, Oregon, and Washington, 1991-~~2001~~ 2005 (see Appendix 2 for data sources and information on timing and location of survey effort). Dashed line represents the U.S. EEZ, ~~thick~~ thin lines indicate~~s~~ ~~the outer boundary~~ completed transect effort 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~~ two shipboard surveys within 300 nmi of the coasts of California, Oregon, and Washington ~~was~~ were conducted in summer/autumn of 2001 (Barlow, 2003) and 2005 (Forney, 2007). 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-~~ 2001-2005 ~~weighted average~~ geometric mean abundance estimate for California, Oregon and Washington waters based on the two most recent ship surveys is ~~16,066~~ 12,093 (CV = ~~0.28~~ 0.24) Risso's dolphins (Barlow 2003, Forney, 2007).

Minimum Population Estimate

The log-normal 20th percentile of the ~~1996-~~2001-2005 weighted average abundance estimate is ~~12,748~~ 9,947 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~~ 12,093 (CV = ~~0.28~~ 0.24) ~~(Barlow 2003)~~, which is ~~relatively unchanged from~~ not significantly different from the estimate of ~~16,483 (CV = 0.28)~~ 16,066 (0.28) from pooled ~~1991-1996~~ 1996-2001 surveys (Barlow ~~1997~~ 2003). Inter-annual variability in the distribution of Risso's dolphin within the ship survey study area is likely responsible for the differences in estimated abundance between surveys. 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~~ 9,947) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of ~~0.45~~ 0.40 (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~~ 80 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~~ 2000-2004 (~~Julian 1997; Cameron and Forney 1999, 2000;~~ Carretta and Chivers 2004 ~~2001, 2002~~; Carretta et al. 2005a, 2005b). 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. Additional mortality and injury information from the former California shallow set longline fishery and unknown fishery-related strandings are included in Table 1. Mean annual takes in Table 1 are based on ~~1997-2001~~ 2000-2004 data. This results in an average estimate ~~of 3.6~~ 6.6 (CV = ~~0.63~~ 1.02) 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~~ 2000-2004 data unless noted otherwise.

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

Fishery Name	Data Type	Year(s)	Percent Observer Coverage	Observed Mortality	Estimated Annual Mortality (CV)	Mean Annual Takes (CV)
CA/OR thresher shark/swordfish drift gillnet fishery	observer	~~1997~~ ~~1998~~ ~~1999~~ 2000 2001 2002 2003 2004	~~23.0%~~ ~~20.0%~~ ~~20.0%~~ 22.9% 20.4% 22.1% 20.2% 20.6%	~~3~~ ~~0~~ ~~0~~ 2 0 0 4 0	~~11 (0.96)~~ ~~0~~ ~~0~~ ~~7 (0.58)~~ 9 (0.71) 0 0 20 (0.50) 0	~~3.6 (0.63)~~ 5.8 (1.02)
CA shallow set longline fishery	observer	2001 2002 2003 2004 No fishery in 2005	n/a	1 animal released injured in 2003, hook not removed	n/a	0.25 (n/a)
Unknown fishery	Stranding	2002 2003		2 1	n/a n/a	0.6 (n/a)
Minimum total annual takes						~~3.6 (0.63)~~ 6.6 (1.02)

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.~~ In addition to mortalities observed in the drift gillnet fishery, there were three fishery-related strandings of Risso's dolphin during 2000-2004. Bullets or bullet fragments were removed from two of the three animals while the third animal showed evidence of gunshot wounds. Two animals had recently been feeding on squid. The timing, circumstances 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~~ 2000-2004), the average annual human-caused mortality (~~3.6~~6.6 animals) is estimated to be less than the PBR (~~115~~ 80), 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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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; Lowther 2006; Lowther et al. in prep.). 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.

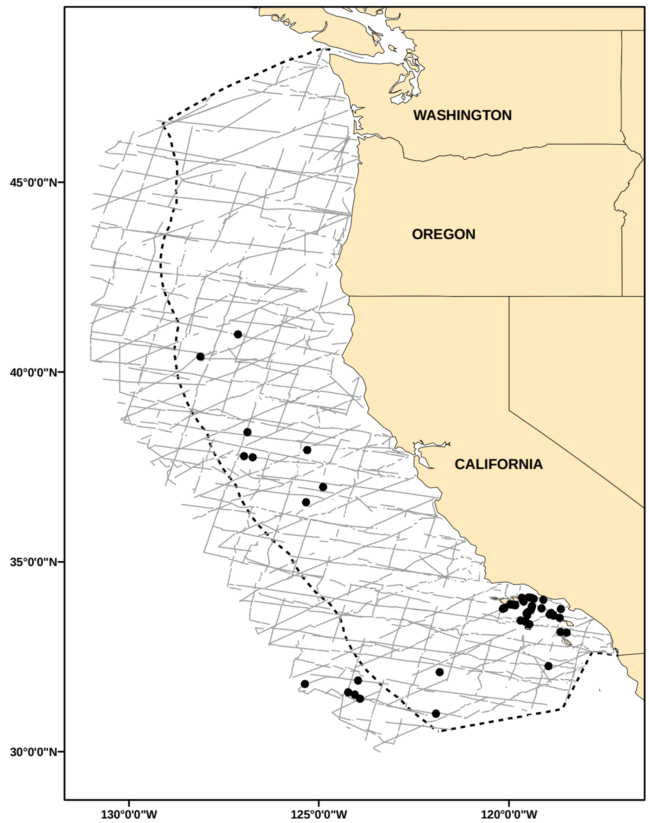

Figure 1. Offshore bottlenose dolphin sightings based on shipboard surveys off California, Oregon, and Washington, 1991-~~2001~~2005 (see Appendix 2 for data sources and information on timing and location of survey effort). Dashed line represents the U.S. EEZ, ~~thick~~ thin lines indicate~~s~~ ~~the outer boundary~~ completed transect effort 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) and 2005 (Forney 2007). 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~~ geometric mean abundance estimate for California, Oregon and Washington waters based on the ~~1996-~~2001-2005 ship surveys, ~~5,065~~ 3,257 (CV = ~~0.66~~ 0.43) offshore bottlenose dolphins (Barlow 2003, Forney 2007).

Minimum Population Estimate

The log-normal 20th percentile of the ~~1996-~~2001-2005 ~~weighted~~ average abundance estimate is ~~3,053~~ 2,295 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~~ 2,295) 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 rate CV < 0.30; Wade and Angliss 1997), resulting in a PBR of ~~31~~ 23 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~~ 2000-2004 (~~Julian 1997; Cameron and Forney 1999, 2000;~~ ~~Carretta 2001, 2002~~ Carretta and Chivers 2004, Carretta et al. 2005a, 2005b). 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. In 2004, a bottlenose dolphin stranded dead near Newport Beach, California, with its flukes cut off, suggestive of an interaction with an entangling net fishery. The haplotype of this animal matched those of known *offshore* bottlenose dolphins (Lowther 2006, Lowther et al., in prep). Mean annual takes in Table 1 are based on ~~1997-2001~~ 2000-2004 data. This results in an average estimate of ~~zero~~ 0.2 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~~ 2000-2004 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 2002 2003 2004	~~23.0%~~ ~~20.0%~~ ~~20.0%~~ 22.9% 20.4% 22.1% 20.2% 20.6%	~~0~~ ~~0~~ ~~0~~ 0 0 0 0 0	~~0~~ ~~0~~ ~~0~~ 0 0 0 0 0	0
Unknown fishery	Strandings	2004		1	≥1	≥0.2 (n/a)
Minimum total annual takes						~~0~~ ≥0.2 (n/a)

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~~ average annual fishery takes (0.2/year) ~~have been documented~~ are less than the calculated PBR (23), offshore bottlenose dolphins are not classified as a "strategic" stock under the MMPA. ~~and the~~ The total fishery mortality and serious injury for this stock is less than 10% of the PBR and thus can be considered to be insignificant and approaching zero.

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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.

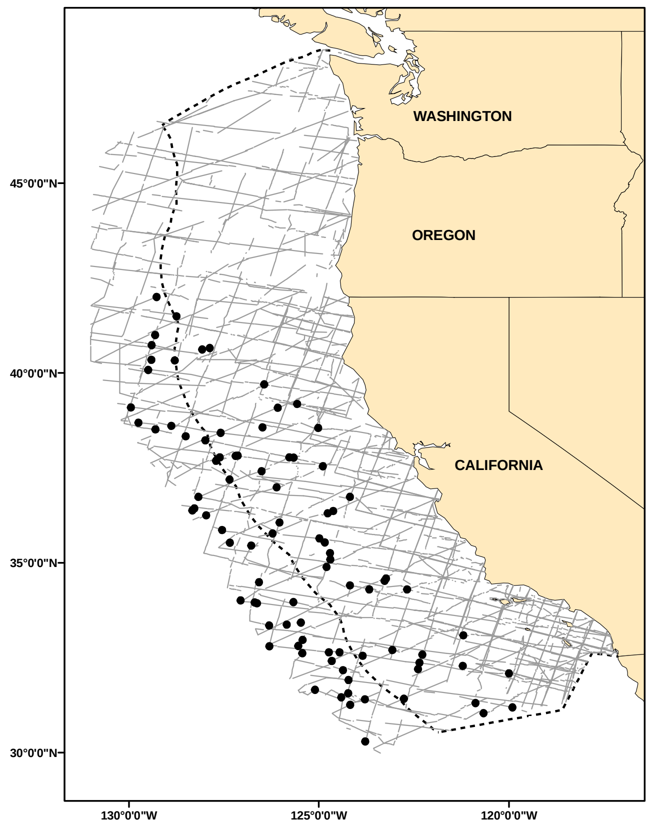

Figure 1. Striped dolphin sightings based on aerial and shipboard surveys off California, Oregon, and Washington, 1991-~~2001~~2005 (see Appendix 2 for data sources and information on timing and location of survey effort). Dashed line represents the U.S. EEZ, ~~thick~~ lines indicate~~s~~ the ~~outer boundary~~ completed transect effort of all surveys combined.

POPULATION SIZE

Abundance is estimated from ~~T~~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) and 2005 (Forney 2007). 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-~~2001-2005 ~~weighted average~~ geometric mean abundance estimate for California, Oregon and Washington waters based on the ~~above two~~ 2001 and 2005 ship surveys is ~~13,934~~ 23,883 (CV = ~~0.53~~ 0.44) striped dolphins (Barlow 2003, Forney 2007).

Minimum Population Estimate

The log-normal 20th percentile of the ~~1996-~~2001-2005 ~~weighted~~ ~~average~~ mean abundance estimate is ~~9,165~~ 16,737 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, and 2005 in California waters were 28,396 (CV = 0.31); 5,489 (0.48); ~~and~~ 22,316 (0.65); and 23,883 (0.44) striped dolphin, respectively (Barlow 2003; Forney 2007). 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~~ 16,737) <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 ~~92~~ 167 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 set and drift gillnet fisheries are included in Table 1 for the five most recent years of monitoring, ~~1997-2001~~ 2000-2004 (~~Julian 1997; Cameron and Forney 1999, 2000;~~ ~~Carretta 2001, 2002~~ Carretta and Chivers 2004, Carretta et al. 2005a, 2005b). No striped dolphins 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~~ 2000-2004 data. This results in an average estimate of zero striped 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 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~~ 2000-2004 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~~ 2000-2004	~~23.0%~~ ~~20.0%~~ ~~20.0%~~ ~~22.9%~~ ~~20.4%~~ 20-23%	~~0~~ ~~0~~ ~~0~~ ~~0~~ ~~0~~ 0	~~0~~ ~~0~~ ~~0~~ ~~0~~ ~~0~~ 0	0
Minimum total annual takes						0

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), t~~The average annual human-caused mortality in ~~1997-2001~~ 2000-2004 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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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~~ have been commonly sighted as far north as 42°N during 1991-2005 NMFS line-transect vessel surveys (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.

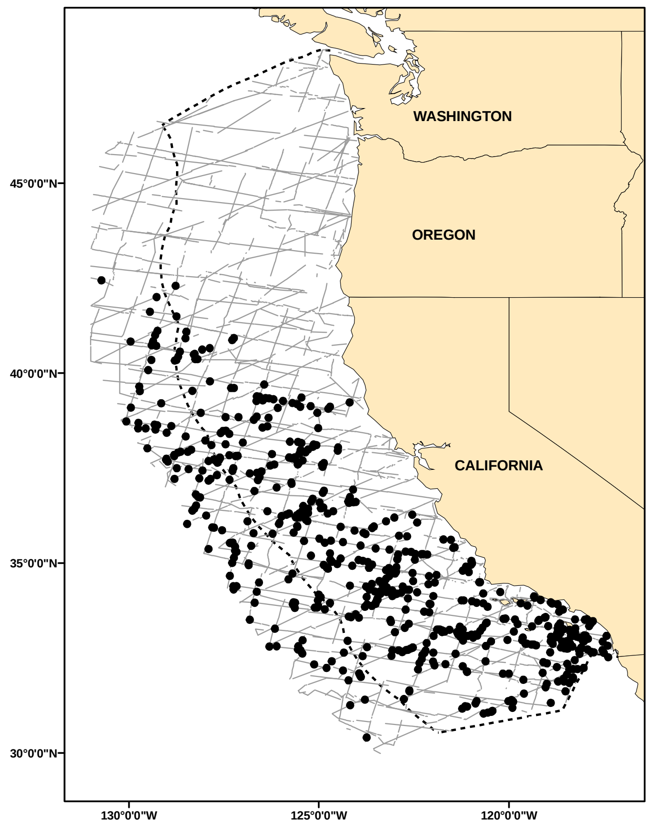

Figure 1. Short-beaked common dolphin sightings based on shipboard surveys off California, Oregon, and Washington, 1991-~~2001~~ 2005 (see Appendix 2, for data sources and information on timing and location of survey effort). No *Delphinus* sightings have been made off Washington. Dashed line represents the U.S. EEZ, ~~thick~~ thin lines indicates ~~the outer boundary~~ completed transect effort of all surveys combined.

For the MMPA stock assessment reports, there is a single Pacific management stock including only animals found within the U.S. Exclusive Economic Zone of California, Oregon and Washington.

POPULATION SIZE

~~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~~ The most recent estimates of 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) and 2005 (Forney 2007). 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~~ 2001-2005 ~~weighted average~~ geometric mean abundance estimate for California, Oregon and Washington waters based on the two ship surveys is ~~449,846~~ 487,622 (CV= ~~0.25~~ 0.26) short-beaked common dolphins (~~Barlow 2003~~ Forney 2007).

Minimum Population Estimate

The log-normal 20th percentile of the ~~1996-2001~~ 2001-2005 ~~weighted average~~ abundance estimate is ~~365,617~~ 392,687 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~~ 2001-2005 summer/fall surveys (~~Barlow 2003~~ Forney 2007) 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~~ 392,687) 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 ~~3,656~~ 3,927 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~~ 2000-2004 (~~Cameron and Forney 1999, 2000;~~ ~~Carretta 2001, 2002~~ Carretta and Chivers 2004, Carretta et al. 2005a, 2005b). ~~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)~~, but entanglement rates increased again in 1999 and 2000 (Figure 2) and have since returned to low levels~~ Since the initial pinger experiments, short-beaked common dolphin entanglement rates have remained below pre-pinger levels, even though a time/area closure in 2001 shifted fishing effort south of Point Conception, California, where common dolphin densities are highest. Between 1990-2005, in the region south of Point Conception, there have been 112 short-beaked common dolphins entangled in 2,700 sets (4.1 per 100 sets), whereas there were 114 entanglements in 1,946 sets without pingers (5.8 per 100 sets) (NMFS, unpublished data). ~~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.~~

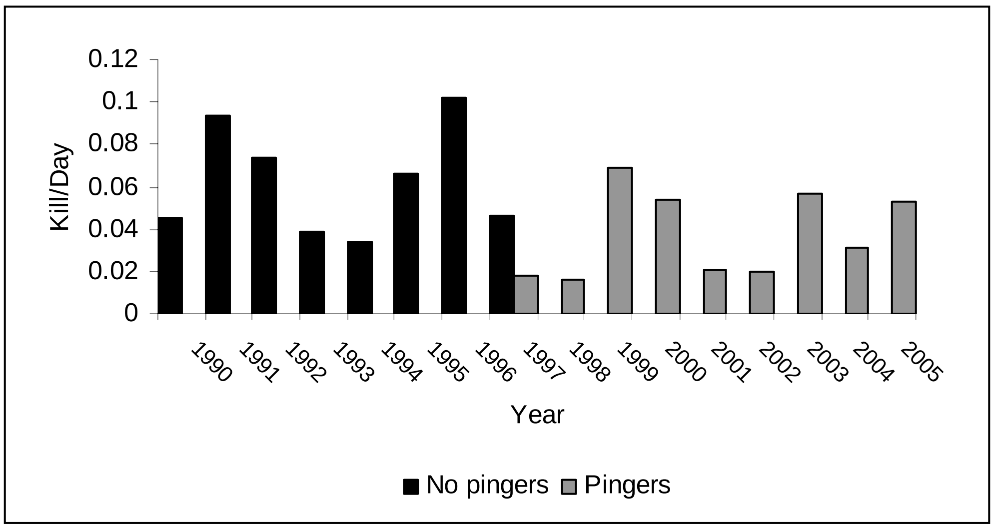

Figure 2. Kill rates of short-beaked common dolphin per set fished in the California drift gillnet fishery for swordfish and thresher shark, 1990-2005. Kill rates include observations from pingered and unpingered sets. Pingers were not used from 1990-95 and were used experimentally in 1996 and 1997. In 1996, no short-beaked common dolphin were observed killed in 146 pingered sets. For the period 1998-2005, more than 99% of all observed sets utilized pingers.

Mean annual takes in Table 1 are based on ~~1997-2001~~ 2000-2004 data. This results in an average estimate of ~~93(CV=0.23)~~ 59 (CV = 0.15) short-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 ~~1994-98~~ 2000-2004 indicate that at least ~~four~~ one common dolphin (type not specified) ~~were~~ was 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~~ Six common dolphin~~s~~ (~~type~~ four not specified) stranded with evidence of fishery interaction (NMFS, Southwest Region, unpublished data) between ~~1997-2001~~ 2000-2004. 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~~ 2000-2004 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 2002 2003 2004	~~23.0%~~ ~~20.0%~~ ~~20.0%~~ 22.9% 20.4% 22.1% 20.2% 20.6%	~~21~~ ~~9~~ ~~34~~ ~~23~~ 24 7 7 17 7	~~105 (0.30)~~ ~~51 (0.33)~~ ~~191 (0.31)~~ ~~75 (0.32)~~ 105 (0.26) ~~26 (0.41)~~ 34 (0.41) 32 (0.46) 84 (0.24) 34 (0.49)	~~(includes prorated)~~ ~~90 (0.17)~~ 58 (0.15)
CA angel shark/ halibut and other species large mesh (>3.5in) set gillnet fishery[1]		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 2002 2003 2004	- - - - - - - -	~~0~~ ~~2~~ ~~0~~ 0 0 0 0 1	~~0~~ ~~2~~ ~~0~~ 0 0 0 0 1	≥~~0.4~~ 0.2 (n/a)

Fishery Name	Data Type	Year	Percent Observer Coverage	Observed Mortality	Estimated Annual Mortality	Mean Annual Takes (CV in parentheses)
Unknown fishery	strandings	~~1997-2001~~ 2000-2004	~~9 common dolphins (species not determined) stranded with evidence of fishery interactions~~ 4 unidentified common and 2 short-beaked common dolphin stranded with evidence of fishery interations			≥~~1.8~~ 1.2 (n/a)
Minimum total annual takes						~~93 (0.23)~~ 59 (0.15)

[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.~~ There are no estimates of common dolphin mortality in this fishery because of a lack of recent observer 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~~ 2000-2004, annual fishing mortality of northern common dolphins (potentially including both short-beaked and long-beaked common dolphins) ranged between ~~9~~ 54 and ~~261~~ 159 animals, with an average of ~~101~~ 102 (IATTC, ~~in prep~~ 2006). 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~~ The average annual human-caused mortality in ~~1997-2001~~ 2000-2004 (~~93~~ 59 animals) is estimated to be less than the PBR (~~3,656~~ 3,927), 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.

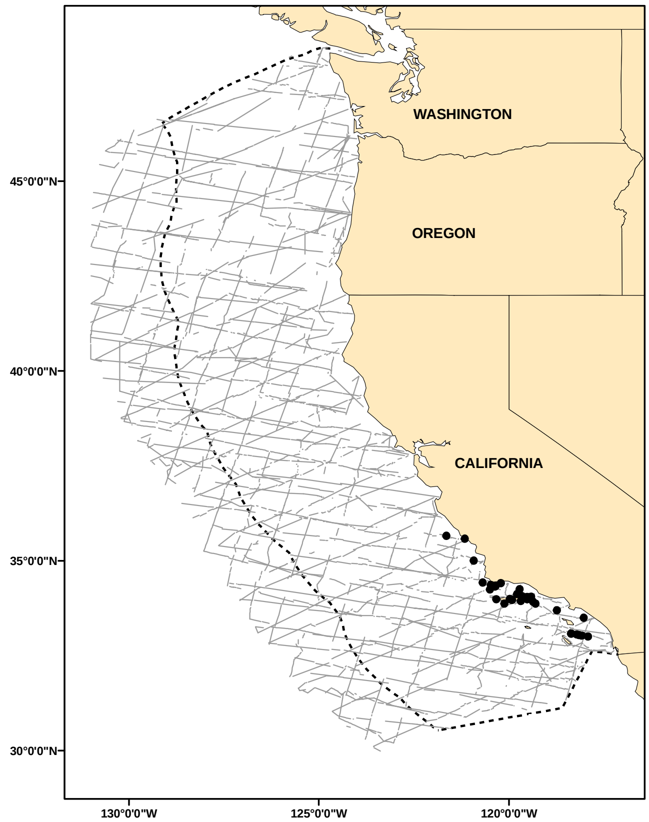

Figure 1. Long-beaked common dolphin sightings based on shipboard surveys off California, Oregon, and Washington, 1991-~~2001~~2005 (see Appendix 2 for information on timing and location of survey effort). No Delphinus sightings have been made off Washington. Dashed line represents the U.S. EEZ, ~~thick~~ thin lines indicates completed transect effort ~~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~~ Barlow (2003) reported long-beaked common dolphin abundance estimates of 10,799 (CV = 0.76), 86,414 (CV = 0.74), and 306 (CV = 1.02) for 1991-93, 1996, and 2001 surveys, respectively. The most recent abundance estimate is 11,714 (CV = 0.99), based on a 2005 ship line transect survey of California, Oregon, and Washington waters (Forney 2007). ~~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~~ move between Mexican and U.S. waters, and therefore a multi-year average abundance estimate is the most appropriate for management within the U.S. waters. The ~~1991-96~~ ~~weighted average~~ geometric mean abundance estimate for California, Oregon and Washington waters based on ~~the~~ ~~three~~ two ship surveys conducted in 2001 and 2005 is ~~43,360~~ 1,893 (CV=~~0.72~~ 0.65) long-beaked common dolphins (Barlow 2003, Forney 2007).

Minimum Population Estimate

The log-normal 20th percentile of the weighted average abundance estimate is ~~25,163~~ 1,152 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.~~ California waters represent the northern limit for this stock and animals likely move between U.S. and Mexican waters. No information on trends in abundance are available for this stock because of high interannual variability in line-transect abundance estimates. 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~~ 1,152) 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~~ 11 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~~ 2000-2004 (~~Cameron and Forney 1999, 2000; Carretta 2001, 2002,~~ Carretta and Chivers 2004, Carretta et al. 2005a, 2005b). ~~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~~ 2000-2004 data. This results in an average estimate of ~~11~~ 17 (CV= ~~0.50~~ 0.57) 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~~ 2000-2004 indicate that at least two common dolphins (type not specified) were killed between ~~1997 and 2001~~ 2000-2004. Although these reports are considered unreliable (see Appendix 4 of Hill and DeMaster 1998) they represent a minimum mortality for this fishery. ~~Nine~~ Sixteen common dolphins (~~type not specified~~ six unidentified common dolphin and ten long-beaked common dolphin) stranded with evidence of fishery interaction (NMFS, Southwest Region, unpublished data) between ~~1997-2001~~ 2000-2004. Two of the long-beaked common dolphin had portions of 'halibut' gillnet around the carcasses and ~~It~~ it is not known which fisheries were responsible for ~~these~~ the remaining mortalities.

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 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~~ 2000-2004 data unless noted otherwise. n/a = information not available.

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 2002 2003 2004	~~23.0%~~ ~~20.0%~~ ~~20.0%~~ 22.9% 20.4% 22.1% 20.2% 20.6%	~~4~~ ~~0~~ ~~1~~ 1 0 4 0 0	~~25 (0.74)~~ ~~0~~ ~~8 (0.93)~~ ~~9 (0.76)~~ 4 (1.08) 0 18 (0.79) 0 0	~~8.4 (0.50)~~ 4.4 (1.69)

Fishery Name	Data Type	Year(s)	Percent Observer Coverage	Observed	Estimated Annual Mortality	Mean Annual Takes (CV in parentheses)
CA small mesh drift gillnet fishery for white seabass, yellowtail, barracuda, and tuna	observer	2000 2001 2002 2003 2004	not observed not observed 11%[1] 11%[1] not observed	n/a n/a 1 1 n/a	n/a n/a 9 (0.94)[1] 9 (0.94)[1] n/a	9 (0.67)
CA angel shark/ halibut and other species large mesh (>3.5in) set gillnet fishery[2]		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 2002 2003 2004	- - - - - - - -	~~0~~ ~~2~~ ~~0~~ 0 0 0 0 1	~~0~~ ~~32~~ ~~0~~ 0 0 0 0 n/a	~~0.4~~ ≥0.2 (n/a)
Undetermined	strandings	~~1997-2001~~ 2000-2004	~~9~~ Sixteen common dolphins (~~species not determined~~ six unidentified and ten longbeaked common dolphin) stranded with evidence of fishery interactions. Two long-beaked common dolphins stranded with portions of 'halibut' gillnet around animal			~~1.8~~ ≥3.2 (n/a)
Minimum total annual takes						~~11 (0.50)~~ 17 (0.57)

[1] Observer coverage in the small mesh drift gillnet fishery was estimated by using logbook effort in this fishery in 2002 (the most recent year for which data are available). Logbook effort totaled 195 sets in 2002 and there were 22 sets observed in this fishery in both 2003 and 2004.

[2] 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.~~ No estimates of current mortality are available for this fishery because of a lack of recent observer coverage.

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~~ 2000-2004, annual fishing mortality of northern common dolphins (potentially including both short-beaked and long-beaked common dolphins) ranged between ~~9~~ 54 and ~~261~~ 159 animals, with an average of ~~101~~ 102 (IATTC, ~~in prep~~ 2006). 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), t~~ The average annual human-caused mortality ~~in 1997-2001 (14 animals)~~ from 2000-2004 (17 animals) ~~is estimated to be less than~~ exceeds the PBR (~~226~~ 11), 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~~ exceeds the PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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.

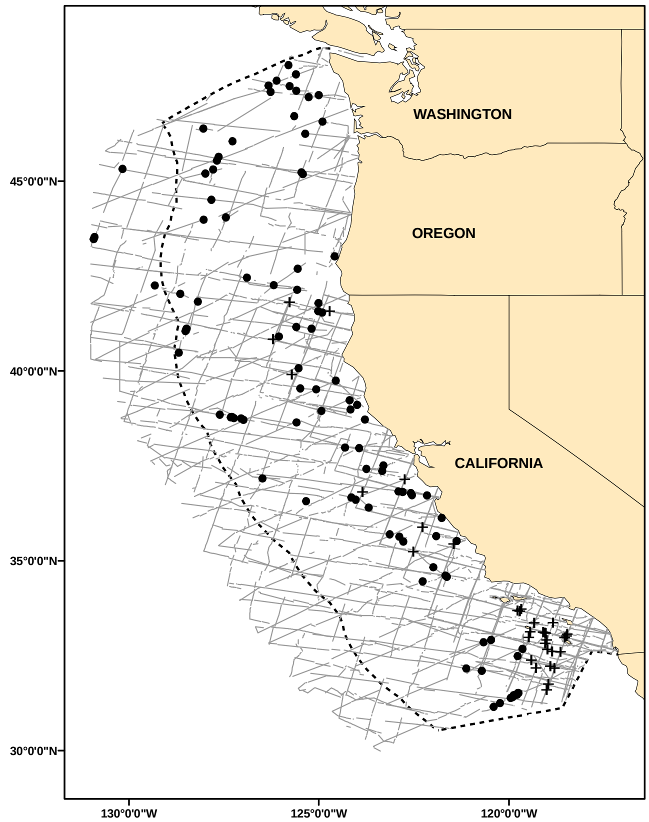

Figure 1. Northern right whale dolphin sightings based on aerial and shipboard surveys off California, Oregon, and Washington, 1991-~~2001~~ 2005 (see Appendix 2 for data sources and information on timing and location of survey effort). Dashed line represents the U.S. EEZ, ~~thick~~ thin lines indicates ~~the outer boundary~~ completed transect effort 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) and 2005 (Forney 2007). 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-~~2001-2005 ~~weighted average~~ geometric mean abundance estimate for California, Oregon and Washington waters based on the two ship surveys is ~~20,362~~ 15,305 (CV=~~0.26~~ 0.32) northern right-whale dolphins (Barlow 2003, Forney 2007).

Minimum Population Estimate

The log-normal 20th percentile of the ~~1996-~~2001-2005 ~~weighted~~ average abundance estimate is ~~16,417~~ 11,754 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, and 2005 surveys were 19,619 (0.43), ~~and~~ 21,104 (0.30), and 11,100 (0.60), 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~~ 11,754) <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~~ 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 ~~164~~ 113 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~~ 2000-2004 (~~Cameron and Forney 1999, 2000;~~ ~~Carretta 2001, 2002~~ Carretta and Chivers 2004, Carretta et al. 2005a, 2005b). 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~~ 2000-2004 data. This results in an average estimate of ~~23~~ 18 (CV= ~~0.27~~ 0.31) 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~~ 2000-2004 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~~	~~23.0%~~	~~5~~	~~29 (0.42)~~	~~23 (0.27)~~ 18 (0.31)
		~~1998~~	~~20.0%~~	~~0~~	~~0~~	
		~~1999~~	~~20.0%~~	~~3~~	~~17 (0.66)~~	
		2000	22.9%	11	~~47~~ 48 (~~0.51~~ 0.48)	
		2001	20.4%	5	~~22~~ 25 (~~0.54~~ 0.57)	
		2002	22.1%	2	9 (0.70)	
		2003	20.2%	1	5 (1.00)	
		2004	20.6%	1	5 (0.99)	
Minimum total annual takes						~~23 (0.27)~~ 18 (0.31)

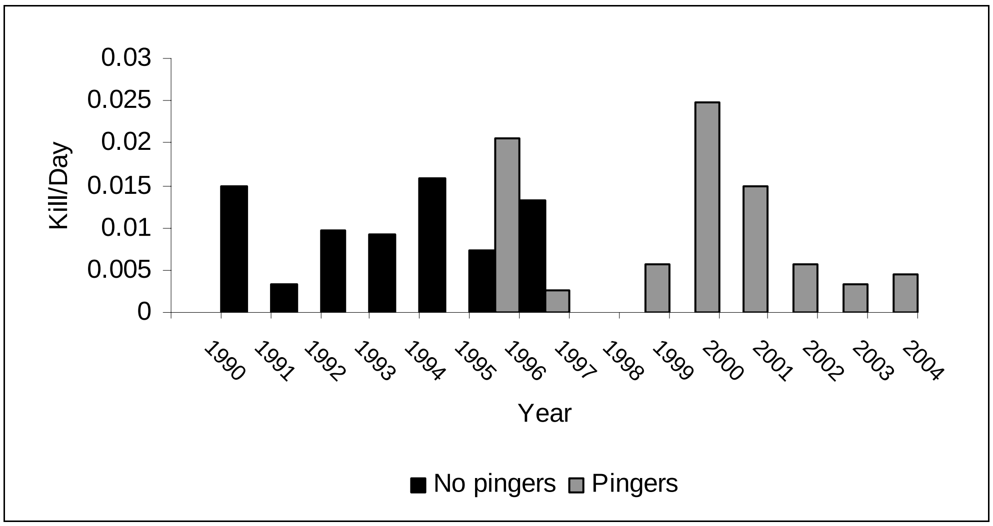

Figure 2. Kill rates of northern right whale dolphin per set fished in the California drift gillnet fishery for swordfish and thresher shark, 1990-~~2002~~ 2004. Kill rates include observations from pingered and unpingered sets. Pingers were not used from 1990-95 and were used experimentally in 1996 and 1997. For the period 1998-~~2002~~2004, over 99% of all observed sets utilized pingers.

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 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~~ 2000-2004 (~~23~~ 18 animals) is estimated to be less than the PBR (~~158~~ 113), 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~~ 05/08/2007

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).

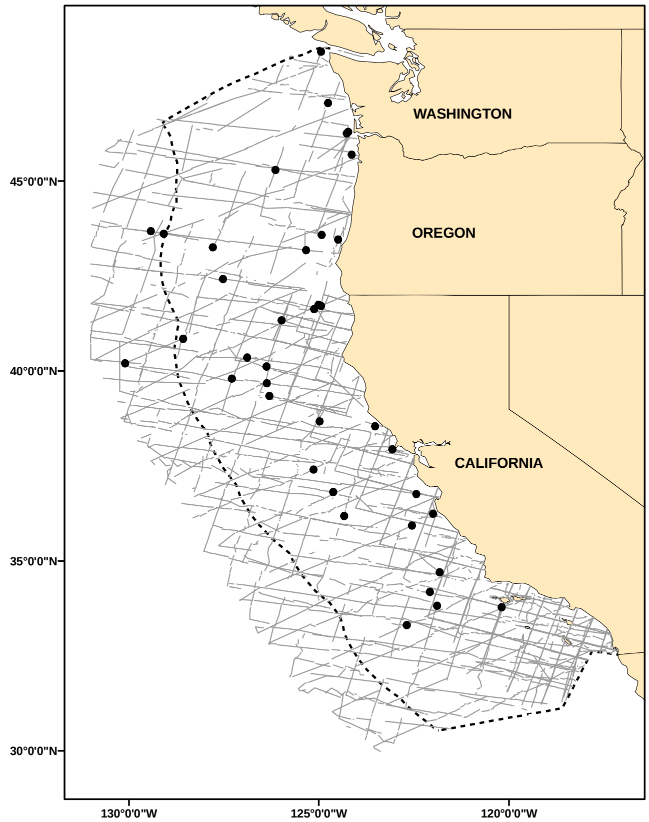

Figure 1. Killer whale sightings based on aerial and shipboard surveys off California, Oregon and Washington, 1991-~~2001~~ 2005 (see Appendix 2 for data sources and information on timing and location of survey effort). Sightings include killer whales from all stocks found in this region. Dashed line represents the U.S. EEZ, ~~thick~~ thin lines indicates ~~the outer boundary~~ completed transect effort of all surveys combined.

Offshore killer whales have more recently also been identified off the coasts of California, Oregon, and rarely, in Southeast Alaska (Ford et al. 1994, Black et al. 1997, Dahlheim et al. 1997). They apparently do not mix with the transient and resident killer whale stocks found in these regions (Ford et al. 1994, Black et al. 1997). Studies indicate the 'offshore' type, although distinct from the other types ('resident' and 'transient'), appears to be more closely related genetically, morphologically, behaviorally, and vocally to the 'resident' type killer whales (Black et al. 1997, Hoelzel et al. 1998; J. Ford, pers. comm.;

L. Barrett-Lennard, pers. comm.). Based on data regarding association patterns, acoustics, movements, genetic differences, and potential fishery interactions, 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) and 2005 (Forney 2007), the total number of killer whales within 300 nmi of the coasts of California, Oregon and Washington ~~was recently~~ is estimated to be ~~1,340~~ 1,214 animals (CV=~~0.31~~ 0.29). 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~~ 1,214 = ~~466~~ 422 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-~~2001-2005 line-transect surveys as the 20th percentile of the mean 2001-2005 abundance estimate, or ~~1,038~~ 953 killer whales. Using the same prorating as above, a minimum of 56/161 * ~~1,038~~ 953 = ~~361~~ 331 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~~ 331) <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~~ 3.3 offshore killer whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

A summary of information on fisheries that may take animals from this killer whale stock is shown in Table 1 (Carretta and Chivers 2004, Carretta et al. 2005a, 2005b). 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~~ Carretta and Chivers 2004, Carretta et al. 2005a, 2005b), 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~~ 2000-2004 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 2002 2003 2004	~~23.0%~~ ~~20.0%~~ ~~20.0%~~ 22.9% 20.4% 22.1% 20.2% 20.6%	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 ~~12/15/2006~~ 05/15/2007

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).

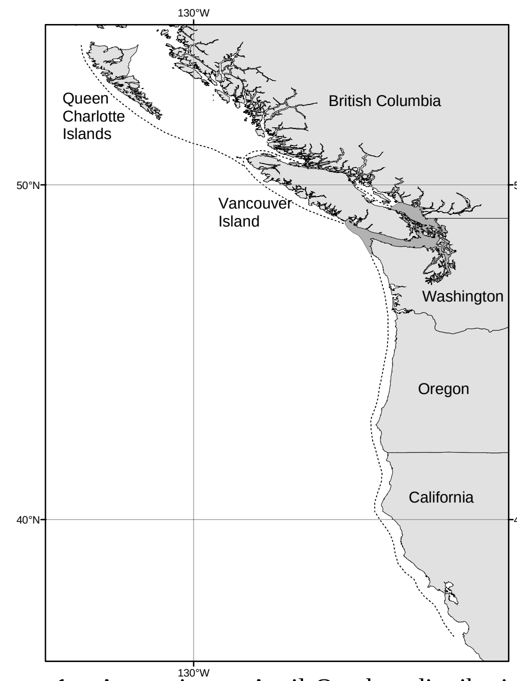

Figure 1. Approximate April-October distribution of the Eastern North Pacific Southern Resident killer whale stock (shaded area) and range of sightings (dotted line).

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, NWFSC unpubl. data). The complete winter range of this stock is uncertain. Of the three pods comprising this stock, one (J1) is commonly sighted in inshore waters in winter, while the other two (K1 and L1) apparently spend more time offshore (Ford et al. 2000). These latter two pods have been sighted as far south as Monterey Bay and central California in recent years (N. Black, pers. comm., K. Balcomb, pers. comm.) They sometimes have also been 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.).

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~~ ~~91~~ and most recently numbered 89 whales in ~~2005~~ 2006. (Fig. 2; Ford et al. 2000; Center for Whale Research, unpubl. data). The 2001-2005 counts included a whale born in 1999 (L-98) that was listed as missing during the annual census in May and June 2001 but was subsequently discovered alone in an inlet off the west coast of Vancouver Island (J. Ford, pers. comm.). L-98 remained separate from L pod until 10 March 2006 when he died due to injuries associated with a vessel interaction in Nootka Sound. ~~He will be~~ L-98 has been subtracted from ~~the population when~~ the official 2006 population census ~~is completed in May/June 2006~~. In addition, ~~the three~~ four whales that ~~were~~ have not been observed during the fall ~~2005~~ 2006 surveys will not be confirmed as missing from the population ~~if they are not seen before~~ until the official census is completed in May/June ~~2006~~ 2007 (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 ~~91~~ 89 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-~~2005~~2006 to a total of ~~91~~89 whales (Ford et al. 2000; Center for Whale Research, unpubl. data).

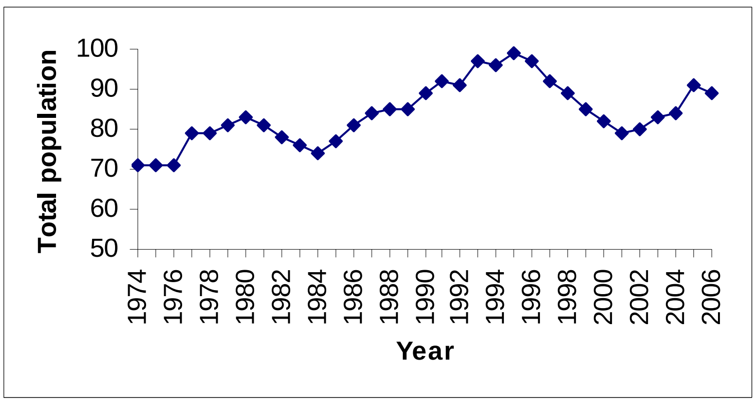

Figure 2. Population of Eastern North Pacific Southern Resident stock of killer whales, 1974-~~2005~~2006. Each year's count includes animals first seen and first missed; a whale is considered first missed the year after it was last seen alive (Ford et al. 2000; Center for Whale Research, unpubl. data).

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 (~~91~~ 89) <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 stock, Wade and Angliss 1997), resulting in a PBR of 0.18 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 2004, 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 1998-2004. There was documentation of a whale-boat collision in Haro Strait in 2005 which resulted in a minor injury to a whale. In 2006, whale L98 was killed during a vessel interaction. It is important to note that L98 had become habituated to regularly interacting with vessels during its isolation in Nootka Sound. The annual level of human-caused mortality for this stock over the past five years is 0.2 animals per year (reflecting the vessel strike mortality of animal L98 in 2006).

STATUS OF STOCK

On November 15, 2005 NMFS listed Southern Resident killer whales as endangered under the ESA. Total annual fishery mortality and serious injury for this stock (0) is not known to exceed 10% of the calculated PBR (0.018) 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 0.2 animals per year exceeds the PBR (0.18). Southern Resident killer whales are formally listed as "endangered" under the ESA and consequently the stock is automatically considered as a "depleted" and "strategic" stock under the MMPA.

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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, and 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.

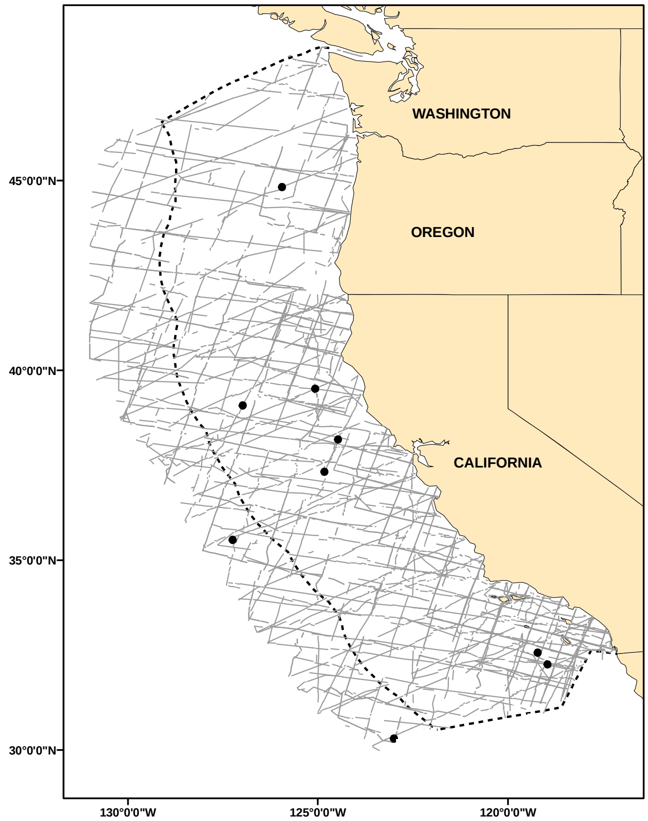

Figure 1. Short-finned pilot whale sightings made during aerial and shipboard surveys conducted off ~~California in 1975-83 (+) and~~ off California, Oregon, and Washington, 1991-2005 ~~2001~~ ~~(●)~~. See Appendix 2 for data sources and information on timing and location of survey effort. Dashed line represents the U.S. EEZ, ~~thick~~ thin lines indicate~~s~~ ~~the outer boundary~~ completed transect effort of all surveys combined.

POPULATION SIZE

Only ~~two~~ one group~~s~~ of pilot whales (numbering approximately ~~80~~ 7 animals) ~~were~~ was seen during the two most recent ship surveys conducted off California, Oregon, and Washington in ~~1996 and~~ 2001 and 2005 (~~Barlow 1997;~~ Barlow 2003; Forney 2007). All animals were seen during the ~~1996~~ 2005 survey. The abundance of short-finned pilot whales in this region appears to be variable and ~~may relate to~~

influenced by prevailing 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-~~2001-2005 unweighted average abundance estimate for California, Oregon and Washington waters based on the two ship surveys is ~~304~~ 245 (CV= ~~1.02~~ 0.97) short-finned pilot whales (Barlow 2003; Forney 2007).

Minimum Population Estimate

The log-normal 20th percentile of the ~~1996-~~2001-2005 unweighted average abundance estimate is ~~149~~ 123 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~~ 123) 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 mortality rate CV>0.80; Wade and Angliss 1997), resulting in a PBR of ~~1.2~~ 0.98 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~~ 2000-2004 (~~Cameron and Forney 1999, 2000; Carretta 2001, 2002~~ Carretta and Chivers 2004, Carretta et al. 2005a, 2005b). 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~~ 2000-2004 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~~ 2000-2004 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~~ 2000 2001 2002 2003 2004	~~20.0%~~ 22.9% 20.4% 22.0% 20.0% 20.6%	~~0~~ 0 0 0 1 0	~~0~~ 0 0 0 5 (1.00) 0	1.0 (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~~ 2000-2004 is 1.0 animal~~s~~, which is ~~less than~~ exceeds the PBR (~~1.2~~ 0.98), and therefore they are ~~not~~ classified as a "strategic" stock under the MMPA.

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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.

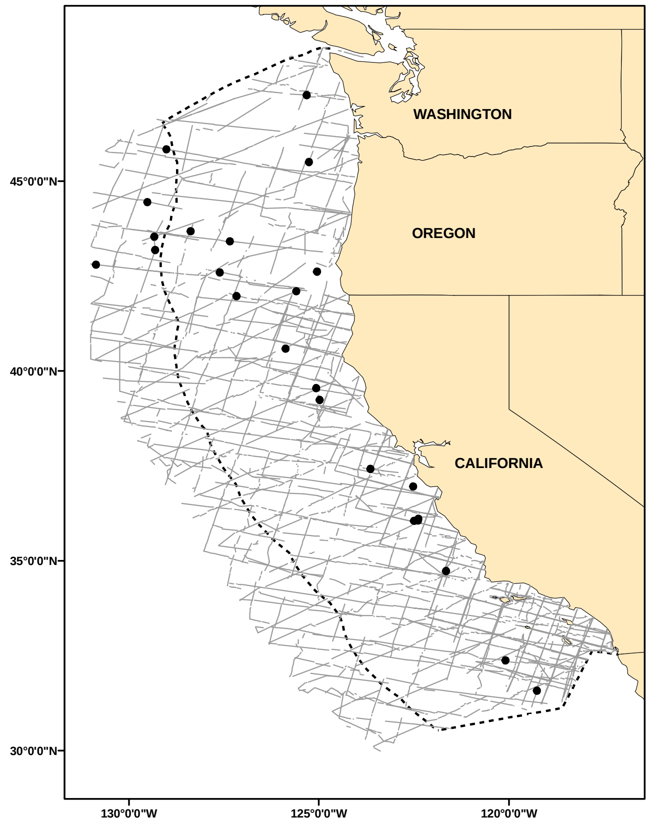

Figure 1. Baird's beaked whale sightings based on aerial and shipboard surveys off California, Oregon and Washington, 1991-~~2001~~2005 (see Appendix 2 for data sources and information on timing and location of survey effort). Dashed line represents the U.S. EEZ, ~~thick~~ thin lines indicate~~s the outer boundary~~ completed transect effort of all surveys combined.

POPULATION SIZE

Two summer/fall shipboard surveys were conducted within 300 nmi of the coasts of California, Oregon and Washington in ~~1996 (Barlow 1997) and~~ 2001 (Barlow 2003) and 2005 (Forney 2007). ~~resulting in a combined total of 11 Baird's beaked whale sightings.~~ Because thei~~r~~ distribution of Baird's beaked whale varies and animals probably spend time outside the U.S. Exclusive Economic Zone, a multi-year average abundance estimate is the most appropriate for management within U.S. waters. The ~~1996-~~2001-2005 ~~weighted average~~ geometric mean abundance estimate for California, Oregon and Washington waters based on the above two ship surveys is ~~228~~ 313 (CV=~~0.51~~ 0.55) Baird's beaked whales (Barlow 1997; Forney 2007). 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-~~2001-2005 weighted average abundance estimate is ~~152~~ 203 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~~ 203) 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~~ 2.0 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~~ 2000-2004 (~~Julian 1997; Cameron and Forney 1999, 2000;~~ ~~Carretta 2001, 2002~~ Carretta and Chivers 2004, Carretta et al. 2005a, 2005b). 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~~ 2000-2004 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~~ 2000-2004 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 2002 2003 2004	~~23.0%~~ ~~20.0%~~ ~~20.0%~~ 22.9% 20.4% 22.1% 20.2% 20.6%	~~0~~ ~~0~~ ~~0~~ 0 0 0 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). One Baird's beaked whale stranded in Washington state in 2003 and the cause of death was attributed to a ship strike.

Additional, unknown levels of injuries and mortalities of Baird's beaked whales may occur as a result of anthropogenic ~~noise~~ sound, 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 one animal that died as the result of a ship strike in 2003, the average annual human-caused mortality in ~~1997-2001~~ 2000-2004 is ~~zero~~ 0.2 animals/year. Because recent fishery and human-caused mortality is ~~zero~~ less than the PBR (2.0), Baird's beaked whales are not classified as a "strategic" stock under the MMPA.~~, and t~~The total fishery mortality and serious injury for this stock is zero and 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.

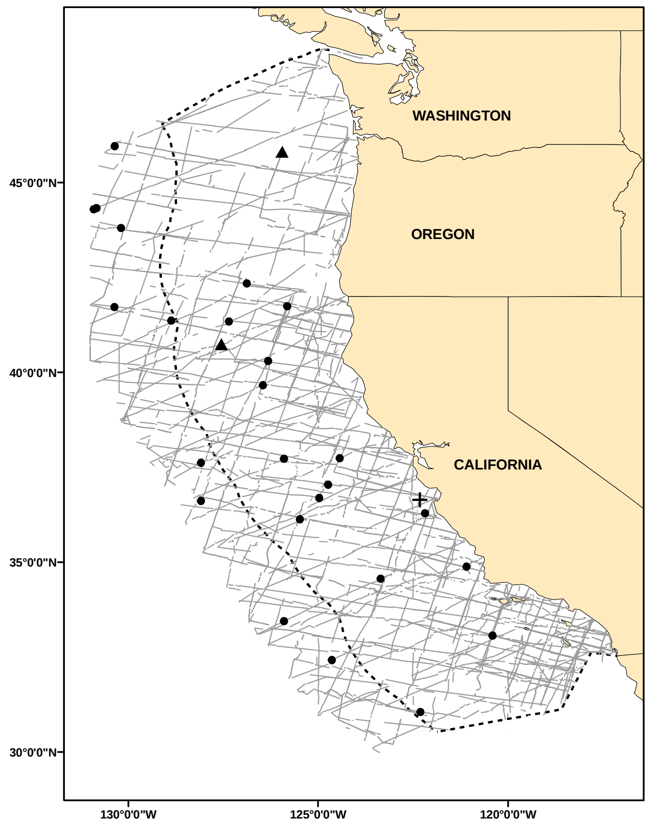

Figure 1. *Mesoplodon* beaked whale sightings based on aerial and shipboard surveys off California, Oregon and Washington, 1991-~~2001~~2005 (see Appendix 2 for data sources and information on timing and location of survey effort). Key: • = *Mesoplodon* spp.; filled triangles = probable and identified *Mesoplodon densirostris*; + = probable *Mesoplodon carlhubbsi*. Dashed line represents the U.S. EEZ, ~~thick~~ thin lines indicates ~~the outer boundary~~ completed transect effort of all surveys combined.

POPULATION SIZE

Although mesoplodont beaked whales have been sighted along the U.S. west coast on several line transect surveys utilizing both aerial and shipboard platforms, 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) and 2005 (Forney 2007), 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~~ 5 sightings of *Mesoplodon* made during ~~the 1996 and 2001~~ 2001- 2005 surveys~~, none~~ two were ~~could be~~ identified to the 'probable' species level (one *Mesoplodon densirostris* and one *Mesoplodon carlhubbsi*; both seen in 2005). The current estimate of Blainville's beaked abundance is based on this one probable sighting, while the Hubb's beaked whale sighting was not recorded during standard survey effort, and thus, there is no estimate of abundance. ~~Thus, an updated estimate of Blainville's beaked whale abundance is unavailable.~~ An updated estimate of abundance for unidentified mesoplodont beaked whales is also presented, based on ~~1996~~-2001-2005 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 abundance of Blainville's beaked whales for California, Oregon, and Washington, based on the geometric mean of 2001-2005 surveys is 603 (CV=1.16). The ~~1996-2001~~ ~~weighted average~~ abundance estimates for mesoplodont beaked whales of unknown species, based on the same 2001-2005 surveys is 421 (CV=0.88). ~~California, Oregon and Washington waters based on the above analyses are 1,247 (CV=0.92) mesoplodont beaked whales of unknown species.~~ The combined estimate of abundance for all species of *Mesoplodon* beaked whales in California, Oregon, and Washington waters out to 300 nmi is 1,024 (CV=0.77) animals.

Minimum Population Estimate

~~Based on the abundance estimate of 1,247 (CV=0.92), t~~ 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~~ 576 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~~ 576) 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~~ 5.7 mesoplodont beaked whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

There have been no recent observed mortalities of mesoplodont beaked whales in the drift gillnet fishery for swordfish and thresher shark (Table 1). Between 1990-95, there were a total of five Hubb's beaked whales, one Stegneger's beaked whale, two unidentified mesoplodont beaked whales, and three unidentified beaked whales killed in this fishery (Julian and Beeson 1998). Since 1996, there have been no mesoplodont beaked whales observed entangled or killed (Carretta et al. 2005), which coincides with the introduction and use of acoustic pingers into this fishery (Barlow and Cameron 2003). 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~~ 2000-2004 (~~Cameron and Forney 1999, 2000; Carretta 2001, 2002~~ Carretta and Chivers 2004, Carretta et al. 2005a, 2005b). 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~~ 2000-2004 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).

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~~ 2000-2004 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~~	~~23.0%~~ ~~20.0%~~ ~~20.0%~~ ~~22.9%~~ ~~20.4%~~	~~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~~	~~23.0%~~ ~~20.0%~~ ~~20.0%~~ ~~22.9%~~ ~~20.4%~~	~~23.0%~~ ~~20.0%~~ ~~20.0%~~ ~~22.9%~~ ~~20.4%~~	~~0~~ ~~0~~ ~~0~~ ~~0~~ ~~0~~	~~0~~ ~~0~~ ~~0~~ ~~0~~ ~~0~~	~~0~~
	~~Unidentified~~ All mesoplodont beaked whales (~~probably~~ *Mesoplodon* spp.)					
	~~observer data~~ 2000 2001 2002 2003 2004	~~23.0%~~ ~~20.0%~~ ~~20.0%~~ 22.9% 20.4% 22.1% 20.2% 20.6%	~~23.0%~~ ~~20.0%~~ ~~20.0%~~ 22.9% 20.4% 22.1% 20.2% 20.6%	~~0~~ ~~0~~ ~~0~~ 0 0 0 0 0	~~0~~ ~~0~~ ~~0~~ 0 0 0 0 0	0
Minimum total annual takes of *Mesoplodon* beaked whales						0

Other mortality

Additional, unknown levels of injuries and mortalities of mesoplodont beaked whales may occur as a result of anthropogenic ~~noise~~ sound, 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).

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~~ 2000-2004 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~~ 05/08/2007

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.

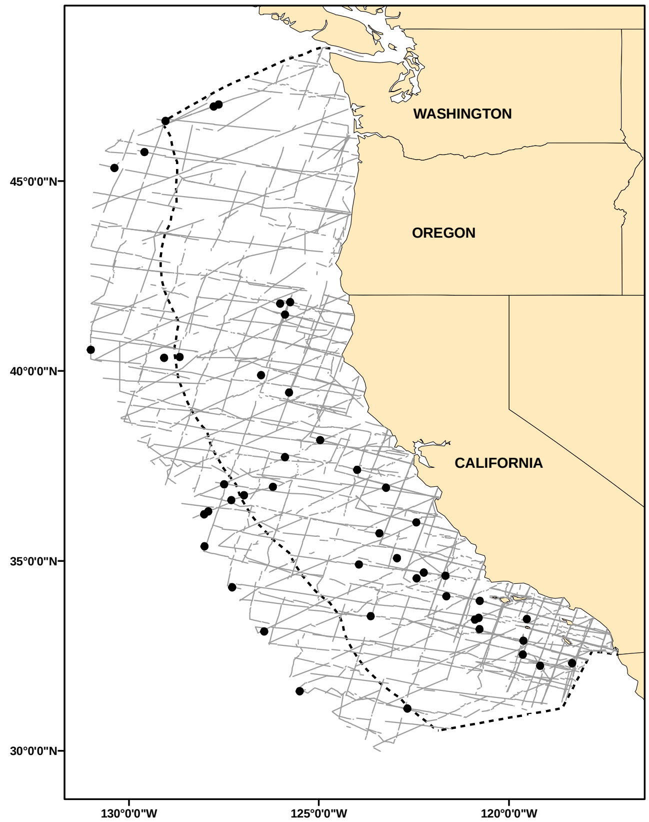

Figure 1. Cuvier's beaked whale sightings based on aerial and shipboard surveys off California, Oregon and Washington, 1991-~~2001~~2005 (see Appendix 2, for data sources and information on timing and location of survey effort). Dashed line represents the U.S. EEZ, ~~thick~~ thin lines indicate~~s the outer boundary~~ completed transect effort of all surveys combined.

POPULATION SIZE

Although Cuvier's beaked whales have been sighted along the U.S. west coast on several line transect surveys utilizing both aerial and shipboard platforms, 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) and 2005 (Forney 2007), 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~~ 2001-2005 ~~weighted average~~ geometric mean abundance estimate for California, Oregon and Washington waters based on the above analyses is ~~1,884~~ 2,171 (CV=~~0.68~~ 0.75) 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~~ 1,234 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~~ 1,234) <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~~ 0.40 (for a species of unknown status with ~~no known recent~~ an unknown fishery mortality CV; Wade and Angliss 1997), resulting in a PBR of ~~11~~ 10 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~~ 2000-2004 (~~Julian 1997; Cameron and Forney 1999, 2000;~~ ~~Carretta 2001, 2002~~ Carretta and Chivers 2004, Carretta et al. 2005a, 2005b). 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.~~ There have been no Cuvier's beaked whales observed entangled in ~~the~~ over 4,000 drift gillnet fishery sets since pingers were first used in this fishery in 1996 ~~1995~~. Prior ~~to the most recent 5-year period~~ to 1996, there were a total of 21 Cuvier's beaked whales entangled in ~~the~~ approximately 3,300 drift gillnet fishery sets: 1992 (six animals), 1993 (three), 1994 (six) and 1995 (six). A dead stranded Cuvier's beaked whale in 2001 died as the result of an interaction with an unknown entangling net fishery (NMFS, Northwest Regional Office, unpublished stranding data, Brent Norberg, pers. comm.; Jim Rice, Oregon State University, pers. comm.). Mean annual takes in Table 1 are based only on ~~1997-2001~~ 2000-2004 data. This results in an average estimated annual mortality of ~~zero~~ 0.2 Cuvier's beaked 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).

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~~ 2000-2004 data unless noted otherwise. n/a = not available.

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 2002 2003 2004	~~23.0%~~ ~~20.0%~~ ~~20.0%~~ 22.9% 20.4% 22.1% 20.2% 20.6%	0 0 0 0 0	0 0 0 0 0	0
Unknown fishery	Stranding	2000-2004	n/a	1	≥1 (n/a)	≥0.2 (n/a)
Minimum total annual takes						≥0.2 (n/a)

Other mortality

Additional, unknown levels of injuries and mortalities of Cuvier's beaked whales may occur as a result of anthropogenic ~~noise~~ sound, 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~~ 2000-2004 is ~~zero~~ 0.2. Because recent human-caused mortality is ~~zero~~ less than the PBR of 10 animals, Cuvier's beaked whales are not classified as a "strategic" stock under the MMPA.~~, and t~~The total fishery mortality and serious injury for this stock is less than 10% of the PBR and thus can be considered to be insignificant and approaching zero.

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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~~ reflects~~ion~~ ~~of~~ their pelagic distribution, small body size and cryptic behavior, rather than a measure of rarity ~~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.

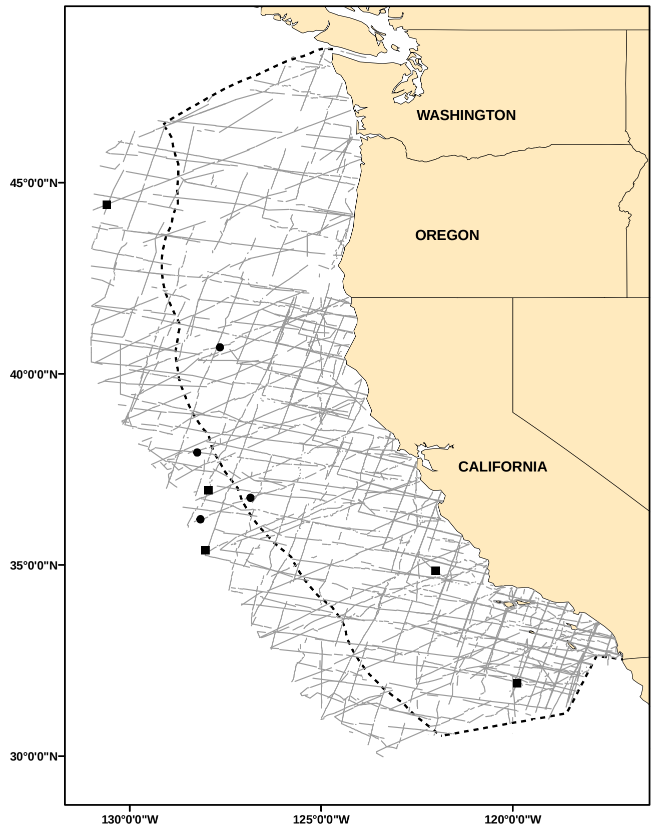

Figure 1. *Kogia* sightings based on aerial and shipboard surveys off California, Oregon and Washington, 1991-~~2001~~2005 (see Appendix 2 for data sources and information on timing and location of survey effort). Key: ■ = *Kogia breviceps*, ● = *Kogia* spp. Dashed line represents the U.S. EEZ, ~~thick~~ thin lines indicates ~~the outer boundary~~ completed transect effort 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)~~ estimates of 247 (CV = 1.06) pygmy sperm whales were based on pooled 1996-2001 ship surveys of California, Oregon, and Washington waters, where there were only two sightings (both in 1996) that could be identified to the genus *Kogia*. (Barlow 2003). Based on previous sighting surveys and historical stranding data, it is likely that these sightings were of pygmy sperm whales; *K. breviceps*. The 1996-2001 pooled estimate incorporates a correction factor ~~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. Because no sightings of pygmy sperm whales have been recorded during the two most recent ship surveys conducted in 2001 (Barlow 2003) and 2005 (Forney 2007), there is no current estimate of abundance available. The lack of recent sightings likely reflects the cryptic nature of this species (they are detected almost exclusively in extremely calm sea conditions), rather than an absence of animals in the region. ~~The 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.~~ No current information on abundance is available to obtain a minimum population estimate for pygmy sperm 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.

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

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

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~~ 2000-2004 (~~Cameron and Forney 1999, 2000; Carretta 2001, 2002~~ Carretta and Chivers 2004, Carretta et al. 2005a, 2005b). 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~~ 2000-2004 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

One pygmy sperm whale stranded in California in 2002 with evidence that it died as a result of a shooting (positive metal detector scan). This results in an average annual human-caused mortality of 0.2 pygmy sperm whales per year. Additional, unknown levels of injuries and mortalities of pygmy sperm whales may occur as a result of anthropogenic ~~noise~~ sound, 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~~ The average annual human-caused mortality for 2000-2004 is ~~zero~~ 0.2 animals, based on one stranded animal in 2002 that had evidence of gunshot wounds. A PBR cannot be calculated for this stock because there have been no sightings of pygmy sperm whales from the two most recent ship line transect surveys conducted in 2001 and 2005 (Barlow 2003, Forney 2007). The lack of recent sightings is probably due to a combination of rough sea conditions during these two cruises and the cryptic nature of this species. Previous estimates of PBR for this stock have ranged between 1 and 28 pygmy sperm whales (Barlow et al. 1995, Barlow et al. 1997, Forney et al. 2000, Carretta et al. 2003). ~~Because~~ ~~r~~ Recent fishery 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. Given the range of PBRs for this stock in previous years, the lack observed fishery mortality, and lack of recent information on population size, pygmy sperm whales are not classified as a “strategic” stock under the MMPA.

Table 1. Summary of available information on the incidental mortality and injury of pygmy sperm whales and unidentified *Kogia* sp. (California/Oregon/Washington Stock) in commercial fisheries that might take this species. Coefficients of variation for mortality estimates are provided in parentheses. Mean annual takes are based on ~~1997-2001~~ 2000-2004 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 2002 2003 2004	~~23.0%~~ ~~20.0%~~ ~~20.0%~~ 22.9% 20.4% 22.1% 20.2% 20.6%	~~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 / 0 0 / 0	0
Minimum total annual takes						0

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Revised ~~12/15/2003~~ 05/08/2007

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.

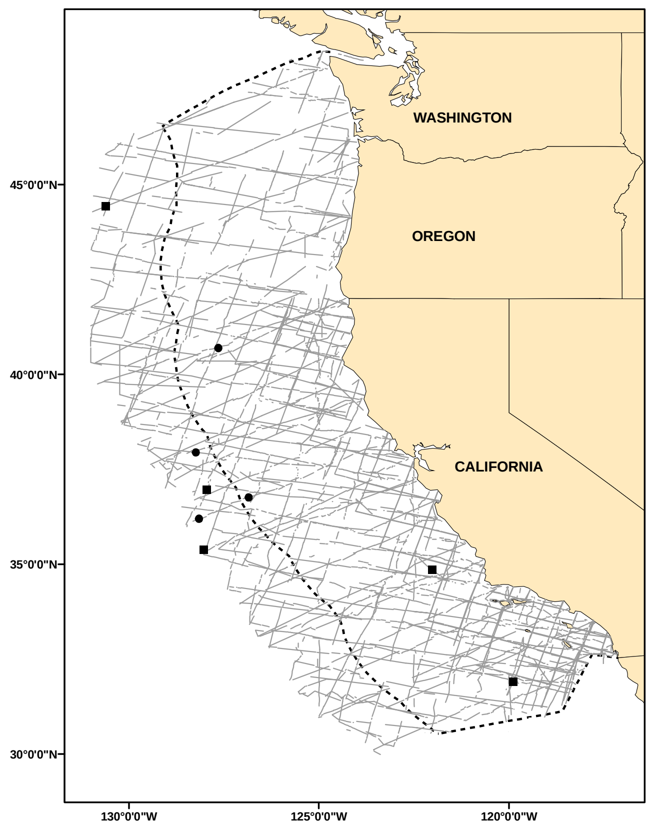

Figure 1. *Kogia* sightings based on aerial and shipboard surveys off California, Oregon and Washington, 1991- 2001 (see Appendix 2 for data sources and information on timing and location of survey effort). Key: ■ = *Kogia breviceps*; • = *Kogia* spp. Dashed line represents the U.S. EEZ, ~~thick~~ thin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

POPULATION SIZE

No information is available to estimate the population size of dwarf sperm whales off the U.S. west coast, as no sightings of this species have been documented despite numerous vessel surveys of this region (Barlow 1995; Barlow and Gerrodette 1996; Barlow 2003; Forney 2007). 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~~ 2000-2004 (~~Cameron and Forney 1999, 2000;~~ ~~Carretta 2001, 2002~~ Carretta and Chivers 2004, Carretta et al. 2005a, 2005b). 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~~ 2000-2004 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).

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.

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~~ 2000-2004 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 2002 2003 2004	~~23.0%~~ ~~20.0%~~ ~~20.0%~~ 22.9% 20.4% 22.1% 20.2% 20.6%	~~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 / 0 0 / 0	0
Minimum total annual takes						0

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Revised ~~12/15/2003~~05/08/2007

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~~ 2005). 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

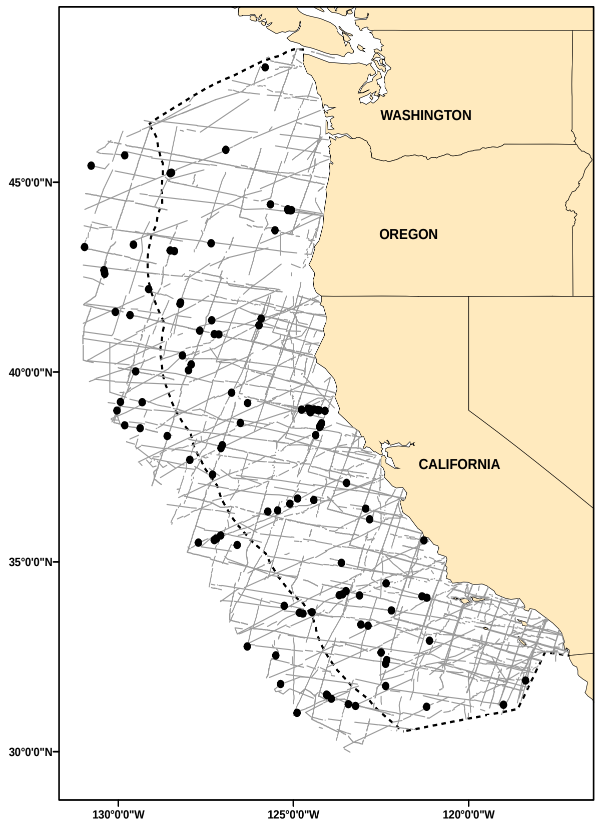

Figure 1. Sperm whale sighting locations based on aerial and shipboard surveys off California, Oregon, and Washington, 1991-~~2001~~2005. Dashed line represents the U.S. EEZ, ~~thick~~ thin lines indicate~~s~~ ~~the outer boundary~~ completed transect effort of all surveys combined. ~~Greater effort 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.

and that genetic differences appeared larger in an east-west direction than in a north-south direction (Mesnick et al. 1999).

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 within 300 nmi of the coast in 1993 and 1996 and 1,634 (CV=0.57) from a survey of the same area in 2001 (Barlow 2003). ~~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.~~ A 2005 survey of this area resulted in an abundance estimate of 3,140 (CV=0.40) (Forney 2007). The most recent ~~abundance~~ estimate of abundance for this stock is the geometric mean of the 2001 and 2005 summer/autumn ship survey estimates, or 2,265 (CV=0.34) sperm whales. ~~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~~ 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)~~ 26,300 (CV=0.81) sperm whales based on visual sightings, and ~~39,200 (CV=0.60)~~ 32,100 (CV=0.36) based acoustic detections and visual group size estimates (Barlow and Taylor ~~1998~~ 2005). 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 2,265 animals (CV=0.34) from the ship surveys conducted in ~~1996 and~~ 2001 (Barlow 2003) and 2005 (Forney 2007).

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~~ 2001-2005 summer/fall ship surveys off California, Oregon and Washington (Barlow 2003; Forney 2007) or approximately ~~885~~ 1,719. 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~~ 1,719) 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), resulting in a PBR of ~~1.8~~ 3.4.

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~~ 2000-2004 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. One sperm whale stranded dead in 2004 with 5 to 6-inch mesh nylon netting found in its stomach (NMFS Southwest Regional Office, unpublished data). The fishery source of this netting is unknown. Mean annual takes for this fishery (Table 1) are based on ~~1997-2001~~2000-2004 data. This results in an average estimate of ~~1.0 (CV = 0.89)~~ 0.2 (CV = not available) 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~~ Carretta and Chivers 2004, Carretta et al. 2005a, 2005b). ~~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~~2000-2004 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 2002 2003 2004	Observer data	~~23.0%~~ ~~20.0%~~ ~~20.0%~~ 22.9% 20.4% 22.1% 20.2% 20.6%	~~0~~ ~~1~~ ~~0~~ 0 0 0 0 0	~~0~~ ~~5 (0.89)~~ ~~0~~ 0 0 0 0 0	~~1 (0.89)~~ 0 (n/a)
Unknown fishery	2000-2004	stranding	n/a	1	≥1	≥0.2
Total annual takes						~~1 (0.89)~~ ≥0.2 (n/a)

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~~2000-2004.

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~~ 0.2 per year) is less than the calculated PBR for this stock (~~1.8~~ 3.4). Total fishery takes may not be approaching zero mortality and serious injury rate. ~~The i~~Increasing levels of anthropogenic ~~noise~~ sound in the world's oceans has been suggested to be a habitat concern for whales, particularly for deep-diving whales like sperm whales that feed in the ocean's "sound channel".

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HUMPBACK WHALE (*Megaptera novaeangliae*): ~~Eastern North Pacific Stock~~ California/Oregon/Washington 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).~~

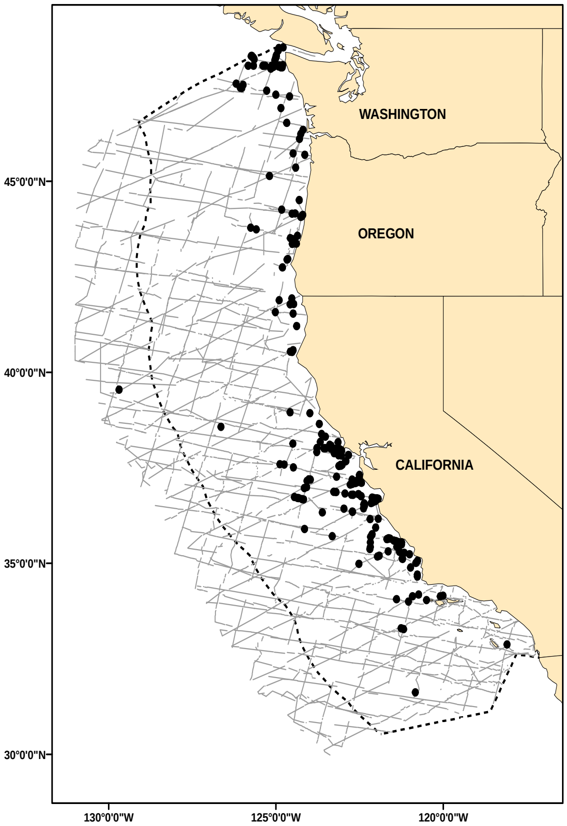

Figure 1. Humpback whale sightings based on shipboard surveys off California, Oregon, and Washington, 1991-~~2001~~ 2005. Dashed line represents the U.S. EEZ, ~~thick line indicates the outer boundary~~ thin lines indicate completed transect effort of all surveys combined. See Appendix 2 for data sources and information on timing and location of survey effort.

~~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.~~ Humpback whales in the North Pacific feed in coastal waters from California to Russia and in the Bering Sea. They migrate south to wintering destinations off Mexico, Central America, Hawaii, southern Japan, and the Philippines. Mitochondrial and nuclear genetic markers show that considerable structure exists in humpback whale populations in the North Pacific (Baker et al. 1998). Significant levels of mitochondrial and nuclear genetic differences were found between central California and Southeast Alaska feeding areas (Baker et al. 1998). Mitochondrial genetic differences are also found between feeding area in the Atlantic (Palsboll et al. 1995). 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). Individually identified whales have been found to move between winter breeding areas in 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. Waters off northern Washington may be an area of mixing between the California/Oregon/Washington stock and a southern British Columbia stock. For humpback whales, maternally directed fidelity to specific feeding areas within an ocean basin appears to be so strong that genetic differences have evolved in both the Atlantic, where there is a single breeding area, and in the Pacific, where there are multiple breeding areas. Because fidelity appears to be greater in feeding areas than in breeding areas, the stock structure of humpback whales is defined based on feeding areas.

For the Marine Mammal Protection Act (MMPA) stock assessment reports, the California/Oregon/Washington Stock is defined to include humpback whales that feed off the west coast of the United States. The winter migratory destination of this stock is primarily in coastal waters of Mexico and Central America. Two other stocks are recognized in the U.S. MMPA stock assessment reports: the Central North Pacific Stock (with feeding areas from Southeast Alaska to the Alaska Peninsula) and the Western North Pacific Stock (with feeding areas from the Aleutian Islands, the Bering Sea, and Russia).

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)~~ 1,109 (CV=0.36) humpbacks in California, Oregon, and Washington waters based on summer/fall ship line-transect surveys in ~~1996 and~~ 2001. Forney (2007) estimated 1,769 (CV=0.16) humpbacks in the same region based on a 2005 summer/fall ship line-transect survey. 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".~~ The combined 2001-2005 line transect estimate of 1,401 (CV=0.19) is more precise than recent mark-recapture estimates and represents the most recent abundance information for this stock of humpback whales. The best estimate of abundance is the unweighted geometric mean of 2002/2003 mark-recapture and 2001-2005 line transect estimates, or 1,396 (CV=0.15) whales.

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)~~ the unweighted mean estimate or approximately ~~1,158~~ 1,236.

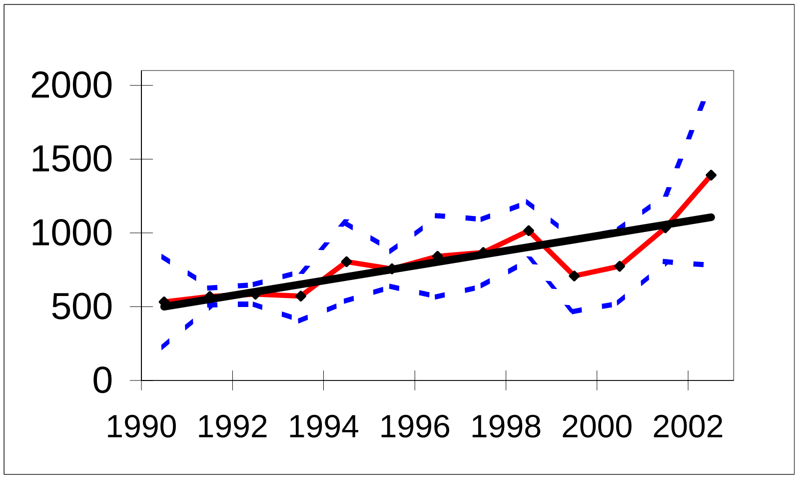

Figure 2. Mark-recapture estimates of the abundance of humpback whales feeding off California, Oregon, and Washington based on photo-identification studies (Calambokidis et al. 2004). Dotted lines indicate +/- 2 standard errors for each estimate. Straight, bold line indicates linear regression.

Current 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).~~and 2005 (Barlow 2003; Forney 2007), but this increase was not steady, and estimates showed a slight dip in 2001. Mark-recapture population estimates increased steadily from 1988/90 to 1997-98 at about 8% per year (Calambokidis et al. 1999), showed a decrease around 1999-2001, and then increased again in 2002-2003 (Figure 2, Calambokidis et al. 2004) The observed decrease in abundance between 1999-2001 may have been related to prevailing oceanographic conditions off the U.S. west coast. 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.

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~~ 1,236) 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~~ N_{min} < 1,500), resulting in a PBR of ~~4.6~~ 4.9. Because this stock spends approximately half its time outside the U.S. EEZ, the PBR allocation for U.S. waters is ~~2.3~~ 2.5 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 for 2000-2004 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~~ 2000-2004 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. Other unobserved fisheries may also result in injuries or deaths of humpback whales. During the period ~~1999-2003~~ 2000-2004, there were nine humpbacks observed entangled with line, buoys, and/or trap pot gear. Some of these animals were females with calves. ~~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 1999, 2000;~~ Carretta and Chivers ~~2001; 2002~~ 2004, Carretta et al. 2005a, 2005b). 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~~ 2000-2004 data unless noted otherwise.

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed Mortality (and injury)	Estimated mortality	Mean Annual Takes
CA/OR thresher shark/swordfish drift gillnet fishery	~~1999~~ 2000 2001 2002 2003 2004	Observer data	~~20.0%~~ 22.9% 20.4% 20.0% 20.3% 20.6%	~~0~~ 0 0 0 0 0	Mortality 0,0,0,0,0 Injury 0,0,0,0,0	Mortality 0 Injury 0
CA angel shark/halibut and other species large mesh (>3.5") set gillnet fishery	1990-94 ~~1999~~ ~~2000~~ 2001 2002 2003 2004 2005	 ~~Observer~~ ~~Data~~ No fishery-wide observer program since 1994	10-15% ~~23.1%[2]~~ ~~26.9%[2]~~ 0% 0% 0% 0% 0%	0,0,0,0,0 ~~0[2]~~ ~~0[2]~~ ~~0[1]~~ n/a ~~0[1]~~ n/a ~~0[1]~~ n/a n/a n/a	0,0,0,0,0 ~~0[2]~~ ~~0[2]~~ ~~0[1]~~ n/a ~~0[1]~~ n/a ~~0[1]~~ n/a n/a n/a	~~0[1]~~ n/a
Unidentified fisheries	~~1999-2003~~ 2000-2004	Strandings& sightings	n/a	0 ~~(6)~~ (9)	n/a	> ~~1.2~~ 1.8
Total Annual Takes						> ~~1.2~~ 1.8

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, Southwest Regional Office, unpubl. data). During ~~1999-2003~~ 2000-2004, there were an additional ~~5~~ five injuries and ~~2~~ three 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~~ 2000-2004 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~~ 2000-2004.

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).~~ As a result of commercial whaling, humpback whales ~~are~~ were formally listed as "endangered" under the Endangered Species Act (ESA) in 1973. The species is still listed as "endangered", 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~~ 1.8/yr), other anthropogenic sources (0.2/yr), plus ship strikes (0.2/yr) in California is less than the PBR allocation of ~~2.3~~ 2.5 for U.S. waters. The ~~three~~ nine humpbacks that were entangled at sea may have been seriously injured. Based on strandings and ~~gillnet~~ at sea observations, annual humpback whale mortality and serious injury in ~~California's~~ ~~drift gillnet~~ commercial fisheries~~y~~ ~~is probably~~ may be 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.

Habitat Concerns

~~The i~~Increasing levels of anthropogenic ~~noise~~ sound in the world's oceans (Andrew et al. 2002), such as those produced by shipping traffic, 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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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° 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 feed 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.~~ Blue whales in the North Pacific produce two distinct, stereotypic calls that have been termed the northwestern and northeastern call types, and it has been proposed that these represent two distinct populations with some degree of geographic overlap (Stafford et al. 2001). The northeastern call predominates in the Gulf of Alaska, the U.S. West Coast, and the eastern tropical Pacific, and the northwestern call predominates from south of the Aleutian Islands to the Kamchatka Peninsula in Russia (Stafford et al. 2001). Both call types are represented in lower latitudes in the central North Pacific but differ in their seasonal patterns (Stafford et al. 2001). Gilpatrick and Perryman (in press) showed that blue whales from California to Central America are on average about two meters shorter than blue whales from the central and western north Pacific regions. Mate et al. (1999) used satellite tags to show that the eastern tropical Pacific is a migratory destination for blue whales that were tagged off southern California, and photographs of blue whales on the Costa Rica Dome in the eastern tropical Pacific have matched individuals that had been previously photographed off California (Calambokidis, pers. comm.). Photographs of blue whales in California have also been matched to individuals photographed off the Queen Charlotte Islands in

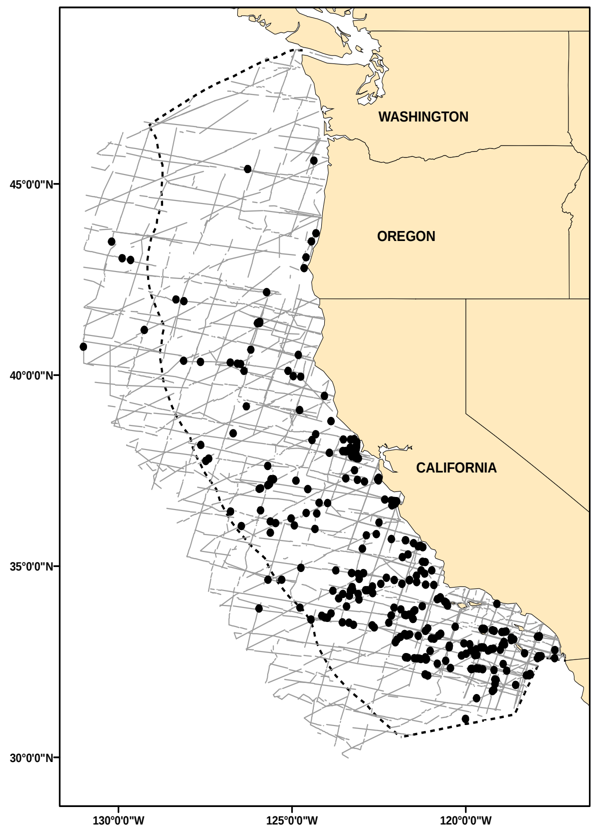

Figure 1. Blue whale sighting locations based on aerial and summer/autumn shipboard surveys off California, Oregon, and Washington, 1991-~~2001~~ 2005 (see Appendix 2 for data sources and information on timing and location of surveys). Dashed line represents the U.S. EEZ; ~~bold line~~ thin lines ~~indicates the outer boundary~~ represent completed transect effort for ~~of~~ all surveys combined.

northern British Columbia (Calambokidis, pers. comm.) and to one individual photographed in the northern Gulf of Alaska (Calambokidis and Barlow, pers. comm.).

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

POPULATION SIZE

The size of the feeding stock of blue whales ~~in California~~ off the U.S. West Coast was estimated recently by both line-transect and mark-recapture methods. Barlow (2003) estimated ~~1,736 (CV=0.23)~~ 888 (CV = 0.40) blue whales off California, Oregon, and Washington based on ship line-transect surveys in ~~1996 and~~ 2001 and Forney (2007), estimated 721 (CV=0.27) from a 2005 line-transect survey of the same area. The unweighted geometric mean of the 2001 and 2005 line transect estimates is 800 (CV=0.24) whales. 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 is ~~(~~1,760 (CV=0.32) whales. ~~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~~ outside of the study area at the time of survey ~~(Wade and Gerrodette 1993)~~(Calambokidis and Barlow 2004). The best estimate of blue whale abundance is the unweighted geometric mean ~~average~~ of the line-transect and mark-recapture estimates, ~~weighted by the inverse of their variances,~~ or ~~1,744 (0.28)~~ 1,186 (0.19).

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~~ 1,005.

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 in 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 IWC protected status in 1966, there is no evidence showing that the eastern North Pacific stock is currently growing. ~~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.~~ Estimates from line transect surveys declined between 1991-2005 (Figure 2), which is probably due to interannual variability in the fraction of the population that utilizes California waters during the summer and autumn.

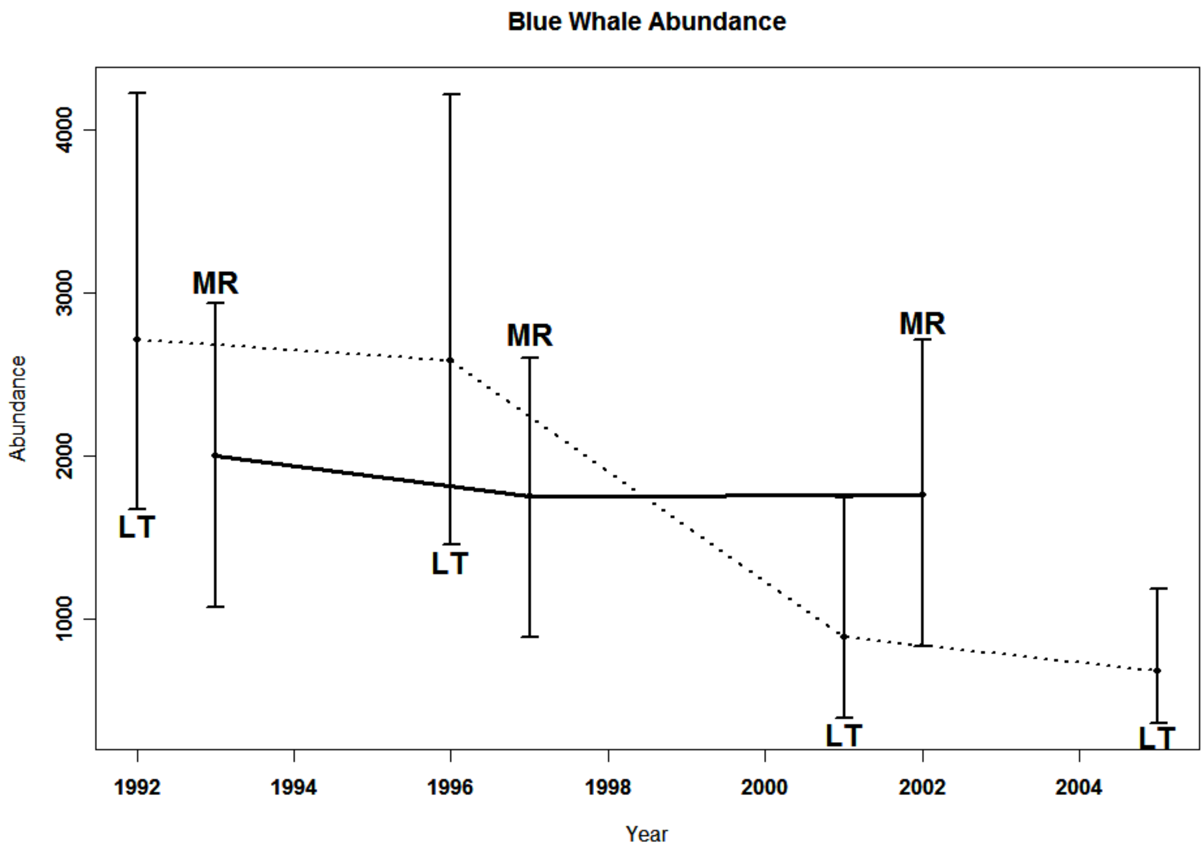

Figure 2. Estimates of abundance from vessel-based line transect (LT) and mark-recapture (MR) surveys conducted in California waters, 1991-~~2001~~2005 (Barlow 2003; Calambokidis et al. 2003; Calambokidis and Barlow 2004; Forney 2007). The four line transect estimates are based on one 1991-93 pooled estimate and three annual surveys conducted in 1996, 2001, and 2005, respectively. The three mark-recapture estimates are based on 1991-93, 1995-97, and 2000-02 pooled estimates, respectively.

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~~ 1,005) 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 which has a minimum abundance less than 1,500), resulting in a PBR of ~~2.8~~ 2.0. 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~~ 1.0 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). Additional blues were killed during this period from land-stations in British Columbia. Blue whales in the North Pacific were given protected status by the IWC in 1966, but Doroshenko (2000) reported that a small number of blue whale were taken illegally by soviet whalers after that date.

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~~ 2000-2004 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 and Chivers ~~2001; 2002~~ 2004, Carretta et al. 2005a, 2005b ~~Carretta and Chivers 2003~~). Mean annual takes are based on ~~1998-2002~~ 2000-2004 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~~ ~~1999~~ 2000 2001 2002 2003 2004	Observer data	~~20.0%~~ ~~20.0%~~ 22.9% 20.4% 20.0% 20.2% 20.6%	~~0~~ ~~0~~ 0 0 0 0 0	~~0~~ ~~0~~ 0 0 0 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 and 2004 (J. Cordaro, Southwest Region, NMFS and J. Heyning, pers. comm.). In addition, there was one blue whale injured as the result of a ship strike in 2003 (blood observed in the water). During ~~1998-2002~~ 2000-2004, there were an additional ~~5~~ five injuries and ~~2~~ three 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 and injuries in California attributed to ship strikes was ~~0.2~~ 0.6 per year for ~~1998-2002~~ 2000-2004.

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~~ As a result of commercial whaling, blue whales ~~are~~ were formally listed as "endangered" under the Endangered Species Act (ESA) in 1973. They are still listed as "endangered", and consequently the Eastern North Pacific stock is automatically considered as a "depleted" and "strategic" stock under the MMPA. The annual incidental mortality and injury rate (0.6/year) from ship strikes is ~~apparently~~ less than the calculated PBR (1.0) for this stock, but this rate does not include unidentified large whales struck by vessels, some of which may have been blue whales. 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.~~

Habitat Concerns

~~The i~~Increasing levels of anthropogenic ~~noise~~ sound in the world's oceans (Andrew et al. 2002) have ~~has~~ been suggested to be a habitat concern for blue whales (Reeves et al. 1998).

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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).

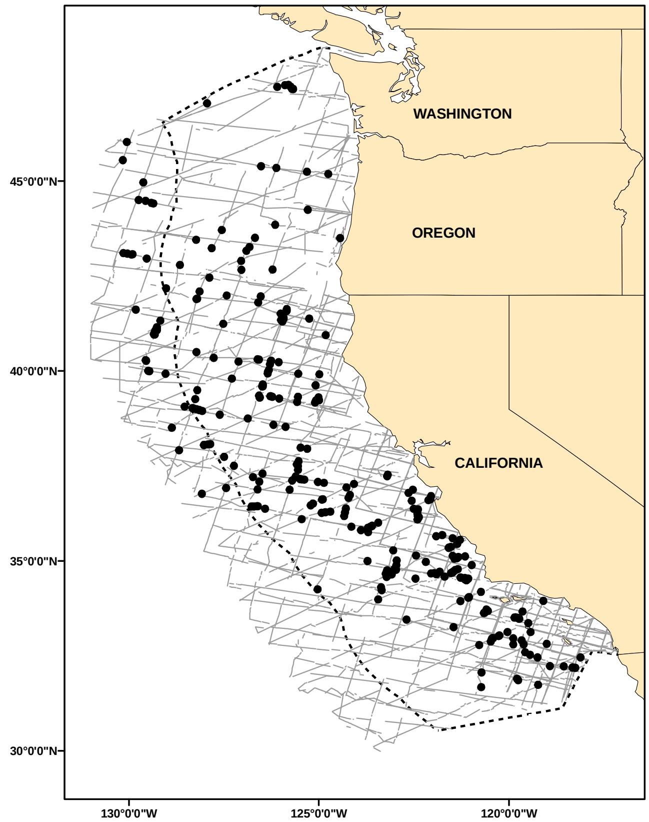

Figure 1. Fin whale sighting locations based on aerial and shipboard surveys off California, Oregon, and Washington, 1991-~~2001~~ 2005 (see Appendix 2 for data sources and information on timing and location of surveys). Dashed line represents the U.S. EEZ; ~~bold~~ thin lines ~~indicates the outer boundary~~ indicate completed transect effort 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). A 2005 ship survey of the same area resulted in an abundance estimate of 3,281 (CV=0.25) fin whales (Forney 2007). The best estimate of fin whale abundance in California, Oregon, and Washington waters out to 300 nmi is the geometric mean of line transect estimates from summer/autumn ship surveys conducted in 2001 (Barlow 2003) and 2005 (Forney 2007), or 3,454 (CV = 0.27) whales. This is probably ~~a slight~~ an 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 and 2005 summer/fall ship surveys (~~Barlow and Taylor 2001;~~ Barlow 2003; Forney 2007) or approximately ~~2,541~~ 2,760.

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. There is no evidence of a population trend from recent line-transect abundance surveys conducted in 1996, 2001, and 2005 in California, Oregon, and Washington waters out to 300 nmi. Estimates from these three surveys have been 2,921 (CV=0.31); 3,636 (CV=0.50); and 3,281 (CV=0.25) whales, respectively (Barlow 2003; Forney 2007).

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~~ 2,760) <u>times</u> one half the default maximum net growth rate for cetaceans (½ of 4%) <u>times</u> 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~~ 16.

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 since 1990 when NMFS began observing the fishery ~~(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~~ 2000-2004 data. This results in an average estimate of ~~1.0~~ zero 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~~ Carretta and Chivers 2004, Carretta et al. 2005a, 2005b).

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 2002 2003 2004	Observer data	~~23.0%~~ ~~20.0%~~ ~~20.0%~~ 22.9% 20.4% 22.1% 20.2% 20.6%	~~0~~ ~~0~~ ~~1~~ 0 0 0 0 0	~~0~~ ~~0~~ ~~5 (0.94)~~ 0 0 0 0 0	~~1 (0.94)~~ 0 (n/a)
Total annual takes						~~1 (0.94)~~ 0 (n/a)

Ship Strikes

Ship strikes were implicated in the deaths of ~~one~~ six fin whales and the injury of another from 2000-2004 ~~in 1997 and 2001 (J. Heyning and J. Cordaro, Southwest Region,~~ NMFS, unpublished stranding data ~~pers. comm.~~). During ~~1997-2001~~ 2000-2004, there were an additional ~~4~~ five injuries and ~~2~~ three 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 and injury due to ship strikes is ~~0.4~~ 1.4 fin whales per year for the period ~~1997-2001~~ 2000-2004.

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~~ zero) and ship strikes (~~0.4/yr~~ 1.4/yr) ~~appears to be~~ is less than the calculated PBR (~~15~~ 16). 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 i~~Increasing levels of anthropogenic ~~noise~~ sound in the world's oceans has been suggested to be a habitat concern for whales, particularly for baleen whales that may communicate using low-frequency sound (Croll *et al.* 2002).

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Revised ~~12/15/2000~~ 05/08/2007

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.

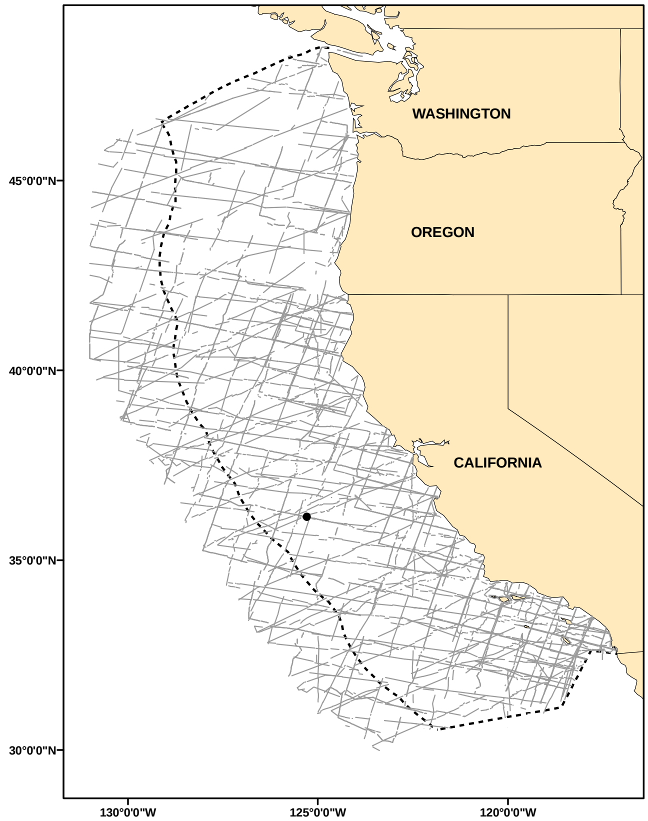

Figure 1. Sighting locations of Bryde's whales based on aerial and shipboard surveys off California, Oregon, and Washington, 1991-~~96~~ 2001 (see Appendix 2, Figures 1-5 for data sources and information on timing and location of surveys). Dashed line represents the U.S. EEZ; ~~bold~~ thin lines indicates ~~the outer boundary~~ completed transect effort 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~~ between 1991 and 2005~~, 1992, 1993, and 1996~~ (Barlow 2003b; Hill and Barlow 1992; Carretta and Forney 1993; Forney 2007; 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).~~ The only sighting of Bryde’s whale in this region occurred during a survey over 10 years ago, thus, there is no current estimate of abundance for California, Oregon, and Washington waters.

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

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock cannot be calculated because 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,~~ collected during line transect ship surveys between 1998 and 2006 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~~ 2000-2004	Observer data	~~12~~20-23%	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 2003a). ~~Because of the changes in this fishery after implementation of the Take Reduction Plan, m~~Mean annual takes for this fishery (Table 1) are based ~~only~~ on ~~1997-98~~ 2000-2004 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.).~~ 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 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. During 2000-2004, there were five injuries and three mortalities of unidentified large whales attributed to ship strikes, but it is unlikely that any of these were Bryde's whales.

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 i~~Increasing levels of anthropogenic ~~noise~~ sound in the world's oceans has been suggested to be a habitat concern for whales, particularly for baleen whales that may communicate using low-frequency sound.

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Revised ~~12/15/2003~~ 05/08/2007

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.

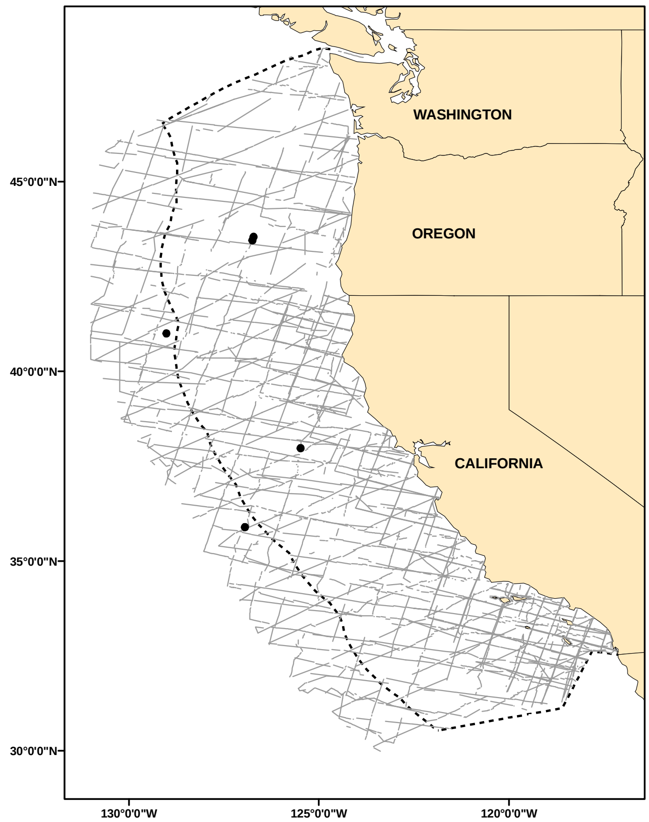

Figure 1. Sei whale sighting locations based on aerial and shipboard surveys off California, Oregon, and Washington, 1991-~~2001~~ 2005 (see Appendix 2 for data sources and information on timing and location of surveys). Dashed line represents the U.S. EEZ; ~~bold~~ thin lines ~~indicates the outer boundary~~ indicate completed transect effort of all surveys combined.

POPULATION SIZE

Ohsumi and Wada (1974) estimate the pre-whaling abundance of sei whales to be 58,000-62,000 in the North Pacific. Later, Tillman (1977) used a variety of different methods to estimate the abundance of sei whales in the North Pacific and revised this pre-whaling estimate to 42,000. His estimates for the year 1974 ranged from 7,260 to 12,620. All methods depend on using the history of catches and trends in CPUE or sighting rates; there have been no direct estimates of sei whale abundance in the entire (or eastern) North Pacific based on sighting surveys. Only ~~two~~ five 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~~ between 1991-2005, ~~1992, 1993, 1996, and 2001~~ (Hill and Barlow 1992; Carretta and Forney 1993; Mangels and Gerrodette 1994; VonSaunder and Barlow 1999; Barlow 2003; Forney 2007). Green et al. (1992) did not report any sightings of sei whales in aerial surveys of Oregon and Washington. Abundance estimates for the two most recent line transect surveys of California, Oregon, and Washington waters out to 300 nmi are 25 (CV=1.01) and 74 (CV=0.88) sei whales, respectively (Barlow 2003, Forney 2007). The best estimate of abundance

~~estimate~~ for California, Oregon, and Washington waters out to 300 nmi ~~, based on~~ ~~1996 and~~ is the unweighted geometric mean of the 2001 and 2005 ~~shipboard surveys~~ estimates, ~~is~~ ~~56~~ or 43 (CV = ~~0.61~~ 0.61) sei whales (Barlow 2003; Forney 2007).

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 and 2005 shipboard line-transect surveys, or approximately ~~35~~ 27.

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~~ 27) 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~~ 0.05.

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~~ 2000-2004 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~~ 2000-2004 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~~ 2000-2004	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~~ One ship strike~~s~~ ~~have been~~ mortality was reported in Washington in 2003 (NMFS Northwest Regional Office, unpublished data). ~~for this species in this area~~. During ~~1997-2001~~ 2000-2004, there were an additional ~~4~~ five injuries and ~~2~~ three 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 0.2 sei whales per year for the period 2000-2004.

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 total incidental mortality due to ship strikes (0.2/yr) is greater than the calculated PBR (0.05). ~~The i~~Increasing levels of anthropogenic ~~noise~~ sound in the world's oceans has been suggested to be a habitat concern for whales, particularly for baleen whales that may communicate using low-frequency sound (Croll *et al.* 2002).

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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°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.

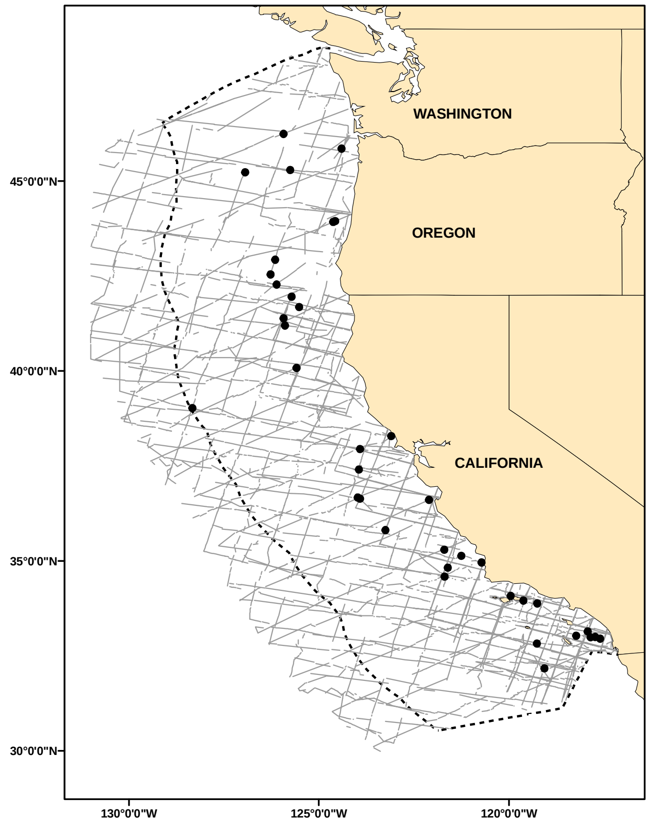

Figure 1. Minke whale sighting locations based on aerial and shipboard surveys off California, Oregon, and Washington, 1991-~~2001~~ 2005 (see Appendix 2 for data sources and information on timing and location of surveys). Dashed line represents the U.S. EEZ; ~~bold~~ thin lines ~~indicates the outer boundary~~ indicate completed transect effort 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 is estimated to be 898 (CV = 0.65), based on ship line transect surveys conducted in summer and autumn of 2001 and 2005 (Barlow 2003; Forney 2007). 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 and 2005 summer/fall ship surveys in California, Oregon, and Washington waters (Barlow 2003; Forney 2007) or approximately ~~585~~ 544.

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~~ 544) 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~~ 5.4.

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~~ 2000-2004 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 2002 2003 2004	Observer data	~~23.0%~~ ~~20.0%~~ ~~20.0%~~ 22.9% 20.4% 22.1% 20.2% 20.6%	~~0~~ ~~0~~ ~~(1)~~ 0 0 0 0 0	~~0~~ ~~0~~ ~~0~~ 0 0 0 0 0	0
WA Puget Sound Region salmon drift gillnet fishery (areas 7 and 7A)	~~1997-~~ ~~2001~~ 2000- 2004	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 2002 2003 2004	~~Extrapolated estimates & observer data~~	~~0%~~ ~~0%~~ ~~4.0%[1]~~ 1.8%[1] 0% 0% 0% 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 for the period 2000-2004. 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~~ 2000-2004 data (Carretta and Chivers 2004, Carretta et al. 2005a, 2005b). 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~~ 2000-2004. 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~~ 5.4), 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 i~~Increasing levels of anthropogenic ~~noise~~ sound in the world's oceans has been suggested to be a habitat concern for whales, particularly for baleen whales that may communicate using low-frequency sound.

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FALSE KILLER WHALE (*Pseudorca crassidens*): Pacific Islands Region Stock Complex - Hawaii & Palmyra Atoll

STOCK DEFINITIONS AND GEOGRAPHIC RANGES

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. There are six stranding records from Hawaiian waters (Nitta 1991; Maldini 2005). One on-effort sighting of false killer whales was made during a 2002 shipboard survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands (Figure 1; Barlow 2006). 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). This species also occurs in U.S. EEZ waters around Palmyra Atoll (Figure 1) and sightings of false killer whales have been recently confirmed within the Johnston Atoll EEZ (NMFS/PIR/PSD unpublished data) and the U.S. EEZ waters of American Samoa (NOS/HIHWNMS unpublished data).

Genetic analyses of tissue samples collected within the Eastern North Pacific (ENP) indicate restricted gene flow between false killer whales sampled near the main Hawaiian Islands and false killer whales sampled in all other regions of the ENP (Chivers et al. 2006). False killer whales sampled at Palmyra Atoll appear more closely related to animals sampled in the waters of the pelagic ENP, Panama and Mexico (Chivers et al. 2006). Thus, false killer whales occurring near Palmyra Atoll may be part of a larger stock covering a broad geographic area within the central and eastern North Pacific.

Since 2003, observers of the Hawaii-based longline fishery have also been collecting tissue samples of caught cetaceans for genetic analysis whenever possible. Four false killer whale samples, two collected outside the Hawaiian EEZ and two collected more than 100 nautical miles from the main Hawaiian Islands (See Figure 3) were determined to have ENP-like haplotypes. This indicates that false killer whales within the Hawaiian EEZ belong to two different genetic populations, with a boundary somewhere within the Hawaiian EEZ. Both genetic types are provisionally included within a single Hawaiian stock for assessment purposes.

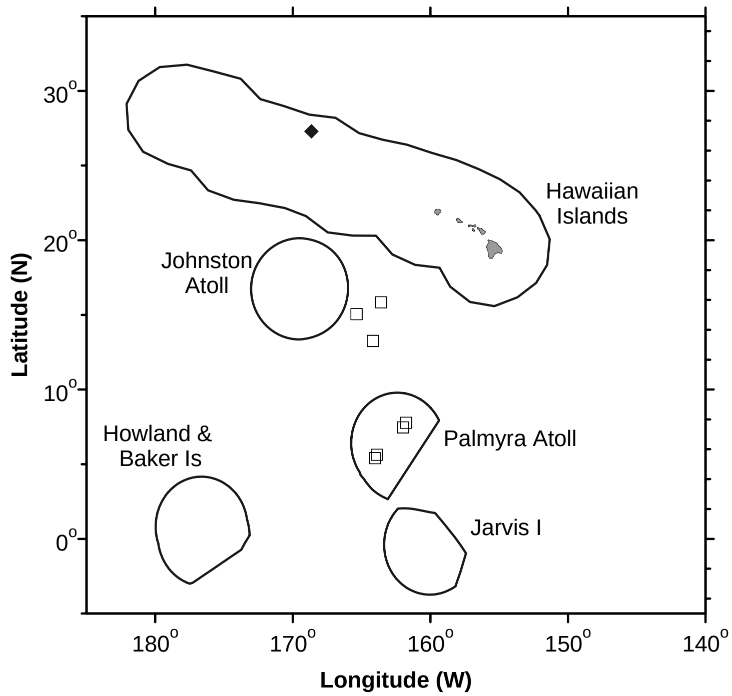

Figure 1. False killer whale sighting locations during standardized shipboard surveys of the Hawaiian U.S. EEZ (2002, black diamond, Barlow 2006), the Palmyra U.S. EEZ (2005, open squares, Barlow and Rankin 2006), and pelagic waters of the central Pacific south of the Hawaiian Islands (2005, open squares, Barlow and Rankin 2006). Outer lines represent approximate boundary of U.S. EEZs.

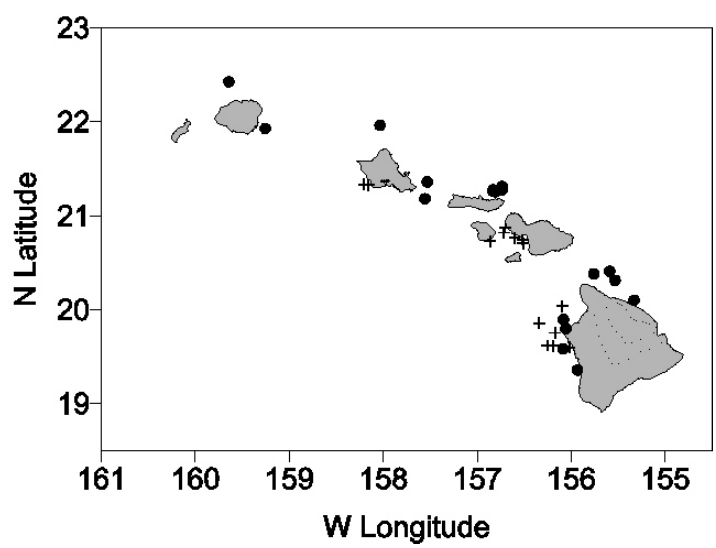

Figure 2. False killer whale sighting locations during 2000-2004 boat-based surveys (+) (Baird et al. 2005) and 1993-2003 aerial surveys (•) (Mobley et al. 2000, Mobley 2001, 2002, 2003, 2004) around the Main Hawaiian Islands. See Appendix 2 for details on timing and location of survey effort.

Efforts are currently underway to obtain and analyze 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 are currently two Pacific Islands Region management stocks: 1) the Hawaii stock, which includes animals found within the U.S. EEZ of the Hawaiian Islands, and 2) the Palmyra Stock, which includes false killer whales found with the U.S. EEZ of Palmyra Atoll. Estimates of abundance, potential biological removal, and status determinations will be presented separately for U.S. EEZ waters of the Hawaiian Islands and Palmyra Atoll.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Interactions with cetaceans have been reported for 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 they have been reported to take large fish (up to 70 pounds) from the trolling lines of both commercial and recreational fishermen (Shallenberger 1981).

Between 1994 and 2005, 20 false killer whales were observed hooked or entangled in the Hawaii-based longline fishery, with approximately 4-34% of all effort observed (Table 1; Forney and Kobayashi 2007). Twelve additional unidentified cetaceans, which may have been false killer whales based on the observer's descriptions, were also taken (hooked or entangled) in this fishery, but were not included in this analysis (Figure 3; Forney and Kobayashi 2007). During 24,542 observed sets, the average interaction rate of false killer whales was 0.81 false killer whales per 1,000 sets. Two of the false killer whales were killed, and all others caught were considered seriously injured, based on an evaluation of the observer's description of the interaction (Forney and Kobayashi 2007) 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 2001-2005 are 7.7 (CV = 0.34) false killer whales outside of U.S. EEZs, 4.9 (CV = 0.41) within the Hawaiian Islands EEZ, and 1.9 (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 6.8 (CV = 0.34) between 2001 and 2005. 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.

Table 1. Summary of available information on incidental mortality and serious injury of false killer whales (Pacific Islands Stock Complex) in commercial fisheries, within and outside of selected U.S. EEZs (Forney and Kobayashi 2007). Mean annual takes are based on 2001-2005 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	2001	observer data	23.0%	2	11 (0.71)	7.7 (0.34)	0	0 (-)	4.9 (0.41)	1	4 (1.00)	1.9 (0.59)
	2002		24.8%	3	12 (0.58)		0	0 (-)		2	5 (0.71)	
	2003		21.9%	0	0 (-)		2	8 (0.68)		0	0 (-)	
	2004		25.4%	3	12 (0.58)		3	12 (0.57)		0	0 (-)	
	2005		34.2%	1	4 (1.00)		1	4 (1.00)		0	0 (-)	
Minimum total annual takes within U.S. EEZ waters							6.8 (0.34)					

HAWAII STOCK

POPULATION SIZE

A recent mark-recapture study of photo-identification data obtained during 2000-2004 around the main Hawaiian Islands produced an estimate of 123 (CV=0.72) false killer whales (Baird et al. 2005). Analyses of a 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ (HICEAS survey) resulted in an abundance estimate of 236 (CV=1.13) false killer whales (Barlow 2006). A recent re-analysis of the HICEAS data using improved methods and incorporating additional sighting information obtained on line-transect surveys south of the Hawaiian EEZ during 2005, resulted in a revised estimate of 484 (CV = 0.93) false killer whales within the Hawaiian Islands EEZ (Barlow & Rankin 2006). This is the best available abundance estimate for false killer whales within the Hawaiian Islands EEZ.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate for the Hawaiian Islands EEZ (Barlow & Rankin 2006) is 249 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 (249) <u>times</u> one half the default maximum net growth rate for cetaceans (½ of 4%) <u>times</u> a recovery factor of 0.48 (for a stock of unknown status with a Hawaiian Islands EEZ mortality and serious injury rate CV between 0.30 and 0.60; Wade and Angliss 1997), resulting in a PBR of 2.4 false killer whales per year.

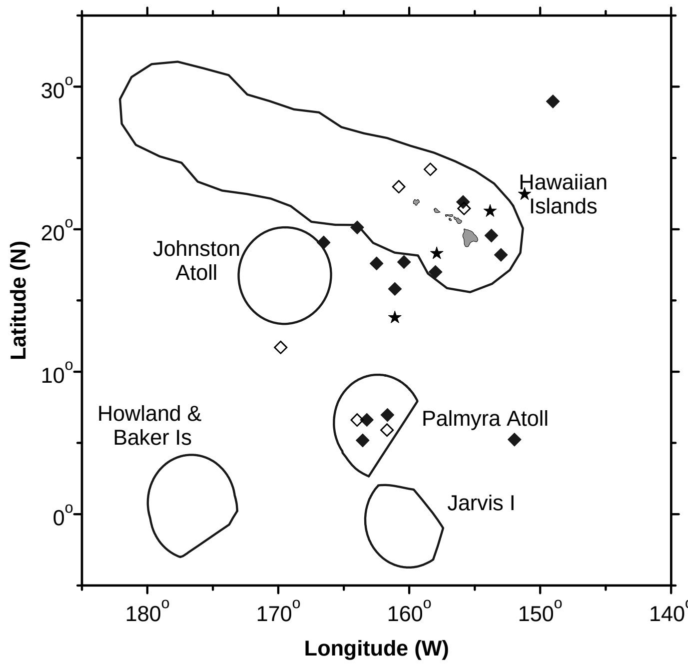

Figure 3. Locations of observed false killer whale takes (filled symbols) and possible takes of this species (open symbols) in the Hawaii-based longline fishery, 1994-2003. Stars are locations of genetic samples from fishery-caught false killer whales. Solid lines represent the U.S. EEZ. Set locations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

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 (4.9 animals per year) exceeds the PBR (2.4), 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. Furthermore, additional injury and mortality of false killer whales is known to occur in longline fishing operations in international waters, and the potential effect on the Hawaiian Islands EEZ stock is unknown.

<u>PALMYRA STOCK</u>

POPULATION SIZE

Recent line transect surveys in the U.S. EEZ waters of Palmyra Atoll produced an estimate of 1,329 (CV = 0.65) false killer whales (Barlow & Rankin 2006). This is the best available abundance estimate for false killer whales within the Palmyra Atoll EEZ.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate for the Palmyra Atoll EEZ (Barlow & Rankin 2006) is 806 false killer whales.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Palmyra Atoll false killer whale stock is calculated as the minimum population size (806) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.48 (for a stock of unknown status with a mortality and serious injury rate CV between 0.30 and 0.60; Wade and Angliss 1997), resulting in a PBR of 7.7 false killer whales per year.

STATUS OF STOCK

The status of false killer whales in Palmyra Atoll EEZ waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this species. They are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The rate of mortality and serious injury to false killer whales within the Palmyra Atoll EEZ in the Hawaii-based longline fishery (1.9 animals per year) does not exceed the PBR (7.7) for this stock and thus, this stock is not considered "strategic" under the 1994 amendments to the MMPA. The total fishery mortality and serious injury for Palmyra Atoll false killer whales is greater than 10% of the PBR and, therefore, cannot be considered to be insignificant and approaching zero. Additional injury and mortality of false killer whales is known to occur in longline fishing operations in international waters, and the potential effect on the Palmyra stock is unknown.

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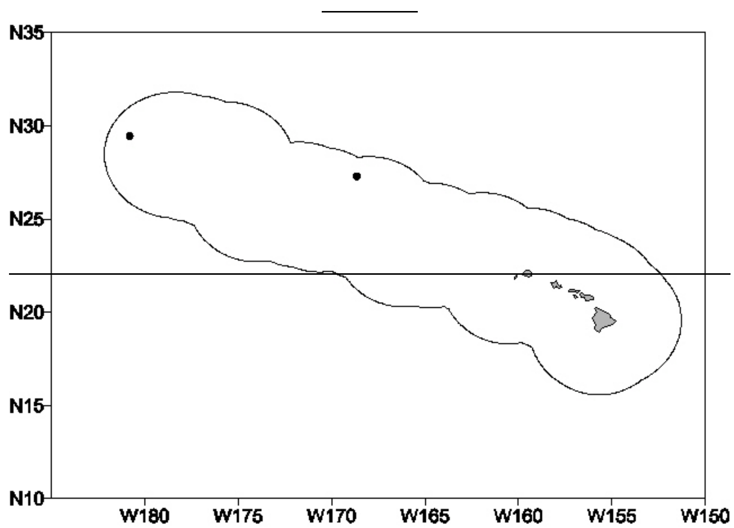
~~FALSE KILLER WHALE (*Pseudorca crassidens*): Hawaiian Stock~~

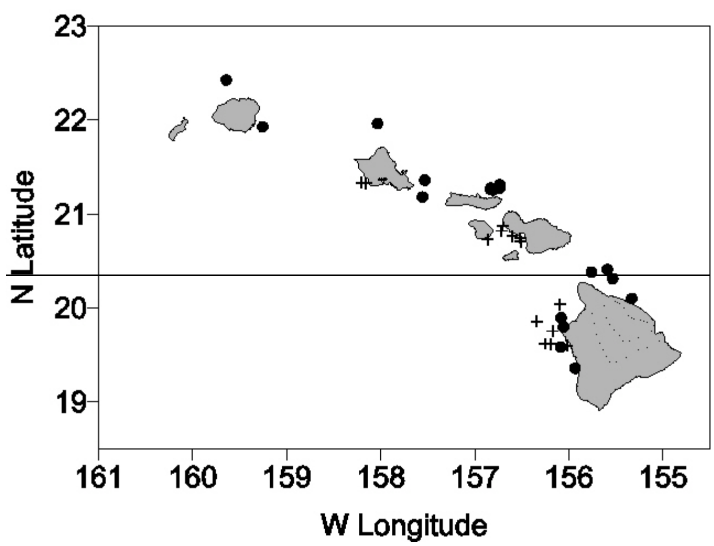
~~STOCK DEFINITION AND GEOGRAPHIC RANGE~~

~~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. 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 2006). 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).~~

~~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. Since 2003, observers in the longline fishery have also been collecting tissue samples of caught cetaceans for genetic analysis whenever possible. Two false killer whale samples, one collected outside the Hawaiian EEZ and one about 120 nmi southwest of Hawaii (See Figure 3) were determined to have eastern tropical Pacific (ETP) haplotypes. This suggests a boundary between the Hawaiian and ETP stocks somewhere within the Hawaiian EEZ. Further samples will be required to resolve this uncertainty.~~



~~**Figure 1.** False killer whale sighting locations during the 2002 shipboard survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006); see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ.~~



~~**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.~~

~~Fishery interactions with false killer whales demonstrate that this species also occurs in U.S. EEZ waters around Palmyra Atoll (Figure 3), 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. The estimate is, however, similar to the mark recapture population estimate of 123 (CV=0.72) obtained during 2000-2004 photo-identification studies around the main Hawaiian Islands (Baird et al. 2005). A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 236 (CV=1.13) false killer whales (Barlow 2006). 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= 1.13) for the U.S. EEZ of the Hawaiian Islands (Barlow 2006); 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 = 352,821 km^2) yields a range of plausible abundance estimates of 37-1,179 false killer whales.~~

~~Minimum Population Estimate~~

~~The log-normal 20th percentile of the 2002 abundance estimate for the Hawaiian Islands EEZ (Barlow 2006) is 109 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 2006, Mobley et al. 2000, Wade and Gerrodette 1993, Ferguson and Barlow 2003; see above) can provide a range of likely values. The lognormal 20th percentiles of plausible abundance estimates for the Palmyra Atoll EEZ, based on the densities observed elsewhere, range from 17-758 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 (109) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.48 (for a stock of unknown status with a Hawaiian Islands EEZ mortality and serious injury rate CV between 0.30 and 0.60; Wade and Angliss 1997), resulting in a PBR of 1.0 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 (17-758), 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 7.3 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 they have been reported to steal large fish (up to 70 pounds) from the trolling lines of both commercial and recreational fishermen (Shallenberger 1981).~~

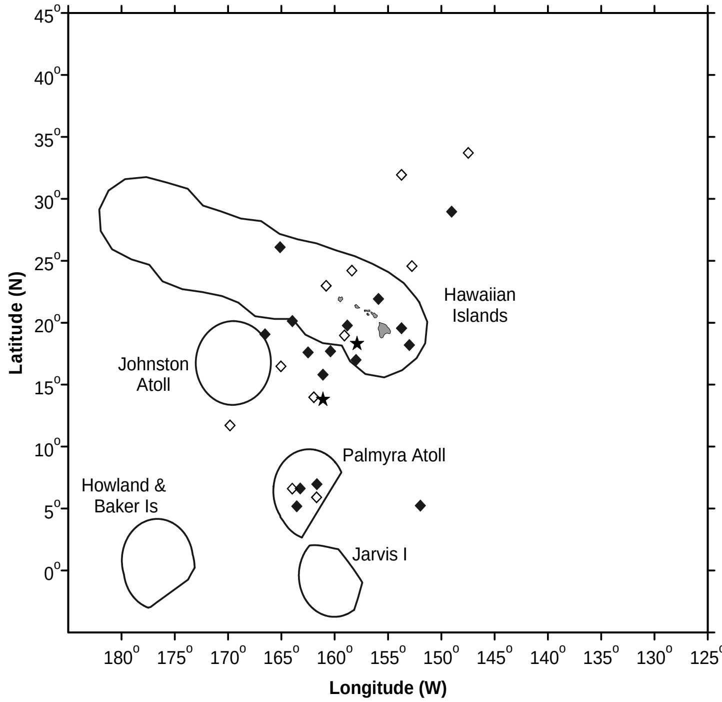


Figure 3. Locations of observed false killer whale takes (filled symbols) and possible takes of this species (open symbols) in the Hawaii-based longline fishery, 1994-2003. Stars are locations of genetic samples from fishery-caught false killer whales. Solid lines represent the U.S. EEZ. Set locations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

~~Between 1994 and 2004, 18 false killer whales were observed hooked and/or entangled in the Hawaii-based longline fishery, with approximately 4-26% of all effort observed (Table 1; Forney and Kobayashi 2005). Eleven additional unidentified cetaceans, which may have been false killer whales based on the observer's descriptions, were also taken (hooked or entangled) in this fishery (Figure 3, Forney and Kobayashi 2005). During 18,353 observed sets, the average interaction rate of false killer whales was~~

~~**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 2000-2004 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**~~	~~2000~~	~~observer data~~	~~11.0%~~	~~0~~	~~0 (-)~~	~~6.8 (0.36)~~	~~0~~	~~0 (-)~~	~~4.2 (0.43)~~	~~0~~	~~0 (-)~~	~~1.8 (0.53)~~
	~~2001~~		~~23.0%~~	~~2~~	~~10 (0.71)~~		~~0~~	~~0 (-)~~		~~1~~	~~4 (1.00)~~	
	~~2002~~		~~24.8%~~	~~3~~	~~12 (0.58)~~		~~0~~	~~1[1] (0.99)~~		~~2~~	~~5 (0.71)~~	
	~~2003~~		~~21.9%~~	~~0~~	~~0 (-)~~		~~2~~	~~8 (0.68)~~		~~0~~	~~0 (-)~~	
	~~2004~~		~~25.7%~~	~~3~~	~~12 (0.58)~~		~~3~~	~~12 (0.57)~~		~~0~~	~~0 (-)~~	
~~**Minimum total annual takes within U.S. EEZ waters**~~							~~6.0 (0.35)~~					

~~[1] See Forney and Kobayashi (2005) for details on the derivation of this estimate.~~

~~0.98 false killer whales per 1,000 sets. One of the false killer whales was killed, and all others 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 2000-2004 are 6.8 (CV = 0.36) false killer whales outside of U.S. EEZs, 4.2 (CV = 0.43) within the Hawaiian Islands EEZ, and 1.8 (CV = 0.53) within the EEZ of Palmyra Atoll (Table 1). Total estimated annual mortality and serious injury for all U.S. EEZs combined averaged 6.0 (CV = 0.35) between 2000 and 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 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 (4.2 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 7.3) for this region.~~

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Species	Stock Area	NMFS Center	N est	CV N est	N min	R max	Fr	PBR	Total Annual Mortality + Serious Injury	Annual Fishery Mortality + Serious Injury	Strategic Status	Recent Abundance Surveys			Last Revised
California sea lion	U.S.	SWC	~~237,000~~ 238,000	n/a	~~138,881~~ 141,842	0.12	1	~~8,333~~ 8,511	~~1,562~~ ≥232	~~1,476~~ ≥159	N	2003	2004	2005	2007
Harbor seal	California	SWC	34,233	n/a	31,600	0.12	1	1,896	≥389	389	N	1995	2002	2004	2005
Harbor seal	Oregon/Washington Coast	AKC	24,732	0.12	22,380	0.12	1	1,343	~~≥17~~ ≥15.2	~~≥15~~ ≥13	N	1999			2007
Harbor seal	Washington Inland Waters	AKC	14,612	0.15	12,844	0.12	1	771	≥34	≥30	N	1999			2003
Northern Elephant Seal	California breeding	SWC	~~101,000~~ 124,000	n/a	~~60,547~~ 74,913	~~0.083~~ 0.117	1	~~2,513~~ 4,382	~~≥88~~ ≥10.4	~~≥86~~ ≥8.8	N	2001	2002	2005	2007
Guadalupe Fur Seal	Mexico to California	SWC	7,408	n/a	3,028	0.12	0.5	91	0	0	Y	1993			2000
Northern Fur Seal	San Miguel Island	AKC	9,424	n/a	5,096	0.086	1	219	≥1.0	≥1.0	N	2003	2004	2005	2006
Monk Seal	Hawaii	PIC	~~1,302~~ 1,247	n/a	~~1,276~~ 1,214	0.07	0.1	undet	unk	unk	Y	2004	2005	2006	2007
Harbor porpoise	Morro Bay	SWC	1,656	0.39	1,206	0.04	0.4	10	4.5	4.5	N	1997	1999	2002	2004
Harbor porpoise	Monterey Bay	SWC	1,613	0.42	1,149	0.04	0.45	10	9.5	9.5	N	1997	1999	2002	2004
Harbor porpoise	San Francisco – Russian River	SWC	8,521	0.38	6,254	0.04	0.5	63	≥0.8	≥0.8	N	1997	1999	2002	2004
Harbor porpoise	Northern CA/Southern OR	SWC	17,763	0.39	12,940	0.04	1	259	≥0	≥0	N	1997	1999	2002	2003
Harbor porpoise	Oregon/Washington Coast	AKC	37,745	0.38	27,705	0.04	0.5	277	0.6	0.6	N	1991	1997	2002	2006
Harbor porpoise	Washington Inland Waters	AKC	10,682	0.38	7,841	0.04	0.4	63	15.2	15.4	N	1996	2002	2003	2006
Dall's porpoise	California/Oregon/Washington	SWC	~~99,517~~ 57,549	~~0.33~~ 0.34	~~75,915~~ 43,425	0.04	~~0.48~~ 0.4	~~729~~ 347	~~7~~ 1.8	~~7~~ 1.4	N	1996	2001	2005	2007
Pacific white-sided dolphin	California/Oregon/Washington	SWC	~~59,274~~ 25,233	~~0.5~~ 0.25	~~39,822~~ 20,441	0.04	~~0.48~~ 0.45	~~382~~ 184	~~≥5.4~~ 5.6	~~≥5.4~~ 5.6	N	1996	2001	2005	2007
Risso's dolphin	California/Oregon/Washington	SWC	~~16,066~~ 12,093	~~0.28~~ 0.24	~~12,748~~ 9,947	0.04	~~0.45~~ 0.4	~~115~~ 80	~~3.6~~ 6.6	~~3.6~~ 6.6	N	1996	2001	2005	2007
Bottlenose dolphin	California Coastal	SWC	323	0.13	290	0.04	0.5	2.4	0.4	0.4	N	2000	2004	2005	2006
Bottlenose dolphin	California/Oregon/Washington Offshore	SWC	~~5,065~~ 3,257	~~0.66~~ 0.43	~~3,053~~ 2,295	0.04	0.5	~~31~~ 23	~~0~~ 0.2	~~0~~ 0.2	N	1996	2001	2005	2007
Striped dolphin	California/Oregon/Washington	SWC	~~13,934~~ 23,883	~~0.53~~ 0.44	~~9,165~~ 16,737	0.04	0.5	~~92~~ 167	0	0	N	1996	2001	2005	2007
Common dolphin, short-beaked	California/Oregon/Washington	SWC	~~449,846~~ 487,622	~~0.25~~ 0.26	~~365,617~~ 392,687	0.04	0.5	~~3,656~~ 3,927	~~93~~ 59	~~93~~ 59	N	1996	2001	2005	2007
Common dolphin, long-beaked	California/Oregon/Washington	SWC	~~43,360~~ 1,893	~~0.72~~ 0.65	~~25,163~~ 1,152	0.04	0.48	~~242~~ 11	~~11~~ 17	~~11~~ 17	~~N~~ Y	1996	2001	2005	2007
Northern right whale dolphin	California/Oregon/Washington	SWC	~~20,362~~ 15,305	~~0.26~~ 0.32	~~16,417~~ 11,754	0.04	~~0.5~~ 0.48	~~164~~ 113	~~23~~ 18	~~23~~ 18	N	1996	2001	2005	2007
Killer whale	Eastern North Pacific Offshore	SWC	~~466~~ 422	~~0.31~~ 0.29	~~361~~ 331	0.04	0.5	~~3.6~~ 3.3	0	0	N	1996	2001	2005	2007
Killer whale	Eastern North Pacific Southern Resident	AKC	~~91~~ 89	und	~~91~~ 89	0.04	0.1	0.18	0.2	0	Y	2004	2005	2006	2007
Short-finned pilot whale	California/Oregon/Washington	SWC	~~304~~ 245	~~1.02~~ 0.97	~~149~~ 123	0.04	0.4	~~1.2~~ 0.98	1	1	~~N~~ Y	1996	2001	2005	2007
Baird's beaked whale	California/Oregon/Washington	SWC	~~228~~ 313	~~0.51~~ 0.55	~~152~~ 203	0.04	0.5	~~1.5~~ 2.0	~~0~~ 0.2	0	N	1996	2001	2005	2007

unk = unknown
undet = undetermined
n/a = not applicable

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Species	Stock Area	NMFS Center	N est	CV N est	N min	R max	Fr	PBR	Annual Mortality + Serious Injury	Fishery Mortality + Serious Injury	Strategic Status	Recent Abundance Surveys			
Mesoplodont beaked whales	California/Oregon/Washington	SWC	~~1,247~~	~~0.92~~	~~645~~	0.04	0.5	~~6.4~~	0	0	N	1996	2001	2005	2007
			1,024	0.77	576			5.7							
Cuvier's beaked whale	California/Oregon/Washington	SWC	~~1,884~~	~~0.68~~	~~1,121~~	0.04	~~0.5~~	~~11~~	~~0~~	0	N	1996	2001	2005	2007
			2,171	0.75	1,234		0.4	10	≥0.2						
Pygmy Sperm whale	California/Oregon/Washington	SWC	~~247~~	~~1.06~~	~~119~~	0.04	0.5	~~1.2~~	~~0~~	0	N	1996	2001	2005	2007
			unk	unk	unk			undet	0.2						
Dwarf sperm whale	California/Oregon/Washington	SWC	unk	unk	unk	0.04	0.5	undet	0	0	N	1996	2001	2005	2007
Sperm whale	California/Oregon/Washington	SWC	~~1,233~~	~~0.41~~	~~885~~	0.04	0.1	~~1.8~~	~~1~~	~~1~~	Y	1996	2001	2005	2007
			2,265	0.34	1,719			3.4	0.2	0.2					
Humpback whale	~~Eastern North Pacific~~	SWC	~~1391~~	~~0.22~~	~~1158~~	0.08	0.1	~~2.3~~	~~≥1.6~~	~~≥1.2~~	Y	1996	2001	2005	2007
	California/Oregon/Washington		1,396	0.15	1,236			2.5	≥2.2	≥ 1.8					
Blue whale	Eastern North Pacific	SWC	~~1,744~~	~~0.28~~	~~1,384~~	0.04	0.1	~~1.4~~	~~0.2~~	0	Y	1996	2001	2005	2007
			1,186	0.19	1,005			1.0	0.6	0					
Fin whale	California/Oregon/Washington	SWC	~~3,279~~	~~0.31~~	~~2,541~~	0.04	0.3	~~15~~	1.4	~~1~~	Y	1996	2001	2005	2007
			3,454	0.27	2,760			16		0					
Bryde's whale	California/Oregon/Washington	SWC	~~12~~	~~2.00~~	4	0.04	0.5	undet	0	0	N	1996	2001	2005	2007
			unk	unk	unk										
Sei whale	Eastern North Pacific	SWC	~~56~~	~~0.61~~	~~35~~	0.04	0.1	~~0.1~~	0	0	Y	1996	2001	2005	2007
			43	0.61	27			0.05							
Minke whale	California/Oregon/Washington	SWC	~~1,015~~	~~0.73~~	~~585~~	0.04	0.5	~~5.8~~	0	0	N	1996	2001	2005	2007
			898	0.65	544			5.4							
Rough-toothed dolphin	Hawaii	SWC	19,904	0.52	13,184	0.04	0.5	132	unk	unk	N		2002	2004	2004
Risso's dolphin	Hawaii	SWC	2,351	0.65	1,426	0.04	0.5	14	unk	unk	N		2002	2004	2004
Bottlenose dolphin	Hawaii	SWC	3,263	0.60	2,046	0.04	0.5	20	≥0.2	≥0.2	N		2002	2004	2006
Pantropical spotted dolphin	Hawaii	SWC	10,260	0.41	7,362	0.04	0.5	74	≥0.8	≥0.8	N		2002	2004	2004
Spinner dolphin	Hawaii	SWC	2,805	0.66	1,691	0.04	0.5	17	0	0	N		2002	2004	2004
Striped dolphin	Hawaii	SWC	10,385	0.48	7,078	0.04	0.5	71	unk	unk	N		2002	2004	2004
Fraser's dolphin	Hawaii	SWC	16,836	1.11	7,917	0.04	0.5	79	unk	unk	N		2002	2004	2004
Melon-headed whale	Hawaii	SWC	2,947	1.11	1,386	0.04	0.5	14	unk	unk	N		2002	2004	2004
Pygmy killer whale	Hawaii	SWC	817	1.12	382	0.04	0.5	3.8	unk	unk	N		2002	2004	2004
False killer whale	Hawaii	SWC	~~268~~	~~1.08~~	~~128~~	0.04	~~0.45~~	~~1.2~~	~~≥1.8~~	~~≥1.8~~	Y		2002	2004	2007
			484	0.93	249		0.48	2.4	4.9	4.9					
False killer whale	Palmyra	SWC	1,329	0.65	806	0.04	0.48	7.7	1.9	1.9	N			2005	2007
Killer whale	Hawaii	SWC	430	0.72	250	0.04	0.5	2.5	unk	unk	N		2002	2004	2004
Pilot whale, short-finned	Hawaii	SWC	8,846	0.49	5,986	0.04	0.5	60	0.8	0.8	N		2002	2004	2006
Blainville's beaked whale	Hawaii	SWC	2,138	0.77	1,204	0.04	0.4	9.6	0.8	0.8	N		2002	2004	2004
Longman's Beaked Whale	Hawaii	SWC	766	1.05	371	0.04	0.5	3.7	unk	unk	N		2002	2004	2004
Cuvier's beaked whale	Hawaii	SWC	12,728	0.83	6,919	0.04	0.5	69	unk	unk	N		2002	2004	2004
Pygmy sperm whale	Hawaii	SWC	7,251	0.77	4,082	0.04	0.5	41	unk	unk	N		2002	2004	2004
Dwarf sperm whale	Hawaii	SWC	19,172	0.66	11,555	0.04	0.5	116	unk	unk	N		2002	2004	2004
Sperm whale	Hawaii	SWC	7,082	0.30	5,531	0.04	0.1	11	0	0	Y		2002	2004	2004
Blue whale	Hawaii	SWC	unk		unk	0.04	0.1	undet	unk	unk	Y		2002	2004	2004
Fin whale	Hawaii	SWC	174	0.72	101	0.04	0.1	0.2	unk	unk	Y		2002	2004	2004
Sei whale	Hawaii	SWC	77	1.06	37	0.04	0.1	0.1	unk	unk	Y		2002	2004	2004
Minke whale	Hawaii	SWC	unk		unk	0.04	0.5	undet	unk	unk	N		2002	2004	2004
Bryde's whale	Hawaii	SWC	493	0.34	373	0.04	0.5	3.7	unk	unk	N		2002	2004	2004

unk = unknown
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			238,000		141,842			8,511	≥232	≥159					
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									≥15.2	≥13					
Harbor seal	Washington Inland Waters	AKC	14,612	0.15	12,844	0.12	1	771	≥34	≥30	N	1999			2003
Northern Elephant Seal	California breeding	SWC	~~101,000~~	n/a	~~60,547~~	~~0.083~~	1	~~2,513~~	~~≥88~~	~~≥86~~	N	2001	2002	2005	2007
			124,000		74,913	0.117		4,382	≥10.4	≥8.8					
Guadalupe Fur Seal	Mexico to California	SWC	7,408	n/a	3,028	0.12	0.5	91	0	0	Y	1993			2000
Northern Fur Seal	San Miguel Island	AKC	9,424	n/a	5,096	0.086	1	219	≥1.0	≥1.0	N	2003	2004	2005	2006
Monk Seal	Hawaii	PIC	~~1,302~~	n/a	~~1,276~~	0.07	0.1	undet	unk	unk	Y	2004	2005	2006	2007
			1,247		1,214										
Harbor porpoise	Morro Bay	SWC	1,656	0.39	1,206	0.04	0.4	10	4.5	4.5	N	1997	1999	2002	2004
Harbor porpoise	Monterey Bay	SWC	1,613	0.42	1,149	0.04	0.45	10	9.5	9.5	N	1997	1999	2002	2004
Harbor porpoise	San Francisco – Russian River	SWC	8,521	0.38	6,254	0.04	0.5	63	≥0.8	≥0.8	N	1997	1999	2002	2004
Harbor porpoise	Northern CA/Southern OR	SWC	17,763	0.39	12,940	0.04	1	259	≥0	≥0	N	1997	1999	2002	2003
Harbor porpoise	Oregon/Washington Coast	AKC	37,745	0.38	27,705	0.04	0.5	277	0.6	0.6	N	1991	1997	2002	2006
Harbor porpoise	Washington Inland Waters	AKC	10,682	0.38	7,841	0.04	0.4	63	15.2	15.4	N	1996	2002	2003	2006
Dall's porpoise	California/Oregon/Washington	SWC	~~99,517~~	~~0.33~~	~~75,915~~	0.04	~~0.48~~	~~729~~	~~7~~	~~7~~	N	1996	2001	2005	2007
			57,549	0.34	43,425		0.4	347	1.8	1.4					
Pacific white-sided dolphin	California/Oregon/Washington	SWC	~~59,274~~	~~0.5~~	~~39,822~~	0.04	~~0.48~~	~~382~~	~~≥5.4~~	~~≥5.4~~	N	1996	2001	2005	2007
			25,233	0.25	20,441		0.45	184	5.6	5.6					
Risso's dolphin	California/Oregon/Washington	SWC	~~16,066~~	~~0.28~~	~~12,748~~	0.04	~~0.45~~	~~115~~	~~3.6~~	~~3.6~~	N	1996	2001	2005	2007
			12,093	0.24	9,947		0.4	80	6.6	6.6					
Bottlenose dolphin	California Coastal	SWC	323	0.13	290	0.04	0.5	2.4	0.4	0.4	N	2000	2004	2005	2006
Bottlenose dolphin	California/Oregon/Washington Offshore	SWC	~~5,065~~	~~0.66~~	~~3,053~~	0.04	0.5	~~31~~	~~0~~	~~0~~	N	1996	2001	2005	2007
			3,257	0.43	2,295			23	0.2	0.2					
Striped dolphin	California/Oregon/Washington	SWC	~~13,934~~	~~0.53~~	~~9,165~~	0.04	0.5	~~92~~	0	0	N	1996	2001	2005	2007
			23,883	0.44	16,737			167							
Common dolphin, short-beaked	California/Oregon/Washington	SWC	~~449,846~~	~~0.25~~	~~365,617~~	0.04	0.5	~~3,656~~	~~93~~	~~93~~	N	1996	2001	2005	2007
			487,622	0.26	392,687			3,927	59	59					
Common dolphin, long-beaked	California/Oregon/Washington	SWC	~~43,360~~	~~0.72~~	~~25,163~~	0.04	0.48	~~242~~	~~11~~	~~11~~	~~N~~	1996	2001	2005	2007
			1,893	0.65	1,152			11	17	17	Y				
Northern right whale dolphin	California/Oregon/Washington	SWC	~~20,362~~	~~0.26~~	~~16,417~~	0.04	~~0.5~~	~~164~~	~~23~~	~~23~~	N	1996	2001	2005	2007
			15,305	0.32	11,754		0.48	113	18	18					
Killer whale	Eastern North Pacific Offshore	SWC	~~466~~	~~0.31~~	~~361~~	0.04	0.5	~~3.6~~	0	0	N	1996	2001	2005	2007
			422	0.29	331			3.3							
Killer whale	Eastern North Pacific Southern Resident	AKC	~~91~~	und	~~91~~	0.04	0.1	0.18	0.2	0	Y	2004	2005	2006	2007
			89		89										
Short-finned pilot whale	California/Oregon/Washington	SWC	~~304~~	~~1.02~~	~~149~~	0.04	0.4	~~1.2~~	1	1	~~N~~	1996	2001	2005	2007
			245	0.97	123			0.98			Y				
Baird's beaked whale	California/Oregon/Washington	SWC	~~228~~	~~0.51~~	~~152~~	0.04	0.5	~~1.5~~	~~0~~	0	N	1996	2001	2005	2007
			313	0.55	203			2.0	0.2						

unk = unknown; undet = undetermined; n/a = not applicable

Draft 2007 Pacific Marine Mammal Stock Assessment Reports summary.

Species	Stock Area	NMFS Center	N est	CV N est	N min	R max	Fr	PBR	Total Annual Mortality + Serious Injury	Annual Fishery Mortality + Serious Injury	Strategic Status	Recent Abundance Surveys			Last Revised
Mesoplodont beaked whales	California/Oregon/Washington	SWC	~~1,247~~	~~0.92~~	~~645~~	0.04	0.5	~~6.4~~	0	0	N	1996	2001	2005	2007
			1,024	0.77	576			5.7							
Cuvier's beaked whale	California/Oregon/Washington	SWC	~~1,884~~	~~0.68~~	~~1,121~~	0.04	~~0.5~~	~~11~~	~~0~~	0	N	1996	2001	2005	2007
			2,171	0.75	1,234		0.4	10	≥0.2						
Pygmy Sperm whale	California/Oregon/Washington	SWC	~~247~~	~~1.06~~	~~119~~	0.04	0.5	~~1.2~~	~~0~~	0	N	1996	2001	2005	2007
			unk	unk	unk			undet	0.2						
Dwarf sperm whale	California/Oregon/Washington	SWC	unk	unk	unk	0.04	0.5	undet	0	0	N	1996	2001	2005	2007
Sperm whale	California/Oregon/Washington	SWC	~~1,233~~	~~0.41~~	~~885~~	0.04	0.1	~~1.8~~	~~1~~	~~1~~	Y	1996	2001	2005	2007
			2,265	0.34	1,719			3.4	0.2	0.2					
Humpback whale	~~Eastern North Pacific~~	SWC	~~1391~~	~~0.22~~	~~1158~~	0.08	0.1	~~2.3~~	~~≥1.6~~	~~≥1.2~~	Y	1996	2001	2005	2007
	California/Oregon/Washington		1,396	0.15	1,236			2.5	≥2.2	≥ 1.8					
Blue whale	Eastern North Pacific	SWC	~~1,744~~	~~0.28~~	~~1,384~~	0.04	0.1	~~1.4~~	~~0.2~~	0	Y	1996	2001	2005	2007
			1,186	0.19	1,005			1.0	0.6	0					
Fin whale	California/Oregon/Washington	SWC	~~3,279~~	~~0.31~~	~~2,541~~	0.04	0.3	~~15~~	1.4	~~1~~	Y	1996	2001	2005	2007
			3,454	0.27	2,760			16		0					
Bryde's whale	California/Oregon/Washington	SWC	~~12~~	~~2.00~~	4	0.04	0.5	undet	0	0	N	1996	2001	2005	2007
			unk	unk	unk										
Sei whale	Eastern North Pacific	SWC	~~56~~	~~0.61~~	~~35~~	0.04	0.1	~~0.1~~	0	0	Y	1996	2001	2005	2007
			43	0.61	27			0.05							
Minke whale	California/Oregon/Washington	SWC	~~1,015~~	~~0.73~~	~~585~~	0.04	0.5	~~5.8~~	0	0	N	1996	2001	2005	2007
			898	0.65	544			5.4							
Rough-toothed dolphin	Hawaii	SWC	19,904	0.52	13,184	0.04	0.5	132	unk	unk	N		2002	2004	2004
Risso's dolphin	Hawaii	SWC	2,351	0.65	1,426	0.04	0.5	14	unk	unk	N		2002	2004	2004
Bottlenose dolphin	Hawaii	SWC	3,263	0.60	2,046	0.04	0.5	20	≥0.2	≥0.2	N		2002	2004	2006
Pantropical spotted dolphin	Hawaii	SWC	10,260	0.41	7,362	0.04	0.5	74	≥0.8	≥0.8	N		2002	2004	2004
Spinner dolphin	Hawaii	SWC	2,805	0.66	1,691	0.04	0.5	17	0	0	N		2002	2004	2004
Striped dolphin	Hawaii	SWC	10,385	0.48	7,078	0.04	0.5	71	unk	unk	N		2002	2004	2004
Fraser's dolphin	Hawaii	SWC	16,836	1.11	7,917	0.04	0.5	79	unk	unk	N		2002	2004	2004
Melon-headed whale	Hawaii	SWC	2,947	1.11	1,386	0.04	0.5	14	unk	unk	N		2002	2004	2004
Pygmy killer whale	Hawaii	SWC	817	1.12	382	0.04	0.5	3.8	unk	unk	N		2002	2004	2004
False killer whale	Hawaii	SWC	~~268~~	~~1.08~~	~~128~~	0.04	~~0.45~~	~~1.2~~	~~≥1.8~~	~~≥1.8~~	Y		2002	2004	2007
			484	0.93	249		0.48	2.4	4.9	4.9					
False killer whale	Palmyra	SWC	1,329	0.65	806	0.04	0.48	7.7	1.9	1.9	N			2005	2007
Killer whale	Hawaii	SWC	430	0.72	250	0.04	0.5	2.5	unk	unk	N		2002	2004	2004
Pilot whale, short-finned	Hawaii	SWC	8,846	0.49	5,986	0.04	0.5	60	0.8	0.8	N		2002	2004	2006
Blainville's beaked whale	Hawaii	SWC	2,138	0.77	1,204	0.04	0.4	9.6	0.8	0.8	N		2002	2004	2004
Longman's Beaked Whale	Hawaii	SWC	766	1.05	371	0.04	0.5	3.7	unk	unk	N		2002	2004	2004
Cuvier's beaked whale	Hawaii	SWC	12,728	0.83	6,919	0.04	0.5	69	unk	unk	N		2002	2004	2004
Pygmy sperm whale	Hawaii	SWC	7,251	0.77	4,082	0.04	0.5	41	unk	unk	N		2002	2004	2004
Dwarf sperm whale	Hawaii	SWC	19,172	0.66	11,555	0.04	0.5	116	unk	unk	N		2002	2004	2004
Sperm whale	Hawaii	SWC	7,082	0.30	5,531	0.04	0.1	11	0	0	Y		2002	2004	2004
Blue whale	Hawaii	SWC	unk		unk	0.04	0.1	undet	unk	unk	Y		2002	2004	2004
Fin whale	Hawaii	SWC	174	0.72	101	0.04	0.1	0.2	unk	unk	Y		2002	2004	2004
Sei whale	Hawaii	SWC	77	1.06	37	0.04	0.1	0.1	unk	unk	Y		2002	2004	2004
Minke whale	Hawaii	SWC	unk		unk	0.04	0.5	undet	unk	unk	N		2002	2004	2004
Bryde's whale	Hawaii	SWC	493	0.34	373	0.04	0.5	3.7	unk	unk	N		2002	2004	2004

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