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U.S. DEPARTMENT OF COMMERCE
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Southwest Fisheries Science Center

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U.S. PACIFIC MARINE MAMMAL STOCK ASSESSMENTS: 2012

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Stock assessment reports and appendices revised in 2012 are highlighted; all others will be reprinted in the as they appear in the 2011 Pacific Region Stock Assessment Reports (Carretta *et al.* 2012).

PINNIPEDS

CETACEANS - U.S. WEST COAST

CETACEANS – HAWAII & WESTERN PACIFIC

APPENDICES

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. The 2012 Pacific marine mammal stock assessments include revised reports for 15 Pacific marine mammal stocks under NMFS jurisdiction, including 5 "strategic" stocks: Hawaiian monk seal, Southern Resident killer whale, Main Hawaiian Islands Insular false killer whale, Hawaii Pelagic false killer whale, and California/Oregon/Washington sperm Whale; and 10 "non-strategic" stocks: Long-beaked common dolphin, Eastern North Pacific gray whale, Northwestern Hawaiian Islands false killer whale, Palmyra Atoll false killer whale, Hawaii Island spinner dolphin, Oahu/4 Islands spinner dolphin, Kauai/Niihau spinner dolphin, Pearl and Hermes Reef spinner dolphin, Midway Atoll/Kure spinner dolphin, and Hawaii Pelagic spinner dolphin. Information on the remaining Pacific region stocks can be found in the final 2011 reports (Carretta *et al.* 2012). The stock assessment report for Palmyra false killer whale now appears separately from false killer whale reports that focus on the Hawaiian Islands region and a new stock of Northwestern Hawaiian Islands false killer whales is presented for the first time. New abundance estimates are available for 8 stocks (Hawaiian monk seal, Long-beaked common dolphin, Southern Resident killer whale, 3 stocks of spinner dolphin (Hawaii Island, Oahu/4 Islands, and Kauai/Niihau), Hawaii Pelagic false killer whale and Northwestern Hawaiian Islands false killer whale). The stock assessment report for gray whales is now included in the Pacific Region stock assessment reports. Stock Assessments for Alaska region marine mammals are published by the National Marine Mammal Laboratory (NMML) in a separate report.

Pacific region stock assessments include those studied by the Southwest Fisheries Science Center (SWFSC, La Jolla, CA), the Pacific Islands Fisheries Science Center (PIFSC, Honolulu, HI), the National Marine Mammal Laboratory (NMML, Seattle, WA), and the Northwest Fisheries Science Center (NWFSC, Seattle, WA).

Draft versions of the 2012 stock assessment reports were reviewed by the Pacific Scientific Review Group at the November 2011 meeting and by the public during a 90-day comment period.

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 original data 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 cited within the stock assessment reports rather than citing this report or previous Stock Assessment Reports.

<u>Recommended Citation:</u>

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<u>Cover photograph:</u> Gray whale off Sakhalin Island, Russia. Photographed by Dave Weller.

Revised 12/15/2011

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The California sea lion (*Zalophus californianus*) is now considered to be a full species, separated from the Galapagos sea lion (*Z. wollebaeki*) and the extinct Japanese sea lion (*Z. japonicus*) (Brunner 2003, Wolf *et al.* 2007, Schramm et al. 2009). The breeding areas of the California sea lion are on islands located in southern California, western Baja California, and the Gulf of California (Figure 1). Mitochondrial DNA analysis of California sea lions identified five genetically distinct geographic populations: (1) Pacific Temperate, (2) Pacific Subtropical, (3) Southern Gulf of California, (4) Central Gulf of California and (5) Northern Gulf of California (Schramm et al. 2009). In that study, the Pacific Temperate population included rookeries within U.S. waters and the Coronados Islands just south of U.S./Mexico border. Animals from the Pacific Temperate population range north into Canadian waters, and movement of animals between U.S. waters and Baja California waters has been documented, though the distance between the major U.S. and Baja California rookeries is at least 400 nmi. Males from western Baja California rookeries may spend most of the year in the United States.

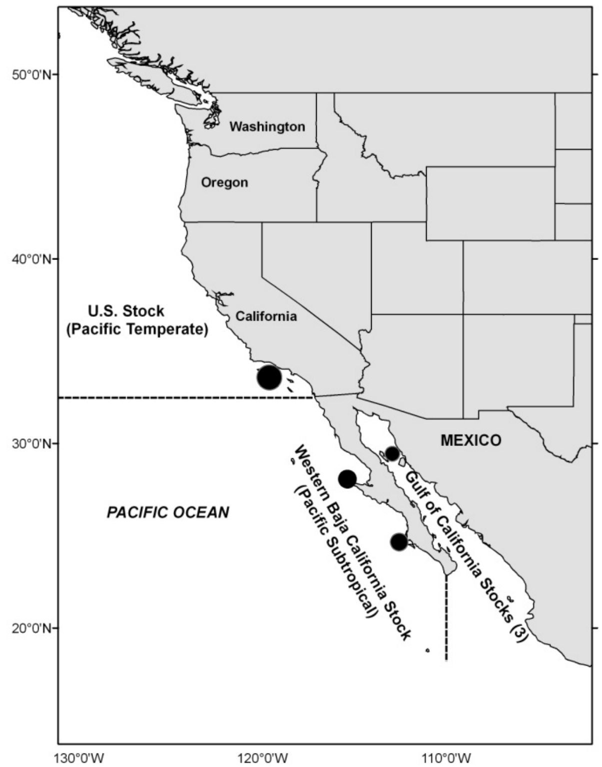

Figure 1. Geographic range of California sea lions showing stock boundaries and locations of major rookeries. The U.S. stock also ranges north into Canadian waters.

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

POPULATION SIZE

The entire population cannot be counted because all age and sex classes are not ashore at the same time. In lieu of counting all sea lions, pups are counted during the breeding season (because this is the only age class that is ashore in its entirety), and the number of births is estimated from the pup count. 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 for rookeries in southern California in 2008 (59,774) was adjusted for an estimated 15% pre-census mortality (Boveng 1988; Lowry et al. 1992), giving an estimated 68,740 live births in the population. The fraction of newborn pups in the population (23.2%) was estimated from a life table derived for the northern fur seal (*Callorhinus ursinus*) (Boveng 1988, Lowry et al. 1992) which was modified to account for the growth rate of this California sea lion population (5.4% yr^{-1}, see below). Multiplying the number of pups born by the inverse of this fraction (4.317) results in a population estimate of 296,750.

Minimum Population Estimate

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

Current Population Trend

Trends in pup counts from 1975 through 2008 are shown in Figure 2 for four rookeries in southern California and for haulouts in central and northern California. The number of pups at rookeries not counted were estimated using multiple regressions derived from counts of two neighboring rookeries using data from 1975-2000 (Lowry and Maravilla 2005): (1) 1980 at Santa Barbara Is.; (2) 1978-1980 at San Clemente Is.; and (3) 1978 and 1979 at San Nicolas Is. The mean was used when more than one count was available for a given rookery. A regression of the natural logarithm of the pup counts against year indicates that the counts of pups increased at an annual rate of 5.4% between 1975 and 2008, when pup counts for El Niño years (1983, 1984, 1992, 1993, 1998, and 2003) were removed from the 1975-2005 time series. Using 1975-2008 non-El Niño year data, the coefficient of variation for this average annual growth rate (CV=0.04) was computed via bootstrap sampling of the count data. The 1975- 2008 time series of pup counts shows the effect of four El Niño events on the sea lion population (Figure 2). Pup production decreased by 35% in 1983, 27% in 1992, 64% in 1998, and 20% in 2003. After the 1992-93, 1997-98 and 2003 El Niños, pup production rebounded to pre-El Niño levels within two years. In contrast, however, the 1983-1984 El Niño affected adult female survivorship (DeLong et al. 1991), which prevented an immediate rebound in pup production because there were fewer adult females available in the population to produce pups (it took five years for pup production to return to the 1982 level). Other characteristics of El Niños are higher pup and juvenile mortality rates (DeLong et al. 1991, NMFS unpubl. data) which affect future recruitment into the adult population for the affected cohorts. The 2002 and 2003 decline can be attributed to (1) reduced number of reproductive adult females being incorporated into the population as a result of the 1992-93 and 1997-98 El Niños, (2) domoic acid poisoning (Scholin et al. 2000, Lefebvre et al. 2000), (3) lower survivorship of pups due to hookworm infestations (Lyons et al. 2001), and (4) the 2003 El Niño.

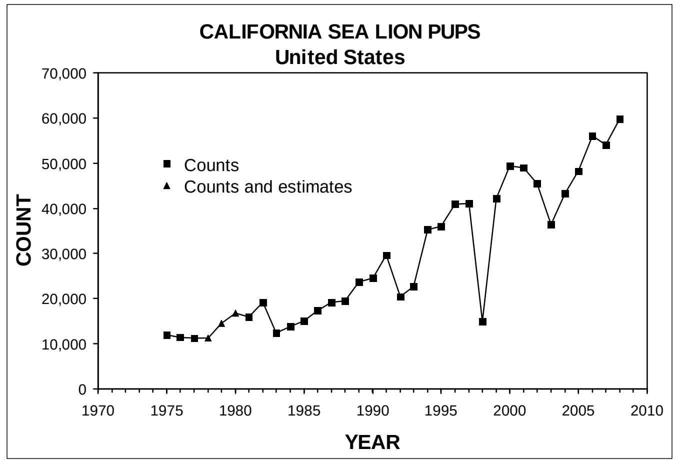

Figure 2. U.S. pup count index for California sea lions (1975-2005 2008). Trends in pup counts from 1975 through 2008 are shown for four rookeries in southern California and for haulouts in central and northern California. Records of pup counts from 1975 to 2008 were compiled from Lowry and Maravilla (2005) and unpublished NMFS data.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A standard logistic growth model indicated that the maximum population growth rate (R_{max}) was 9.2 percent when pup counts from El Niño years (1983, 1984, 1992, 1993, 1998, and 2003) were removed (Figure 3). However, the apparent growth rate from the population trajectory underestimates the intrinsic growth rate because it does not consider human-caused mortality that was occurring during the time series. Here we use the default maximum net productivity rate for pinnipeds (12% per year).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (153,337) times one half the default maximum net growth rate for pinnipeds (½ of 12%) times a recovery factor of 1.0 (for a stock of unknown status that is growing, Wade and Angliss 1997); resulting in a PBR of 9,200 sea lions per year.

ANNUAL HUMAN-CAUSED MORTALITY

Historical Depletion

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

Fisheries Information

California sea lions are killed incidentally in set and drift gillnet fisheries (Hanan et al. 1993; Barlow et al. 1994; Julian and Beeson, 1998; Carretta et al. 2005) and trawl fisheries along the U.S. west coast (Heery et al. 2010). Detailed information on these fisheries is provided in Appendix 1. Mortality estimates for the California set and drift gillnet fisheries and trawl fisheries are included in Table 1 for the five most recent years of monitoring (Carretta and Enriquez 2006, 2007, 2009a, 2009b, 2010, Heery et al. 2010). 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. Historically, the majority of California sea lion gillnet mortality was in the California halibut and white seabass set gillnet fishery (Julian and Beeson 1998), but this fishery has undergone regulatory changes that has reduced its range to southern California waters south of Pt. Arguello and has shifted fishing effort to greater than 3 nmi from the mainland or 1 nmi from the islands. There has also been a considerable decline in fishing effort in this fishery since the early 1990s (see Figure 3 in Appendix 1). An observer program for the set gillnet fishery was in place during 2006 and 2007, although the only meaningful levels of observer coverage occurred in 2007. Annual estimates of bycatch mortality for this fishery are based solely on 2007 for that reason (Table 1). Logbook and observer data, and fishermen reports indicate that mortality of California sea lions occurs or has occurred in the past in the following fisheries: (1) California, Oregon, and Washington salmon troll; (2) Oregon and Washington non-salmon troll; (3) California herring purse-seine; (4) California anchovy, mackerel, and tuna purse-seine; (5) California squid purse-seine; (6) Washington, Oregon, California and British Columbia, Canada salmon net pen ; (7) Washington, Oregon, and California groundfish trawl; (8) Washington, Oregon and California commercial passenger fishing vessels (NMFS 1995, M. Perez pers. comm, and P. Olesiuk pers. comm.) (9) California small mesh drift gillnet fishery, and (10) California anchovy, mackerel, and tuna purse-seine. Not all of these fisheries continue to operate or have current observer programs. Those for which recent observations or estimates of bycatch mortality exist are summarized in Table 1. Stranding data from California, Oregon, and Washington during 2005-2009 show that an additional 55 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 many entanglements are likely unreported or undetected.

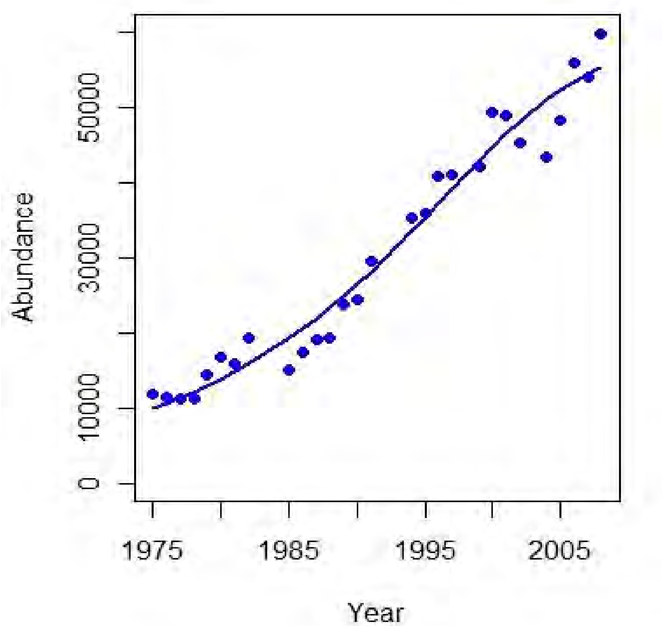

Figure 3. Fit of standard logistic growth curve to California sea lion pup counts, 1975-2008 (excluding El Niño years).

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, but no quantitative estimates of recent mortality are available.

California sea lions injured by entanglement in gillnet and other man-made debris are 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 hauled out, with the majority (52%) entangled in monofilament gillnets. Data from a marine mammal rehabilitation center showed that 87% of 87 rescued California sea lions were entangled in 4 to 4.5-inch 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.

California sea lions are also incidentally killed and injured by hooks from recreational and commercial fisheries. Sea lion deaths due to hook-and-line fisheries are often the result of complications resulting from ingestion of hooks, perforation of body cavities leading to infections, or the inability of the animal to feed. Many of the animals die post-stranding during rehabilitation or are euthanized as a result of their injuries. Between 2005 and 2009, there were 88 California sea lion deaths attributed to hook and line fisheries, or an annual average of 18 animals (NMFS Southwest and Northwest Regional Stranding Data, unpublished).

One sea lion death was reported in a tribal salmon gillnet in 2009 along the U.S. west coast.

Table 1. Summary of available information on the mortality and serious injury of California sea lions in commercial fisheries that might take this species (Carretta and Enriquez 2006, 2007, 2009a, 2009b, 2010; Heery et al. 2010; Appendix 1). Mean annual takes are based on 2005-2009 data unless noted otherwise.

Fishery Name	**Year(s)**	**Data Type**	**Percent Observer Coverage**	**Observed Mortality**	**Estimated Mortality (CV in parentheses)**	**Mean Annual Takes (CV in parentheses)**
CA/OR thresher shark/swordfish large mesh drift gillnet fishery	2005 2006 2007 2008 2009 2008	observer	20.9% 18.5% 16.4% 13.5% 13.3%	1 12 8 7 5	5 (0.97) 64 (0.43) 48 (0.65) 51 (0.52) 37 (0.83)	41 (0.28)
CA halibut and white seabass set gillnet fishery	2005 2006 2007 2008 2009	12 sets observed in 2006 and 248 sets observed in 2007	0% <1% 17.8% 0% 0%	n/a 0 34 n/a n/a	n/a n/a 190 (0.68) n/a n/a	190 (0.68)[1]
CA small-mesh drift gillnet fishery for white seabass, yellowtail, barracuda, and tuna	2003 2004	observer	11% 11%	2 1	18 (0.71) 9 (0.94)	13.5 (0.57)
CA anchovy, mackerel, sardine, and tuna purse-seine fishery	2004-2008	observer	~5%	2	n/a	≥2 (n/a)

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed Mortality	Estimated Mortality (CV in parentheses)	Mean Annual Takes (CV in parentheses)
WA, OR, CA domestic groundfish trawl fishery (includes at-sea hake and other limited-entry groundfish sectors)	2004 2005 2006 2007 2008	observer	99% to 100% of tows in at-sea hake fishery 18%-26% of landings in other groundfish sectors	8 14 21 8 7	13 (n/a) 21 (n/a) 95 (n/a) 31 (n/a) 13 (n/a)	34.6 (n/a)
Unknown entangling net fishery	2005-2009	stranding	n/a	55	n/a	≥ 55 (n/a)
Unknown pot or trap fishery	2005-2009	stranding	n/a	1	n/a	≥ 1 (n/a)
Minimum total annual takes						≥ 337 (0.56)

[1] Only 2007 data is included in the mean annual take calculation for the CA halibut and white seabass fishery, due to the low observer coverage (<1%) in 2006.

Other Mortality

Live strandings and dead beach-cast California sea lions 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 2005-2009 from California, Oregon, and Washington stranding databases shows the following non-fishery related human-caused mortality: boat collisions (12 deaths), car collisions (6 deaths), entrainment in power plants (158 deaths), shootings (113 deaths), marine debris entanglement or ingestion (13 deaths), research permit- related takes (3 deaths), and unknown sources (19 deaths). Stranding records are a gross under-estimate of injury and mortality because many animals and carcasses are never recovered. There are currently no estimates of the total number of California sea lions being killed or injured by guns, boat and car collisions, entrainment in power plants, marine debris, or gaffs, but the minimum number from 2005-2009 was 324, or an annual average of 65 animals.

Under authorization of MMPA Section 120, individually identifiable California sea lions have been killed or captured since 2008 in response to their predation on endangered salmon and steelhead stocks in the Columbia River. Captured animals were transferred to aquaria and/or zoos. Between April 2008 and September 2010, 40 California sea lions were removed from this stock (30 lethal removals and 10 relocations to aquaria and/or zoos). The average annual mortality due to direct removals for the period April 2008 to September 2010 is 17 animals per year (relocations to aquaria/zoos are treated the same as mortality because animals are effectively removed from the stock).

Between 2005 and 2009, 15 California sea lions were incidentally killed along the U.S. west coast during scientific trawl and longline operations conducted by NMFS (Southwest Regional Office Stranding Program, unpublished data). The average annual research-related mortality of California sea lions from 2005 to 2009 is 3.0 animals.

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

STATUS OF STOCK

California sea lions in the U.S. are not listed as "endangered" or "threatened" under the Endangered Species Act or as "depleted" under the MMPA. The optimum sustainable population (OSP) status of this population has not been formally determined. The average annual commercial fishery mortality is 337 animals per year (Table 1). Other sources of human-caused mortality (shootings, direct removals, recreational hook and line fisheries, tribal takes, entrainment in power plant intakes, etc.) average 94 animals per year. Total human-caused mortality of this stock is at least 431 animals per year. California sea lions are not considered "strategic" under the MMPA because total human-caused mortality is less than the PBR (9,200). The total fishery mortality and serious injury rate (337 animals/year) for this stock is less than 10% of the calculated PBR and, therefore, is considered to be insignificant and approaching a zero mortality and serious injury rate.

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Revised 12/15/2011

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

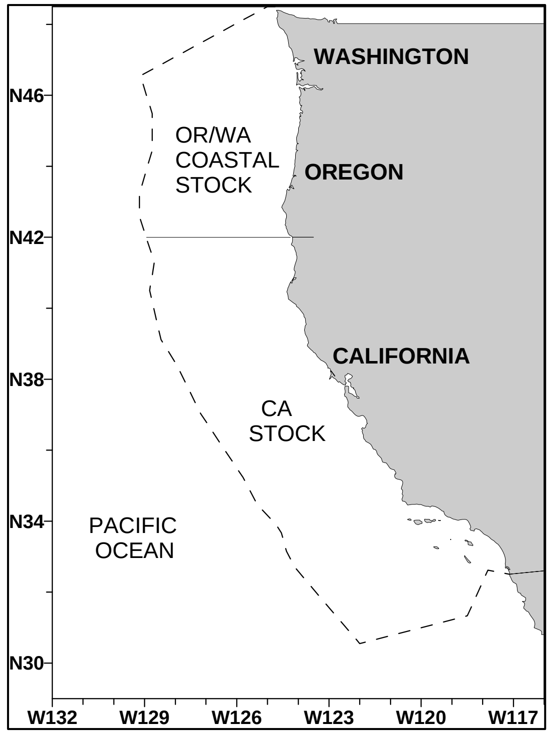

Figure 1. Stock boundaries for the California and Oregon/Washington coastal stocks of harbor seals. Dashed line represents the U.S. EEZ.

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

POPULATION SIZE

A complete count of all harbor seals in California is impossible because some are always away from the haulout sites. A complete pup count (as is done for other pinnipeds in California) is also not possible because harbor seals are precocial, with pups entering the water almost immediately after birth. Population size is estimated by counting the number of seals ashore during the peak haul-out period (May to July) and by multiplying this count by a correction factor equal to the inverse of the estimated fraction of seals on land. Harvey and Goley (2011) calculated a correction factor of 1.54 (CV=0.157) based on 180 seals radio-tagged in California. This correction factor is based on the mean of four date-specific correction factors (1.31, 1.38, 1.62, 1.84) calculated for central and northern California. Based on the most recent harbor seal counts (19,608 in May-July 2009; NMFS unpublished data) and the Harvey and Goley (2011) correction factor, the harbor seal population in California is estimated to number 30,196 seals (CV=0.157).

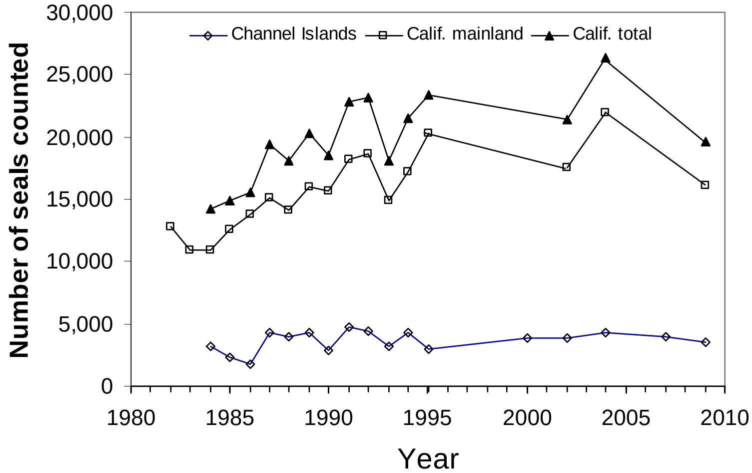

Figure 2. Harbor seal haulout counts in California during May/June (Hanan 1996; R. Read, CDFG unpubl. data; Lowry *et al*. 2008, NMFS unpubl. data from 2009 surveys).

Minimum Population Estimate

The minimum population size is estimated from the number of seals counted hauled out in 2009 (19,608), multiplied by the lower 20th percentile of the correction factor (1.36), or 26,667 seals.

Current Population Trend

Counts of harbor seals in California increased from 1981 to 2004 (Fig. 2). The maximum statewide count in the 1981-2009 time series occurred in 2004 (Fig. 2).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A realized rate of increase was calculated for the 1982-1995 period (when annual counts were available) by linear regression of the natural logarithm of total count versus year. The slope of this regression line was 0.035 (s.e.= 0.007) which gives an annualized growth rate estimate of 3.5%. The true rate of net production is greater than this observed growth rate because fishery and other human-caused mortality removes a fraction of the net production. Annual gillnet mortality may have been as high as 5-10% of the California harbor seal population in the mid-1980s; a kill this large would have depressed population growth rates appreciably. Net productivity was therefore calculated for 1980-1994 as the realized rate of population growth (increase in seal counts from year *i* to year *i*+1, divided by the seal count in year *i*) plus the human-caused mortality rate (fishery mortality in year *i* divided by population size in year *i*). Between 1983 and 1994, the net productivity rate for the California stock averaged 9.2% (Fig. 3). A regression shows a decrease in net production rates, but the decline is not statistically significant. Maximum net productivity rates cannot be estimated because measurements were not made when the stock size was very small. A current estimate of net production for the California harbor seal stock is difficult to determine because the fishery that was responsible for the most mortality (California halibut and white seabass set gillnet) has only been intermittently observed since the mid-1990s, and statewide annual counts of seals at rookeries are not available after 1995 (Fig. 2).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (26,667) <u>times</u> one half the default maximum net productivity rate for pinnipeds (½ of 12%) <u>times</u> a recovery factor of 1.0 (for a stock of unknown status that is growing or for a stock at OSP, Wade and Angliss 1997), resulting in a PBR of 1,600.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Historical Takes

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

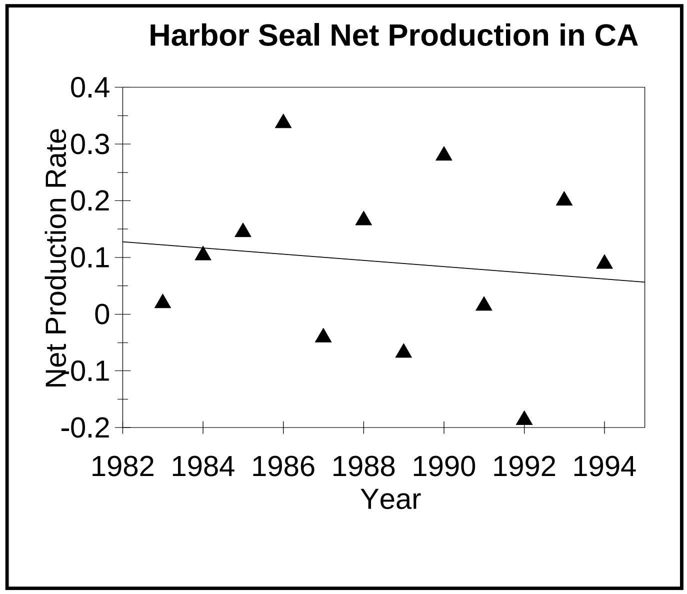

Figure 3. Net production rates and regression line estimated from haulout counts and fishery mortality.

Fishery Information

A summary of known fishery mortality and injury for this stock of harbor seals is given in Table 1. More detailed information on these fisheries is provided in Appendix 1. Historically, the set gillnet fishery for halibut and white seabass was the largest source of fishery mortality and remains the most likely fishery in California to interact with harbor seals today. Julian and Beeson (1998) reported a range of annual mortality estimates from 227 to 1,204 seals (mean = 584) from 1990 to 1994, based on 5% to 15% fishery observer coverage. Regulations implemented in 1994 moved the fishery farther offshore in southern California, which may have reduced harbor seal entanglements in this region. The fishery was not observed again until 1999 and 2000 in Monterey Bay, although annual mortality estimates of 300-400 seals were still calculated based on 1990-1994 bycatch rates and 1999-2000 fishing effort (Cameron and Forney 2000, Cameron and Forney 2001, Carretta 2002, 2003). The observer program for this fishery was discontinued after 2000. In 2002 the fishery was subject to further area restrictions that effectively eliminated fishing north of Point Arguello, California. In 2006, the fishery was again observed at low levels (12 sets out of an estimated 1,300), with one observed mortality. In 2007, 248 sets were observed (~17% observer coverage) with 2 harbor seal deaths observed and a resulting mortality estimate of 11 animals (Table 1). Total effort in the set gillnet fishery has declined from approximately 4,000 sets annually to approximately 1,300 (Carretta and Enriquez 2009a). Stranding data from California between 2005 and 2009 include eight harbor seal deaths caused by hook-and-line fisheries (The total annual human-caused mortality from 2005 to 2009 from commercial fisheries is 18 animals per year (Table 1). There were also 7 harbor seal deaths attributed to recreational hook and line fisheries between 2005 and 2009 (NMFS, unpublished stranding data).

Other Mortality

NMFS stranding records for California for the period 2005-2009 include the following human-caused mortality not included in Table 1: shootings (2), ship/vessel strikes (1), entrainment in power plants (52), and research-related deaths (3). This results in an annual average of 12 harbor seal deaths per year for the years 2005-2009.

STATUS OF STOCK

A review of harbor seal dynamics through 1991 concluded that their status relative to OSP could not be determined with certainty (Hanan 1996). California harbor seals are not listed as "endangered" or "threatened" under the Endangered Species Act nor as "depleted" under the MMPA. Annual human-caused mortality from commercial fisheries (18/yr) and other human-caused sources (13/year) is 31 animals, which is less than the calculated PBR for this stock (1,600), and thus they would not be considered a "strategic" under the MMPA. The fishery that historically removed the largest numbers of harbor seals (halibut and white seabass set gillnet) has been observed only intermittently in recent years, but annual bycatch from 2007 when the fishery had ~18% observer coverage indicates that current rates of absolute bycatch are much lower than during the 1990s. The average annual rate of incidental commercial fishery mortality (18 animals) is less than 10% of the calculated PBR (1,600 animals);

therefore, fishery mortality is considered insignificant and approaching zero mortality and serious injury rate. The population appears to be stabilizing at what may be its carrying capacity and the fishery mortality is declining. There are no known habitat issues that are of particular concern. Two unexplained harbor seal mortality events occurred in Point Reyes National Seashore involving at least 90 seals in 1997 and 16 seals in 2000. Necropsy of three seals in 2000 showed severe pneumonia; tests for morbillivirus were negative, but attempts are being made to identify another virus isolated from one of the three (F. Gulland, pers. comm.). All west-coast harbor seals that have been tested for morbilliviruses were found to be seronegative, indicating that this disease is not endemic in the population and that this population is extremely susceptible to an epidemic of this disease (Ham-Lammé et al. 1999).

Table 1. Summary of available information on the mortality and serious injury of harbor seals (California stock) in commercial fisheries that might take this species (Carretta and Enriquez 2006, 2009; Heery et al. 2010). n/a indicates that data are not available. Mean annual takes are based on 2005-2009 data unless noted otherwise.

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed Mortality	Estimated Mortality (CV in parentheses)	Mean Annual Takes (CV in parentheses)
CA halibut and white seabass set gillnet fishery	2005 2006 2007 2008 2009	observer	0% <1% 17.8% 0% 0%	0 0 2 0 0	n/a n/a 11 (0.73) n/a n/a	11 (0.73)[1]
CA anchovy, mackerel, sardine, and tuna purse seine fishery	2004-2006	observer	~2%	0	0	0
WA, OR, CA groundfish trawl (includes at-sea hake and other limited-entry groundfish sectors)	2004 2005 2006 2007 2008	observer	99% to 100% of tows in at-sea hake fishery; 18%-26% of landings in other groundfish sectors	1 1 1 0 4	1 (n/a) 1 (n/a) 1 (n/a) 0 (n/a) 29 (n/a)	6.4 (n/a)
CA squid purse seine fishery	2004-2006	observer	~5%	0	0	0
(unknown net fisheries)	2005-2009	stranding	n/a		n/a	≥0.8
Total annual takes						18 (0.73)

[1] Only 2007 data is included in the mean annual take calculation for the CA halibut and white seabass fishery, due to the low observer coverage (<1%) in 2006.

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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).

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 (Fig. 1). Genetic analyses provide additional support for this stock structure (Huber et al. 1994, 2010; 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 Washington inland waters possess unique haplotypes not found in seals from the coasts of Washington, Oregon, and California (Lamont et al. 1996). Recent genetic evidence suggests that the population of harbor seals in Washington inland waters has more structure than is currently recognized (Huber et al. 2010). 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. Harbor seals occurring in British Columbia are not included in any of the U.S. Marine Mammal Protection Act (MMPA) stock assessment reports.

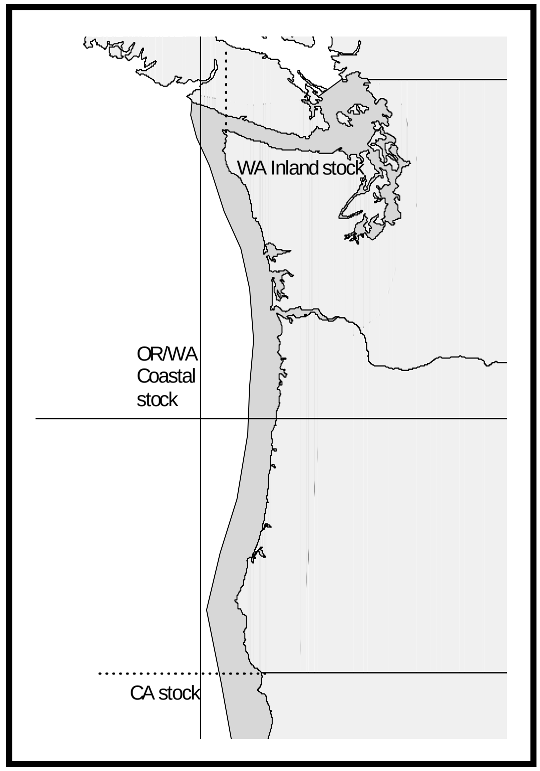

Figure 1. Approximate distribution of harbor seals in the U.S. Pacific Northwest (shaded area). Stock boundaries separating the three stocks are shown.

POPULATION SIZE

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

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

Minimum Population Estimate

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

Current Population Trend

Historical levels of harbor seal abundance in Oregon and Washington are unknown. The population apparently decreased during the 1940s and 1950s due to state-financed bounty programs. Approximately 17,133 harbor seals were killed in Washington by bounty hunters between 1943 and 1960 (Newby 1973). More than 3,800 harbor seals were killed in Oregon between 1925 and 1972 by bounty hunters and a state-hired seal hunter (Pearson 1968). The population remained relatively low during the 1960s but, since the termination of the harbor seal bounty program and with the protection provided by the passage of the MMPA in 1972, harbor seal counts for this stock have increased from 6,389 in 1977 to 16,165 in 1999 (Jeffries et al. 2003; ODFW, unpublished data). Based on the analyses of Jeffries et al. (2003) and Brown et al. (2005), both the Washington and Oregon portions of this stock have reached carrying capacity and are no longer increasing (Fig. 2).

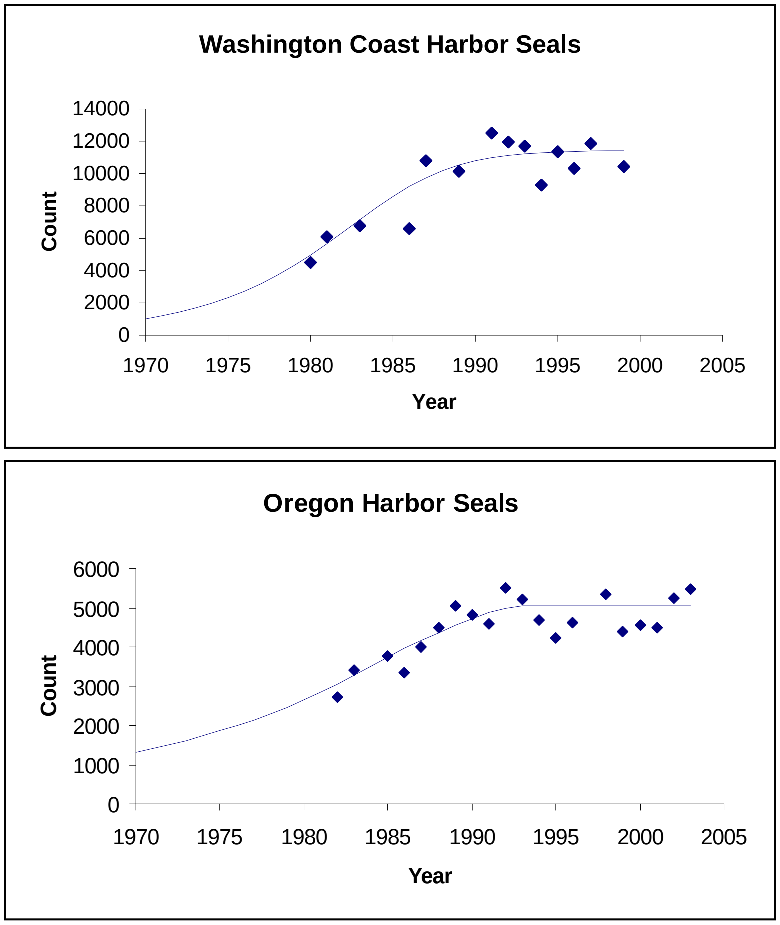

Figure 2. Generalized logistic growth curves of Washington Coast (Jeffries et al. 2003) and Oregon (Brown et al. 2005) harbor seals.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

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

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Fishing effort in the northern Washington marine gillnet tribal fishery is conducted within the range of both stocks of harbor seals (Oregon/Washington Coast and Washington Inland Waters) 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 waters south and west of Cape Flattery, WA, are assumed to have belonged to the Oregon/Washington Coast stock, and Table 1 includes data only from that portion of the fishery. Fishing effort in the coastal marine set gillnet tribal fishery has declined since 2004. There was one fisher self-report of a harbor seal death in a set gillnet in coastal waters in 2004 (Makah Fisheries Management, unpublished data). A test set gillnet fishery, with 100% observer coverage, was conducted in coastal waters in 2004 and 2008. This test fishery required the use of nets equipped with acoustic alarms, and observers reported five harbor seal deaths in 2004 and one harbor seal death in 2008 (Makah Fisheries Management, unpublished data). The mean estimated mortality for the marine set gillnet tribal fishery in 2004-2008 is 1.2 (CV=0) harbor seals per year from observer data plus 0.2 seals per year from fisher self-reports.

The Washington/Oregon/California (WA/OR/CA) groundfish trawl fishery (Pacific hake at-sea processing component) was monitored for incidental take during 2002-2006 (NWFSC 2008), and harbor seal deaths were observed in 2005 and 2006. The mean estimated mortality for this fishery in 2002-2006 is 0.4 (CV=0.30) harbor seals per year.

Table 1. Summary of available information on the incidental mortality and serious injury of harbor seals (Oregon/Washington Coast stock) in commercial and tribal fisheries that might take this species and calculation of the mean annual mortality rate; n/a indicates that data are not available. Mean annual takes are based on 2004-2008 data unless otherwise noted.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean annual takes (CV in parentheses)
Northern WA marine set gillnet (tribal test fishery in coastal waters)	2004 2005 2006 2007 2008	observer data	100% no fishery no fishery no fishery 100%	5 0 0 0 1	5 (0) 0 (0) 0 (0) 0 (0) 1 (0)	1.2 (0)
Northern WA marine set gillnet (tribal fishery in coastal waters)	2004	fisher self-reports		1	n/a	≥0.2 (n/a)
WA/OR/CA groundfish trawl (Pacific hake at-sea processing component)	2002 2003 2004 2005 2006	observer data	100%[1] 100%[1] 100%[1] 100%[1] 100%[1]	0 0 0 1 1	0 (0) 0 (0) 0 (0) 1 (0.42) 1 (0.44)	0.4 (0.30)
WA Grays Harbor salmon drift gillnet[2]	1991-1993	observer data	4-5%	0, 1, 1	0, 10, 10	see text[2]
WA Willapa Bay drift gillnet[2]	1991-1993	observer data	1-3%	0, 0, 0	0, 0, 0	see text[2]
WA Willapa Bay drift gillnet[2]	1990-1993	fisher self-reports	n/a	0, 0, 6, 8	n/a	see text[2]
Unknown West Coast fisheries	2004-2008	stranding data	n/a	0, 0, 0, 0, 0	n/a	0
Minimum total annual takes						≥1.8 (0.08)

[1]Percent observer coverage equals percent of vessels with observers.

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

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 mortality, incidental to the fishery, was observed only in the winter season and was 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 spring chinook stocks listed under the Endangered Species Act (ESA). 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 deaths or serious injuries were reported to NMFS by vessel operators.

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 mortality was recorded in 1991. In 1992, observers recorded one harbor seal death incidental to the fishery, resulting in an extrapolated estimated total kill of 10 seals (CV=1.0). In 1993, observers recorded one harbor seal death 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. 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.

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 mortality was reported by observers. However, because mortality was self-reported by fishers in 1992 and 1993, the low level of observer coverage failed to document harbor seal mortality that had apparently occurred. Due to the low level of observer coverage for this fishery, the self-reported fishery mortality has been included in Table 1 and represents 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).

Combining recent estimates from the northern Washington marine set tribal gillnet (1.2 from observer data + 0.2 from fisher self-reports) and WA/OR/CA groundfish trawl (0.4 from observer data) fisheries results in an estimated mean mortality rate of 1.8 harbor seals per year from these fisheries.

The Marine Mammal Authorization Program (MMAP) fisher self-reports, required of commercial vessel operators by the MMPA, are an additional source of information on the number of harbor seals killed or seriously injured incidental to commercial fishery operations. Between 2002 and 2006, there were two fisher self-reports of harbor seal deaths in the WA/OR/CA groundfish trawl (Pacific hake at-sea processing) fishery. Since this is an observed fishery, these deaths are not included in Table 1. Although these reports are considered incomplete (see details in Appendix 1), they represent a minimum mortality.

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. According to Northwest Marine Mammal Stranding Network records, maintained by the NMFS Northwest Region (NMFS, Northwest Regional Office, unpublished data), there were no fishery-related strandings of harbor seals from this stock reported in 2004-2008, resulting in an average annual mortality of zero harbor seals. This estimate is considered a minimum because not all stranded animals are found, reported, or examined for cause of death (via necropsy by trained personnel).

Other Mortality

According to Northwest Marine Mammal Stranding Network records, maintained by the NMFS Northwest Region (NMFS, Northwest Regional Office, unpublished data), a total of 10 human-caused harbor seal deaths or serious injuries were reported from non-fisheries sources in 2004-2008. Seven animals were shot, two animals were struck by boats, and one animal was entangled in line, resulting in an estimated mortality of 2.0 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

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

STATUS OF STOCK

Harbor seals are not considered to be "depleted" under the MMPA or listed as "threatened" or "endangered" under the ESA. Based on currently available data, the level of human-caused mortality and serious injury is 3.8 (1.8 + 2.0) harbor seals per year. A PBR cannot be calculated for this stock because there is no current abundance estimate. The previous estimate of PBR was 1,343 (Carretta et al. 2009). Human-caused mortality relative to PBR is unknown, but it is considered to be small relative to the stock size. Therefore, the Oregon/Washington Coast stock of harbor seals is not classified as a "strategic" stock. The minimum total fishery mortality and serious injury for this stock (based on recent observer data (1.6) and self-reported fisheries information (0.2) or stranding data (0) where observer data were not available or failed to detect harbor seal mortality) is 1.8. Since a PBR cannot be calculated for this stock, fishery mortality relative to PBR is unknown. The stock is within its Optimum Sustainable Population (OSP) level (Jeffries et al. 2003, Brown et al. 2005).

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HARBOR SEAL (*Phoca vitulina richardsi*): Washington Inland Waters Stock

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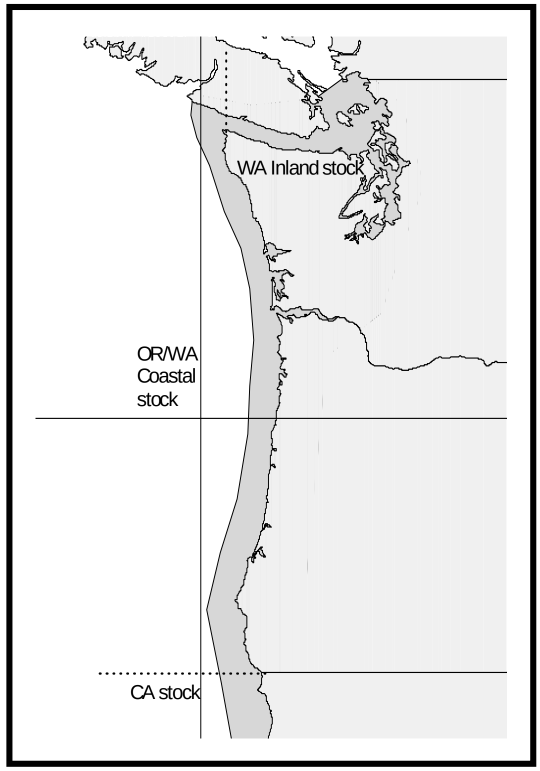
Harbor seals inhabit coastal and estuarine waters off Baja California, north along the western coasts of the continental U.S., British Columbia, and Southeast Alaska, west through the Gulf of Alaska and Aleutian Islands, and in the Bering Sea north to Cape Newenham and the Pribilof Islands. They haul 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).



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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). Genetic analyses provide additional support for this stock structure (Huber et al. 1994, 2010; 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 Washington inland waters possess unique haplotypes not found in seals from the coasts of Washington, Oregon, and California (Lamont et al. 1996). Recent genetic evidence suggests that the population of harbor seals in Washington inland waters has more structure than is currently recognized (Huber et al. 2010). In this report, only the Washington Inland Waters stock is addressed. Harbor seal stocks that occur in the inland and coastal waters of Alaska are reported separately in the Stock Assessment Reports for the Alaska Region.

POPULATION SIZE

Aerial surveys of harbor seals in Washington were conducted during the pupping season in 1999, during which time the total numbers of hauled-out seals (including pups) were counted. In 1999, the mean count of harbor seals occurring in Washington's inland waters was 9,550 (CV=0.14) animals (Jeffries et al. 2003).

Radio-tagging studies conducted at six locations (three Washington inland waters sites and three Oregon and Washington coastal sites) collected information on haulout patterns from 63 harbor seals in 1991 and 61 harbor seals in 1992. Data from coastal and inland sites were not significantly different and were thus pooled, resulting in a correction factor of 1.53 (CV=0.065) to account for animals in the water which are missed during the aerial surveys (Huber et al. 2001). Using this correction factor results in a population estimate of 14,612 (9,550 x 1.53; CV=0.15) for the Washington Inland Waters stock of harbor seals (Jeffries et al. 2003). However, because the most recent abundance estimate is >8 years old, there is no current estimate of abundance.

Minimum Population Estimate

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

Current Population Trend

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

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

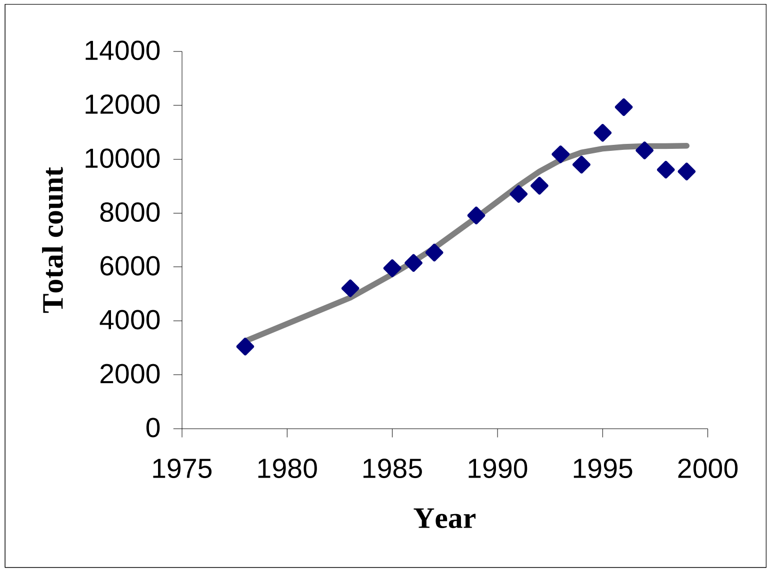

Figure 2. Generalized logistic population growth curve for the Washington Inland Waters stock of harbor seals, 1978-1999 (Jeffries et al. 2003).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

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

Fisheries Information

Fishing effort in the northern Washington marine gillnet tribal fishery is conducted within the range of both stocks of harbor seals (Oregon/Washington Coast and Washington Inland Waters) 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 waters east of Cape Flattery, WA, are assumed to have belonged to the Washington Inland Waters stock, and Table 1 includes data only from that portion of the fishery. There was no observer coverage in the northern Washington marine set gillnet tribal fishery in inland waters in 2004-2008; however, there were two fisher self-reports of harbor seal deaths in this fishery in 2008 (Makah Fisheries Management, unpublished data). The mean estimated mortality for this fishery in 2004-2008 is 0.4 harbor seals per year from fisher self-reports. Fishing effort in the northern Washington marine drift gillnet tribal fishery in inland waters is also conducted within the range of the Washington Inland Waters stock of harbor seals. This fishery is not observed; however, there was one fisher self-report of a harbor seal death in 2008 (Makah Fisheries

Management, unpublished data). The mean estimated mortality for this fishery in 2004-2008 is 0.2 harbor seals per year from fisher self-reports.

In 1993, as a pilot for future observer programs, NMFS, in conjunction with the Washington Department of Fish and Wildlife (WDFW) monitored all non-treaty components of the Washington Puget Sound Region salmon gillnet fishery (Pierce et al. 1994). Observer coverage was 1.3% overall, ranging from 0.9% to 7.3% for the various components of the fishery. Two harbor seal deaths were reported. Pierce et al. (1994) cautioned against extrapolating this mortality to the entire Puget Sound fishery due to the low observer coverage and potential biases inherent in the data. The area 7/7A sockeye landings represented the majority of the non-treaty salmon landings in 1993, approximately 67%. Results of this pilot study were used to design the 1994 observer programs discussed below.

Table 1. Summary of available information on the incidental mortality and injury of harbor seals (Washington Inland Waters stock) in commercial and tribal fisheries that might take this species and calculation of the mean annual mortality rate; n/a indicates that data are not available. All entanglements resulted in the death of the animal. Mean annual takes are based on 2004-2008 data unless noted otherwise.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean annual takes (CV in parentheses)
Northern WA marine set gillnet (tribal fishery in inland waters)	2004 2005 2006 2007 2008	observer data	0% 0% 0% 0% 0%	n/a n/a n/a n/a n/a	n/a n/a n/a n/a n/a	n/a
	2008	fisher self-reports		2	n/a	≥0.4 (n/a)
Northern WA marine drift gillnet (tribal fishery in inland waters)	2008	fisher self-reports		1	n/a	≥0.2 (n/a)
WA Puget Sound Region salmon set/drift gillnet (observer programs listed below covered segments of this fishery):	-	-	-	-	-	-
Puget Sound non-treaty salmon gillnet (all areas and species)	1993	observer data	1.3%	2	n/a	see text
Puget Sound non-treaty chum salmon gillnet (areas 10/11 and 12/12B)[1]	1994	observer data	11%	1	10	see text[1]
Puget Sound treaty chum salmon gillnet (areas 12, 12B, and 12C)[1]	1994	observer data	2.2%	0	0	see text[1]
Puget Sound treaty chum and sockeye salmon gillnet (areas 4B, 5, and 6C)[1]	1994	observer data	7.5%	0	0	see text[1]
Puget Sound treaty and non-treaty sockeye salmon gillnet (areas 7 and 7A)[1]	1994	observer data	7%	1	15	see text[1]
Unknown Puget Sound fisheries	2004-2008	stranding data	n/a	1, 0, 0, 8, 6	n/a	≥3.0 (n/a)
Minimum total annual takes						≥3.6 (n/a)

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

In 1994, NMFS, in conjunction with WDFW conducted an observer program during the Puget Sound non-treaty chum salmon gillnet fishery (areas 10/11 and 12/12B). A total of 230 sets were observed during 54 boat trips, representing approximately 11% observer coverage of the 500 fishing boat trips comprising the total effort in this fishery, as estimated from fish ticket landings (Erstad et al. 1996). One harbor seal was taken in the fishery, resulting in an entanglement rate of 0.02 harbor seals per trip (0.004 harbor seals per set), which extrapolated to approximately 10 deaths for the entire fishery. The Puget Sound treaty chum salmon gillnet fishery in Hood Canal (areas 12, 12B, and 12C) and the Puget Sound treaty sockeye/chum gillnet fishery in the Strait of Juan de Fuca (areas 4B, 5, and 6C) were also monitored in 1994 (NWIFC 1995). No harbor seal mortality was reported in the observer programs covering these treaty salmon gillnet fisheries, where observer coverage was estimated at 2.2% (based on % of total catch observed) and approximately 7.5% (based on % of observed trips to total landings), respectively.

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

It should be noted that the 1994 observer programs did not sample all segments of the Washington Puget Sound Region salmon set/drift gillnet fishery and, further, the extrapolations of total kill did not include effort for the unobserved segments of this fishery. The percentage of the overall Washington Puget Sound Region salmon set/drift gillnet fishery effort that was observed in 1994 was not quantified. However, the areas having the highest salmon catches and in which a majority of the vessels operated in 1994 were covered by the 1994 observer programs (Joe Scordino, pers. comm.). Harbor seal takes in the Washington Puget Sound Region salmon drift gillnet fishery are unlikely to have increased since the fishery was last observed in 1994, due to reductions in the number of participating vessels and available fishing time (see details in Appendix 1). Fishing effort and catch have declined throughout all salmon fisheries in the region due to management efforts to recover ESA-listed salmonids.

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

Combining the estimates from the northern Washington marine set gillnet tribal fishery (0.4) and the northern Washington marine drift gillnet tribal fishery (0.2), results in an estimated mean annual mortality rate of 0.6 harbor seals from this stock. One harbor seal also entangled in a tribal drift gillnet test fishery in area 8-2 in 2006, resulting in an annual mortality of 0.2 harbor seals for this fishery.

The Marine Mammal Authorization Program (MMAP) fisher self-reports, required of commercial vessel operators by the MMPA, are an additional source of information on the number of harbor seals killed or seriously injured incidental to commercial fishery operations. Between 2004 and 2008, there were no fisher self-reports of harbor seal deaths from the Washington Puget Sound Region salmon set/drift gillnet fishery. Unlike the 1994 observer program data, the self-reported fishery data cover the entire fishery (including treaty and non-treaty components). Although these reports are considered incomplete (see details in Appendix 1), they represent a minimum mortality.

Strandings of harbor seals entangled in fishing gear or with injuries caused by interactions with gear are a final source of fishery-related mortality information. According to Northwest Marine Mammal Stranding Network records, maintained by the NMFS Northwest Region (NMFS, Northwest Regional Office, unpublished data), there were 15 fishery-related strandings of harbor seals from this stock reported in 2004-2008, resulting in an average annual mortality of 3.0 harbor seals. Evidence of fishery interactions included entanglements in fishing nets (10), entanglements in fishing gear (three), hook injuries (one), and ingested hooks (one). As the strandings could not be attributed to a particular fishery, they have been included in Table 1 as occurring in unknown Puget Sound fisheries. 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 (NMFS, Northwest Regional Office, unpublished data), a total of 46 human-caused harbor seal deaths or serious injuries were reported from non-fisheries sources in 2004-2008. Twenty-four animals were shot, 13 were struck by boats, two died in oil spills, three were killed by dogs, one was beaten by a fisherman, one was caught in the Ballard Locks, one entangled in wire, and one entangled in a scientific research capture net, resulting in an estimated mortality of 9.2 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

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

STATUS OF STOCK

Harbor seals are not considered to be "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Based on currently available data, the level of human-caused mortality and serious injury is 13.0 (3.8 + 9.2) harbor seals per year. A PBR cannot be calculated for this stock because there is no current abundance estimate. The previous estimate of PBR was 771 (Carretta et al. 2009). Human-caused mortality relative to PBR is unknown, but it is considered to be small relative to the stock size. Therefore, the Washington Inland Waters stock of harbor seals is not classified as a "strategic" stock. At present, the minimum estimated fishery mortality and serious injury for this stock is 3.8 (based on recent observer data (0) and self-reported fisheries information (0.8) or stranding data (3.0) where observer data were not available or failed to detect harbor seal mortality). Since a PBR cannot be calculated for this stock, fishery mortality relative to PBR is unknown. The stock is within its Optimum Sustainable Population (OSP) level (Jeffries et al. 2003).

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Revised 10/30/2007

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.

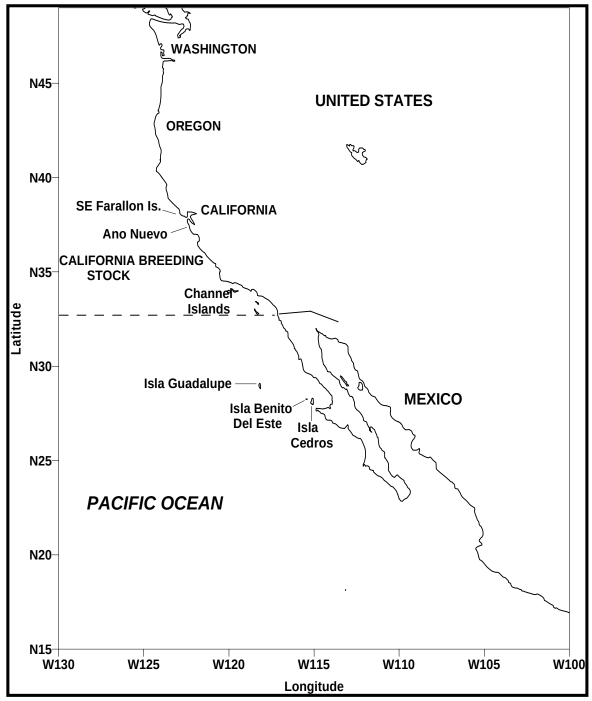

Figure 1. Stock boundary and major rookery areas for northern elephant seals in the U.S. and Mexico.

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

Minimum Population Estimate

The minimum population size for northern elephant seals can be estimated very conservatively as 74,913, which is equal to twice the observed pup count (to account for the pups and their mothers) plus 3,815 males and juveniles counted at the Channel Islands and central California sites in 2005 (Mark Lowry, NMFS unpubl. data) . 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 2005 (Figure 2), but appear to be stable or slowly decreasing in Mexico (Stewart et al. 1994).

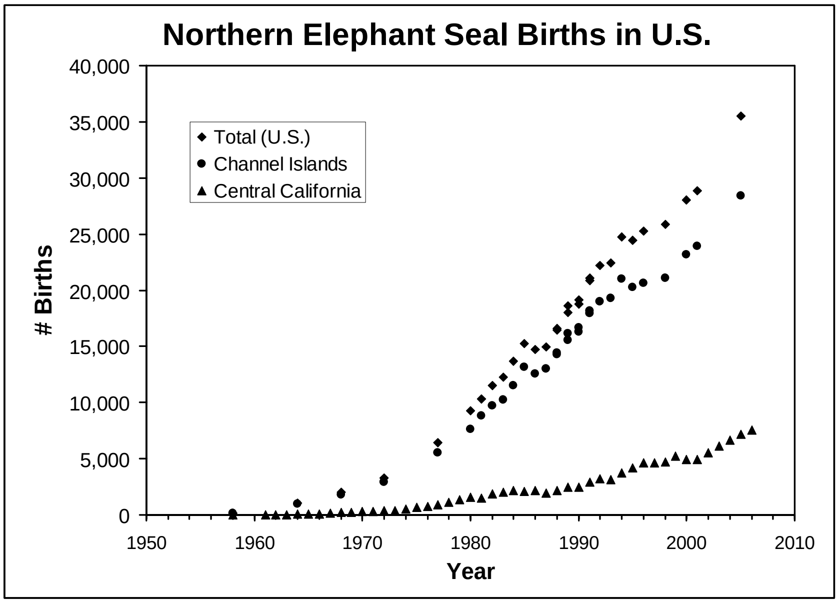

Figure 2. Estimated number of northern elephant seal births in California 1958-2005. Multiple independent estimates are presented for the Channel Islands 1988-91. Estimates are from Stewart et al. (1994), Lowry et al. (1996), Lowry (2002) and unpublished data from Sarah Allen, Dan Crocker, Brian Hatfield, 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 generalized logistic growth model indicates that the maximum population growth rate (R_{max}) is 11.7 percent (SE = 2.7) (Figure 3).

POTENTIAL BIOLOGICAL REMOVAL

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

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. Stranding data reported to the California, Oregon, and Washington Marine Mammal Stranding Networks in 2000-2004 include elephant seal injuries caused by hook-and-line fisheries (two injuries) and gillnet fisheries (one injury).

Table 1. Summary of available information on the mortality and serious injury of northern elephant seals (California breeding stock) in commercial fisheries that might take this species (Carretta and Chivers 2004, Carretta et al. 2005a, 2005b, Perez 2003 , Perez 2003; Perez, in prep.; NMFS unpubl. data). n/a indicates information is not available. Mean annual takes are based on 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	2000 2001 2002 2003 2004	observer data	22.9% 20.4% 22.1% 20.2% 20.6%	6 1 1 1 0	26 (0.39) 5 (0.94) 5 (0.92) 5 (1.00) 0	8 (0.40)
CA angel shark/halibut and other species large mesh (>3.5") set gillnet fishery[1]	2001[1] 2002[1] 2003[1] 2004[1] 2005[1]	observer data	0% 0% 0% 0% 0%	n/a n/a n/a n/a n/a	n/a n/a n/a n/a n/a	n/a
WA, OR, CA domestic groundfish trawl (At-sea processing Pacific whiting fishery only)	2000 2001 2002 2003 2004	observer data	80.6% 96.2% 100% 100% 100%	1 0 0 0 3	1 (n/a) 0 (n/a) 0 (n/a) 0 (n/a) 3 (n/a)	0.8 (n/a)
WA, OR, CA domestic groundfish trawl fishery (bottom trawl)	2000-2004	observer	n/a	0	0	0 (n/a)
Total annual takes						> 8.8 (0.40)

[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.

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

Stranding databases for California, Oregon, and Washington states that are maintained by the National Marine Fisheries Service contain the following records of human-related elephant seal mortality and injuries in 2000-2004: (1) boat collision (three deaths), (2) power plant entrainment (one death), (3) shootings (four deaths) and (4) entanglement in marine debris (10 injuries). This results in a minimum annual average of 1.6 non-fishery related deaths for 2000-2004.

STATUS OF STOCK

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 (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 (>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 mortality that likely occurs 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.

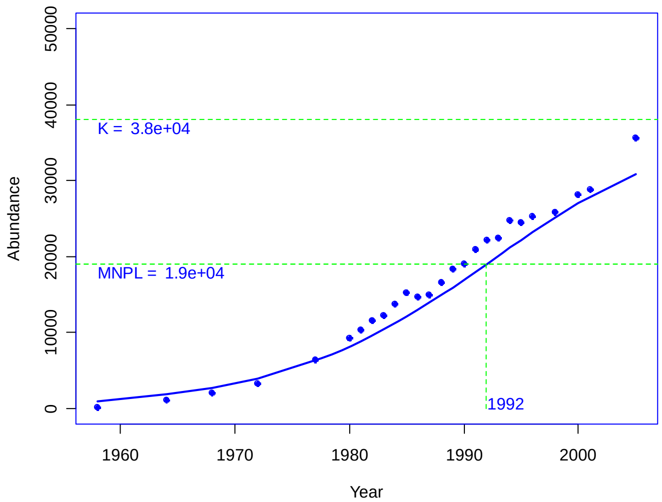

Figure 3. Generalized logistic growth model of elephant seal pup counts, 1958-2005.

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Revised 12/15/2000

GUADALUPE FUR SEAL (*Arctocephalus townsendi*)

STOCK DEFINITION AND GEOGRAPHIC RANGE

Commercial sealing during the 19th century reduced the once abundant Guadalupe fur seal to near extinction in 1894 (Townsend 1931). Prior to the harvest it ranged from Monterey Bay, California, to the Revillagigedo Islands, Mexico (Fleischer 1987, Hanni et al. 1997; Figure 1). The capture of two adult males at Guadalupe Island in 1928 established the specie's continued existence (Townsend 1931); however, they were not seen again until 1954 (Hubbs 1956). Guadalupe fur seals pup and breed mainly at Isla Guadalupe, Mexico. In 1997, a second rookery was discovered at Isla Benito del Este, Baja California (Maravilla-Chavez and Lowry 1999) and a pup was born at San Miguel Island, California (Melin and DeLong 1999). Individuals have stranded or been sighted as far north as Blind Beach, California (38° 26' 10" N, 123° 07' 20" W); inside the Gulf of California and as far south as Zihuatanejo, Mexico (17° 39' N, 101° 34'W; Hanni et al. 1997 and Aurioles-Gamboa and Hernadez-Camacho 1999). The population is considered to be a single stock because all are recent descendants from one breeding colony at Isla Guadalupe, Mexico.

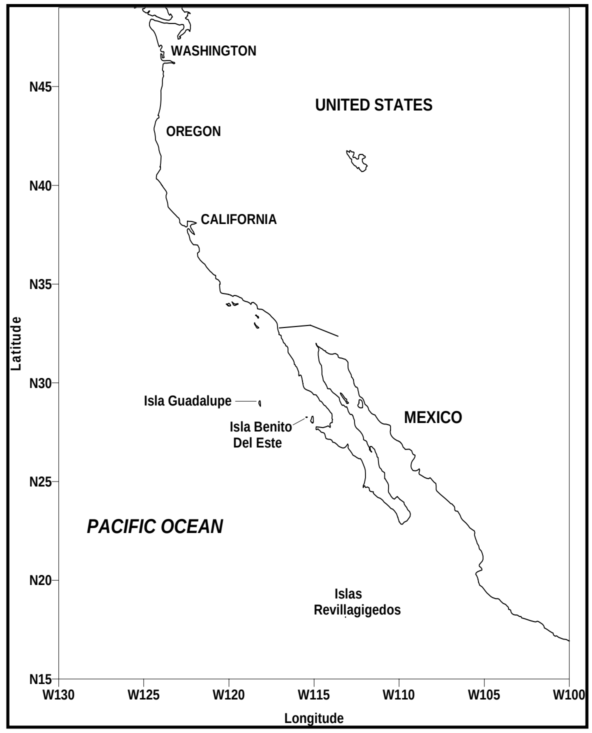

Figure 1. Geographic range of the Guadalupe fur seal, showing location of two rookeries at Isla Guadalupe and Isla Benito Del Este.

POPULATION SIZE

The size of the population prior to the commercial harvests of the 19th century is not known, but estimates range from 20,000 to 100,000 animals (Wedgeforth 1928, Hubbs 1956, Fleischer 1987). The population was estimated by Gallo (1994) to be about 7,408 animals in 1993. The population estimate was derived by multiplying the number of pups (counted and estimated) by a factor of 4.0.

Minimum Population Estimate

All the individuals of the population cannot be counted because all age and sex classes are never ashore at the same time and some individuals that are on land are not visible during the census. Sub-sampling portions of the rookery indicate that only 47-55% of the seals present (i.e., hauled out) are counted during the census (Gallo 1994). The 1993 count of all age classes plus the estimate of missed animals was 6,443 (Gallo 1994). The minimum size of the population in Mexico can be estimated as the actual count of 3,028 hauled out seals [The actual count data were not reported by Gallo (1994); this number is derived by multiplying the estimated number hauled out by 47%, the minimum estimate of the percent counted]. In the United States, a few Guadalupe fur seals are known to inhabit California sea lion rookeries in the Channel Islands (Stewart et al. 1987).

Current Population Trend

Counts of Guadalupe fur seals have been made sporadically since 1954. Records of Guadalupe fur seal counts through 1984 were compiled by Seagars (1984), Fleischer (1987), and Gallo (1994). The count for 1988 was taken from Torres et al. (1990). A few of these counts were made during the breeding season, but the majority were made at other times of the year (Figure 1). Also, the counts that are documented in the literature generally provide only the total of all Guadalupe fur seals counted (i.e., the counts are not separated by age/sex class). The counts that were made during the breeding season, when the maximum number of animals are present at the rookery, were used to examine population growth (Gallo 1994). The natural logarithm of the counts was regressed against year to calculate the growth rate of the population. These data indicate that the population of Guadalupe fur seals is increasing exponentially at an average annual growth rate of 13.7% (Gallo 1994; Figure 2).

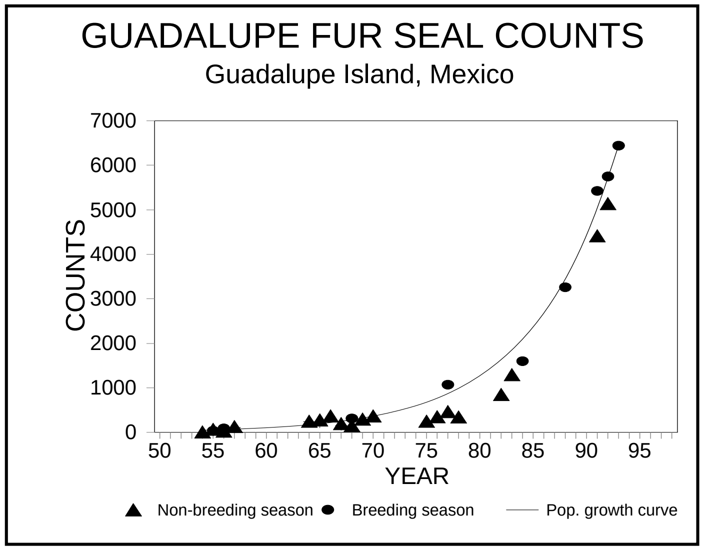

Figure 2. Counts of Guadalupe fur seals at Guadalupe Island, Mexico, and the estimated population growth curve derived from counts made during the breeding season.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

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

HUMAN-CAUSED MORTALITYAND SERIOUS INJURY

Fisheries Information

Drift and set gillnet fisheries may cause incidental mortality of Guadalupe fur seals in Mexico and the United States. In the United States there have been no reports of mortality or injuries for Guadalupe fur seals (Barlow et al.1994, Julian 1997, Julian and Beeson 1998, Cameron and Forney 1999. No information is available for human-caused mortality or injuries in Mexico. However, similar drift gillnet fisheries for swordfish and sharks exist along the entire Pacific coast of Baja California, Mexico and may take animals from the same population. Quantitative data are available only for the Mexican swordfish drift gillnet fishery (Sosa-Nishizaki et al. 1993). The total number of sets in this fishery in 1992 can be estimated from data provided by these authors to be approximately 2,700, with an observed rate of marine mammal bycatch of 0.13 animals per set (10 marine mammals in 77 observed sets; Sosa-Nishizaki et al. 1993). This overall mortality rate is similar to that observed in California driftnet fisheries during 1990-93 (0.15 marine mammals per set), but species-specific information is not available for the Mexican fisheries. There are currently efforts underway to convert the Mexican swordfish driftnet fishery to a longline fishery (D. Holts, pers. comm.). The number of set gillnets used in Mexico is unknown.

Other mortality

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

STATUS OF STOCK

The state of California lists the Guadalupe fur seal as a fully protected mammal in the Fish and Game Code of California (Chap. 8, sec. 4700, d), and it is listed also as a threatened species in the Fish and Game Commission California Code of Regulations (Title 14, sec. 670.5, b, 6, H). The Endangered Species Act lists it as a threatened species, which automatically qualifies this as a "depleted" and "strategic" stock under the Marine Mammal Protection Act. There is insufficient information to determine whether the fishery mortality in Mexico exceeds the PBR for this stock. The total U.S. fishery mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate. The population is growing at approximately 13.7% per year.

Table 1. Summary of available information on the incidental mortality and injury of Guadalupe fur seals in commercial fisheries that might take this species (Julian 1997, Julian and Beeson 1998, Cameron and Forney 1999, M. Perez per. comm, Appendix 1). Mean annual takes are based on 1994-98 data unless noted otherwise.

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed Mortality	Estimated Mortality (CV in parentheses)	Mean Annual Takes (CV in parentheses)
CA driftnet fishery for sharks and swordfish	1994 1995 1996 1997 1998	observer	17.9% 15.6% 12.4% 22.8% 20.2%	0 0 0 0 0	0 0 0 0 0	0[1]
CA set gillnet fishery for halibut and angel shark	1994 1995 1996 1997 1998	observer extrapolated estimates (1995-98)	7.7% 0% 0% 0% 0%	0 0 0 0 0	0 0[2] 0[2] 0[2] 0[2]	0[2]
WA, OR, CA ground fish trawl fishery (At-sea processing Pacific whiting fishery only)	1994 1995 1996 1997 1998	observer	53.8% 56.2% 65.2% 65.7% 77.3%	0 0 0 0 0	0 0 0 0 0	0
Minimum total annual takes						0

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

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Revised 01/15/2011

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Northern fur seals occur from southern California north to the Bering Sea and west to the Okhotsk Sea and Honshu Island, Japan (Fig. 1). During the breeding season, approximately 74% of the worldwide population is found on the Pribilof Islands in the southern Bering Sea, with the remaining animals spread throughout the North Pacific Ocean (Lander and Kajimura 1982). Of the seals in U.S. waters outside of the Pribilofs, approximately 1% of the population is found on Bogoslof Island in the southern Bering Sea and San Miguel Island off southern California (NMFS 2007). Northern fur seals may temporarily haul out on land at other sites in Alaska, British Columbia, and on islets along the coast of the continental United States, but generally this occurs outside of the breeding season (Fiscus 1983).

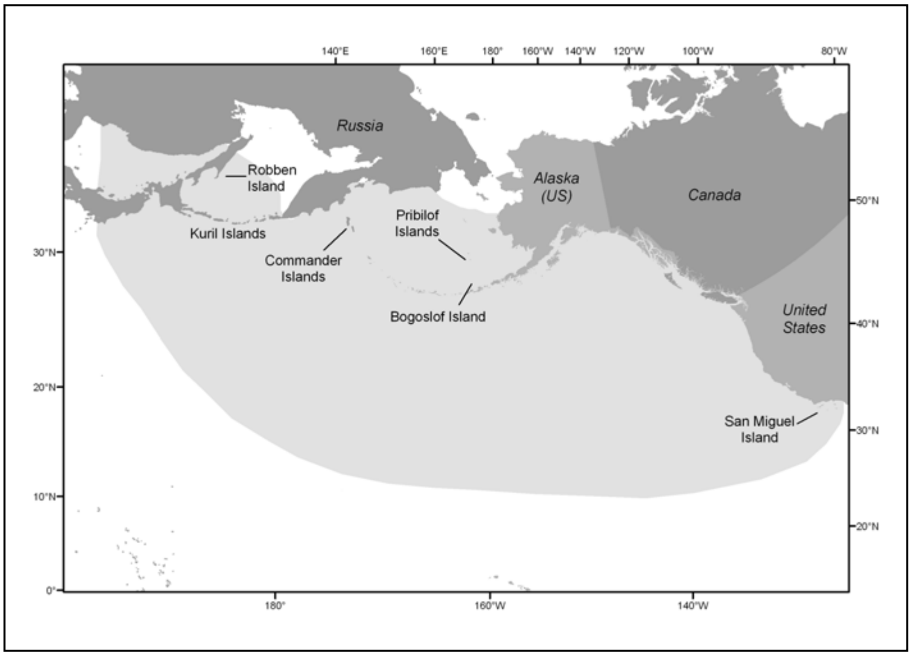

Figure 1. Approximate distribution of northern fur seals in the North Pacific (shaded area).

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

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

POPULATION SIZE

The population estimate for the San Miguel Island stock of northern fur seals is calculated as the estimated number of pups at rookeries multiplied by an expansion factor. Based on research conducted on the Eastern Pacific stock of northern fur seals, Lander's (1981) life table analysis was used to estimate the number of yearlings, two-year-olds, three-year-olds, and animals at least four years old. The resulting population estimate was equal to the pup count multiplied by 4.475. The expansion factors are based on a sex and age distribution estimated after the commercial harvest of juvenile males was terminated in 1984. A more appropriate expansion factor for the San Miguel Island stock is 4.0, because immigration of recruitment-age females is occurring in the population (DeLong 1982) as well as mortality and possible emigration of adults associated with the El Niño Southern Oscillation events in 1982-1983 and 1997-1998 (Melin et al. 2008). A 1998 pup count resulted in an 80% decrease from the 1997 count (Melin et al. 2005). In 1999, the population began to recover, and by 2007 the total pup count was 2,492 (Melin et al. 2008). Based on the 2007 count and the expansion factor, the most recent population estimate of the San Miguel Island stock is 9,968 (2,492 x 4.0) northern fur seals. Currently, a coefficient of variation (CV) for the expansion factor is unavailable.

Minimum Population Estimate

The survey technique utilized for estimating the abundance of northern fur seals within the San Miguel Island stock is a direct count, with no associated CV, as sites are surveyed only once. Additional estimates of the overall population size (i.e., N_{BEST}) and associated CV are also unavailable. Therefore, the minimum population size for this stock cannot be estimated by calculating the lower 20th percentile of the log-normal distribution of the population estimate. Rather, the minimum population size is estimated as twice the maximum number of pups born in 2007 (to account for the pups and their mothers) plus the maximum number of adult (147) and sub-adult (264) males counted for the 2007 season (Melin et al. 2008), which results in an estimate of 5,395 ((2,492 x 2) + 411). This method provides a very conservative estimate of the northern fur seal population at San Miguel Island.

Current Population Trend

The population of northern fur seals on San Miguel Island originated from the Pribilof Islands and Russian populations during the late 1950s or early 1960s (DeLong 1982). The colony has increased steadily, since its discovery in 1968, except for severe declines in 1983 and 1998 associated with El Niño Southern Oscillation events in 1982-1983 and 1997-1998 (DeLong and Antonelis 1991, Melin et al. 2005). El Niño events, which occur periodically along the California coast, impact population growth of northern fur seals at San Miguel Island and are an important regulatory mechanism for this population (DeLong and Antonelis 1991; Melin and DeLong 1994, 2000; Melin et al. 1996, 2005, 2008).

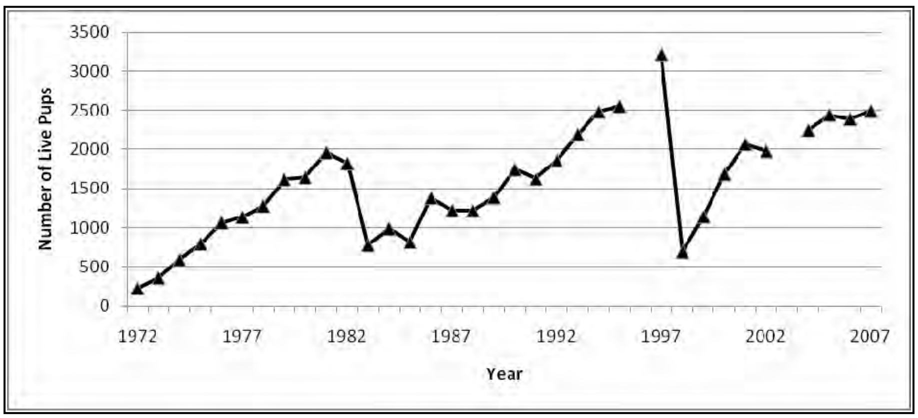

Figure 2. Number of live northern fur seal pups counted on San Miguel Island, 1972-2007.

Specifically, live pup counts increased about 24% annually from 1972 through 1982 (Fig. 2), an increase due, in part, to immigration of females from the Bering Sea and the western North Pacific Ocean (DeLong 1982). The 1982-1983 El Niño event resulted in a 60.3% decline in the northern fur seal population at San Miguel Island (DeLong and Antonelis 1991). It took the population 7 years to recover from this decline, because adult female mortality or emigration occurred in addition to pup mortality (Melin and DeLong 1994). The 1992-1993 El Niño conditions resulted in reduced pup production in 1992, but the population recovered in 1993 and increased in 1994 (Melin et al. 1996).

From July 1997 through May 1998, the most severe El Niño event in recorded history affected California coastal waters (Lynn et al. 1998). In 1997, total fur seal pup production was the highest recorded since the colony has been monitored. However, it appears that up to 87% of the pups born in 1997 died before weaning, and total production in 1998 declined 80% from 1997 (Melin et al. 2005). Although total production increased to 2,492 in 2007 (Melin et al. 2008), the population has not yet recovered. Recovery from the 1998 decline has been slowed by the adult female mortality or emigration which occurred in addition to the high pup mortality in 1997 and 1998 (Melin et al. 2008).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population estimate (5,395) times one-half the default maximum net growth rate (½ of 12%) times a recovery factor of 1.0 (for stocks of unknown status that are increasing in size: Wade and Angliss 1997), resulting in a PBR of 324 San Miguel Island northern fur seals per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Northern fur seals taken during the winter/spring along the west coast of the continental U.S. could be from the Eastern Pacific stock. However, it is the intention of NMFS to consider any takes of northern fur seals by commercial fisheries in waters off California, Oregon, and Washington as being from the San Miguel Island stock. Information concerning observed fisheries that may have interacted with northern fur seals is listed in Table 1. There were no observer reports of northern fur seal deaths in any observed fishery along the west coast of the continental U.S. in 2004-2008 (Table 1; Carretta et al. 2005; Carretta and Enriquez 2006, 2007, 2009a, 2009b; NWFSC 2008). The estimated mean mortality rate in observed fisheries is zero northern fur seals per year from this stock.

Table 1. Summary of available information on the incidental mortality and serious injury of northern fur seals (San Miguel Island stock) in commercial fisheries that might take this species and calculation of the mean annual mortality rate; n/a indicates that data are not available. Mean annual takes are based on 2004-2008 data unless noted otherwise.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean annual takes (CV in parentheses)
CA/OR thresher shark/ swordfish drift gillnet	2004	observer data	20.6%	0	0	0 (n/a)
	2005		20.9%	0	0	
	2006		18.5%	0	0	
	2007		16.4%	0	0	
	2008		13.5%	0	0	
CA halibut/white seabass and other species large mesh (>3.5 in) set gillnet	2003	observer data	0%	n/a	n/a	0 (n/a)
	2004		0%	n/a	n/a	
	2005		0%	n/a	n/a	
	2006		0%	n/a	n/a	
	2007		17.8%	0	0	
WA/OR/CA groundfish trawl (Pacific hake at-sea processing component)	2002	observer data	100%[1]	0	0 (0)	0 (0)
	2003		100%[1]	0	0 (0)	
	2004		100%[1]	0	0 (0)	
	2005		100%[1]	0	0 (0)	
	2006		100%[1]	0	0 (0)	
Minimum total annual takes						0 (n/a)

[1]Percent observer coverage equals percent of vessels with observers.

The Marine Mammal Authorization Program (MMAP) fisher self-reports, required of commercial vessel operators by the MMPA, are an additional source of information on the number of northern fur seals killed or seriously injured incidental to commercial fishery operations. There were no fisher self-reports of northern fur seal deaths in any MMAP-listed fishery operating in waters off California, Oregon, or Washington between 2004 and

2008. Although these reports are considered incomplete (see details in Appendix 1), they represent a minimum mortality.

Strandings of northern fur seals entangled in fishing gear or with serious injuries caused by interactions with gear are a final source of fishery-related mortality information. According to Marine Mammal Stranding Network records, maintained for California by the NMFS Southwest Region (NMFS, Southwest Regional Office, unpublished data) and for Oregon and Washington by the NMFS Northwest Region (NMFS, Northwest Regional Office, unpublished data), no fishery-related strandings were reported between 2004 and 2008. 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

In 2007 and 2008, four northern fur seals were incidentally killed in California waters during scientific sardine trawling operations conducted by NMFS (NMFS, Southwest Regional Office, unpublished data): one death occurred in 2007 and three in 2008. After marine mammal deaths, including one northern fur seal, occurred in April 2008 trawls, NMFS scientists met to discuss and implement a mitigation plan to avoid future mortality. The initial mitigation plan included use of 162 dB acoustic pingers, a marine mammal watch, and scheduling trawls to occur when the ship first arrived on station to avoid attracting animals to a stationary vessel. Two additional northern fur seals were killed in subsequent 2008 trawls, including one in July and one in August. In 2009, a marine mammal excluder device was added to the trawls and no additional deaths were observed during 42 trawls. The average annual research-related mortality of northern fur seals from 2004 to 2008 is 0.8 animals.

According to the Marine Mammal Stranding Network records maintained by the NMFS Southwest (NMFS, Southwest Regional Office, unpublished data) and Northwest (NMFS, Northwest Regional Office, unpublished data) Regions, two human-caused northern fur seal deaths were reported from non-fisheries sources in California in 2004-2008. One animal was shot in 2007 and one was entangled in marine debris in 2008, resulting in an estimated annual mortality of 0.4 animals from this stock between 2004 and 2008. This estimate is considered a minimum because not all stranded animals are found, reported, or examined for cause of death (via necropsy by trained personnel).

STATUS OF STOCK

The San Miguel Island northern fur seal stock is not considered to be "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Based on currently available data, the estimated annual level of total human-caused mortality and serious injury (1.2) does not exceed the PBR (324). Therefore, the San Miguel Island stock of northern fur seals is not classified as a "strategic" stock. The minimum total fishery mortality and serious injury for this stock (0) is not known to exceed 10% of the calculated PBR (32.4) and, therefore, appears to be insignificant and approaching zero mortality and serious injury rate. The stock decreased 80% from 1997 to 1998, began to recover in 1999, and is currently at 77% of the 1997 level. The status of this stock relative to its Optimum Sustainable Population (OSP) level is unknown, unlike the Eastern Pacific northern fur seal stock which is formally listed as "depleted" under the MMPA.

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HAWAIIAN MONK SEAL (*Monachus schauinslandi*)

STOCK DEFINITION AND GEOGRAPHIC RANGE

Hawaiian monk seals are distributed throughout the Northwestern Hawaiian Islands (NWHI), with subpopulations at French Frigate Shoals, Laysan Island, Lisianski Island, Pearl and Hermes Reef, Midway Atoll, Kure Atoll, and Necker and Nihoa Islands. They also occur throughout the main Hawaiian Islands (MHI). Genetic variation among monk seals is extremely low and may reflect a long-term history at low population levels and more recent human influences (Kretzmann et al. 1997, 2001, Schultz et al. 2009). 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 different island subpopulations have exhibited considerable demographic independence. Observed interchange of individuals among the NWHI and MHI regions is uncommon, but genetic stock structure analysis (Schultz et al. 2011) supports management of the species as a single stock.

POPULATION SIZE

The best estimate of the total population size is 1,212. This estimate is the sum of estimated abundance at the six main Northwestern Hawaiian Islands subpopulations, an extrapolation of counts at Necker and Nihoa Islands, and an estimate of minimum abundance in the main Hawaiian Islands. 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). 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 actually identified was used. In 2010, total enumeration was achieved at Laysan Island and Midway Atoll based on analysis of discovery curves (Baker et al. 2006). Capture-recapture estimates larger than known minimum abundance were available for Lisianski Island and Pearl and Hermes Reef. Thus, abundance at the six main NWHI subpopulations was estimated to be 893 (including 147 pups). Counts at Necker and Nihoa Islands 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 2006 and 2010 was 16.0 ±6.6 at Necker Island and 32.1 (±6.6) at Nihoa Island. The relationship between mean counts and total abundance at the reproductive sites indicates that 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 2006-2010 are 49.2 (±19.1) at Necker Island and 102.4 (±19.1) at Nihoa Island.

Complete, systematic surveys for monk seals in the MHI were conducted in 2000 and 2001 (Baker and Johanos 2004). NMFS continues to collect information on seal sightings reported by a variety of sources, including a volunteer network, reports from the public and directed NMFS observation effort. The total number of individually identifiable seals documented in 2010 was 153, the current best minimum abundance estimate for the MHI.

Minimum Population Estimate

The total number of seals (893) identified at the six main NWHI reproductive sites is the best estimate of minimum population size at those sites. Minimum population sizes for Necker and Nihoa Islands (based on the formula provided by Wade and Angliss (1997)) are 36 and 88, respectively. The minimum abundance estimate for the main Hawaiian Islands in 2008 is 153 seals. The minimum population size for the entire stock (species) is the sum of these estimates, or 1,170 seals.

Current Population Trend

Current population trend is based solely on the six NWHI subpopulations because these sites have historically comprised virtually the entire species, while information on the remaining smaller seal aggregations have been inadequate to reliably evaluate abundance or trends. The total of mean non-pup beach counts at the six main reproductive NWHI subpopulations in 2010 is 71% lower than in 1958. The trend in total abundance at the six main NWHI subpopulations estimated as described above is shown in Figure 1. A log-linear regression of estimated abundance on year for the past 10 years (2001-2010) estimates that abundance declined 4.0% yr^{-1} (95% CI = -4.7% to -3.2% yr^{-1}). The MHI monk seal population appears to be increasing with an intrinsic population growth rate estimated at 6.5% per year based on simulation modeling (Baker et al. 2011). Likewise, sporadic beach counts at Necker and especially Nihoa Islands, suggest positive growth. While these sites have historically comprised a small fraction of the total species abundance, the decline of the six main NWHI subpopulations, coupled with growth at Necker, Nihoa and the MHI may mean that these latter three sites now substantially influence the total abundance trend. The MHI, Necker and Nihoa Islands estimates, uncertain as they are, comprised 25% of the stock's estimated total abundance in 2010. Unfortunately, because of a lack reliable abundance estimates for these areas, their influence cannot currently be determined. A remote camera system is slated for installation on Nihoa Island, which should result in improved abundance information at this site.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Trends in abundance vary considerably among subpopulations. Mean non-pup beach counts are used as a long-term index of abundance for years when data are insufficient to estimate total abundance as described above. Prior to 1999, beach count increases of up to 7% yr^{-1} were observed at Pearl and Hermes Reef, and this is the highest estimate of the maximum net productivity rate (R_{max}) observed for this species.

POTENTIAL BIOLOGICAL REMOVAL

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 on average, declined 4.0% a year since 2000. Thus, 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. Three seals (including a pregnant female) were shot and killed in the MHI in 2009 (Baker et al. 2010). This level of intentional killing is unprecedented in recent decades and represents a disturbing new threat to the species. In 2010, a juvenile female seal was found dead on Kauai due to multiple skull fractures caused by blunt force trauma. Whether this was an intentional killing or an accidental occurrence (e.g., boat strike) is not known. The intentional killing of monk seals in the MHI is well-documented and it is extremely unlikely that all carcasses of intentionally killed monk seals are discovered and reported. Studies of the recovery rates of carcasses for other marine mammal species have shown that the probability of detecting and documenting most deaths (whether from human or natural causes) is quite low (Peltier et al. 2012; Williams et al. 2011; Perrin et al. 2011; Punt and Wade 2010).

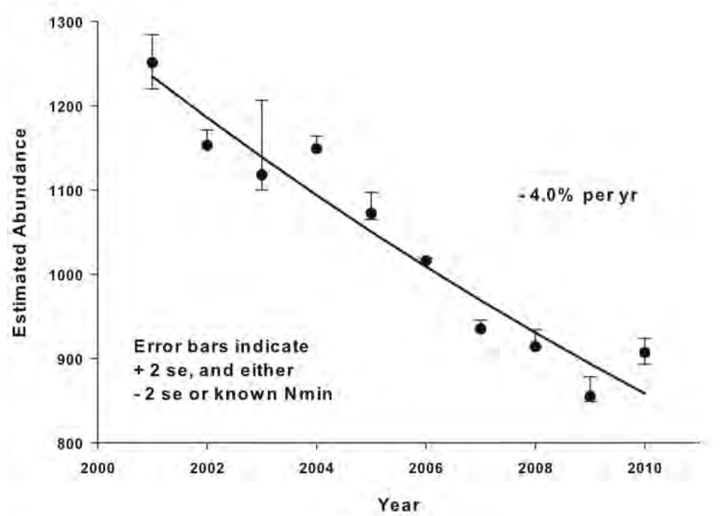

Figure 1. Trend in abundance of monk seals at the six main Northwestern Hawaiian Islands subpopulations, based on a combination of total enumeration and capture–recapture estimates. Error bars indicate ±2 s.e. (from variances of capture-recapture estimates). Fitted log-linear regression line is shown.

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.

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)
Pelagic Longline	2006 2007 2008 2009 2010	observer observer observer observer observer	22.1% & 100%[1] 20.1% & 100%[1] 21.7% & 100%[1] 20.6% & 100%[1] 21.1% & 100%[1]	0 0 0 0 0	0 0 0 0 0	0 (0)
NWHI Bottomfish	2004 2005 2006	observer observer observer	18.3% 25.0% 3.9%	0 0 0	0 0 0	0 (0)
MHI Bottomfish[2]	2006 2007 2008 2009 2010	Incidental observations of seals	none	0 0 0 0 0	n/a	n/a
Nearshore[3]	2006 2007 2008 2009 2010	Incidental observations of seals	none	2 2 3 4 1	n/a	n/a

Fishery interactions are a serious concern in the MHI, especially involving State of Hawaii managed nearshore fisheries. Four seals have been confirmed dead in nearshore gillnets (in 1994, 2006, 2007, and 2010), and one additional seal in 2010 may have also died in similar circumstances but the carcass was not recovered. A seal was also found dead in 1995 with a hook lodged in its esophagus. A total of 75 seals have been observed with embedded hooks in the MHI during 1989-2010 (including 11 in 2010, none of which constituted serious injuries). Several incidents, including the dead hooked seal mentioned above, involved hooks used to catch ulua (jacks, *Caranx* spp.). Most reported hookings and gillnet entanglements have occurred since 2000 (NMFS unpubl. data). The MHI monk seal population appears to have been increasing in abundance during this period (Baker et al. 2011). No mortality or serious injuries have been attributed to the MHI bottomfish handline fishery (Table 1). 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 quantitative fatty acid signature analysis (QFASA) results support previous studies illustrating that monk seals consume a wide range of species (Iverson et al. 2011). However, deepwater-slope species, including two commercially targeted bottomfishes and other species not caught in the fishery, were estimated to comprise a large portion of the diet for some individuals. Similar species were estimated to be consumed by seals regardless of location, age or gender, but the relative importance of each species varied. Diets differed considerably between individuals. These results highlight the need to better understand potential ecological interactions with the MHI bottomfish handline fishery.

There are no fisheries operating in or near the NWHI. In the past, interactions between the Hawaii-based domestic pelagic longline fishery and monk seals were documented (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

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

[2] Data for MHI bottomfish and nearshore fisheries are based upon incidental observations (i.e., hooked seals and those entangled in active gear). All hookings not clearly attributable to either fishery with certainty were attributed to the bottomfish fishery, and hookings which resulted in injury of unknown severity were classified as serious.

[3] Includes seals entangled/drowned in nearshore gillnets, recognizing that it is not possible to determine whether the nets involved were being used for commercial purposes.

extending 50 nautical miles around the NWHI and the corridors between the islands. Subsequently, no additional monk seal interactions with the swordfish or tuna components of the longline fishery have been observed. Possible reduction of monk seal prey by the NWHI lobster fishery has also been raised as a concern, though whether the fishery indirectly affected monk seals is unknown. However, the NWHI lobster fishery closed in 2000. In 2006, the Northwestern Hawaiian Islands (later renamed *Papahanaumokuokea*) Marine National Monument was established. Subsequent regulations prohibited commercial fishing in the Monument, except for the bottomfish fishery (and associated pelagic species catch), which had potential to continue until 2011 (U.S. Department of Commerce and Department of the Interior, 2006). However, in 2009 the remaining permit holders surrendered their permits to NMFS in exchange for compensation from the Federal Government and the fishery closed.

Fishery Mortality Rate

Total fishery mortality and serious injury is not considered to be insignificant and approaching a rate of zero. Monk seals are being hooked and entangled in the MHI at a rate that has not been reliably assessed but is certainly greater than zero. The information above represents only reported direct interactions, and without purpose-designed observation effort the true interaction rate cannot be estimated. Monk seals also die from entanglement in fishing gear and other debris throughout their range (likely originating from various 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 a topic of ongoing investigation.

Entanglement in Marine Debris

Hawaiian monk seals become entangled in fishing and other marine debris at rates higher than reported for other pinnipeds (Henderson 2001). A total of 311 cases of seals entangled in fishing gear or other debris have been observed from 1982 to 2010 (Henderson 2001; NMFS, unpubl. data), including eight documented deaths resulting from entanglement in marine debris (Henderson 1990, 2001; NMFS, unpubl. data). The fishing gear fouling the reefs and beaches of the NWHI and entangling monk seals only rarely includes types used in Hawaii fisheries. For example, trawl net and monofilament gillnet accounted for approximately 35% and 34% 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, trawl fisheries have been prohibited in Hawaii since the 1980s.

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

Other Mortality

From 1982 to 2010, 23 seals (many of which were in poor health when brought into captivity) died during rehabilitation efforts, two died in captivity, two died when captured for translocation, one was euthanized (an aggressive male known to cause mortality), four died during captive research and four died during field research (Baker and Johanos 2002; NMFS unpubl. data).

Other sources of mortality that impede recovery include food limitation (see Habitat Issues), single and multiple-male intra-species aggression (mobbing), shark predation, and disease/parasitism. Multiple-male aggression has primarily been identified as a problem at Laysan and Lisianski Islands, though it has also been documented at other subpopulations. Past removals of adult males from Laysan Island effectively reduced but did not entirely eliminate male-aggression caused mortality at this site (Johanos et al. 2010). Attacks by single adult male seals have resulted in several monk seal deaths, most notably at French Frigate Shoals in 1997, where at least 8 pups died from this cause. Many more pups likely were 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 declined, but this source of mortality remains a serious concern. Various mitigation efforts have been undertaken by NMFS (Gobush 2010), yet shark predation remains a serious problem at French Frigate Shoals. 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 naïve monk seals in the MHI and potentially spread to the core population in the NWHI. In 2003 and 2004, two deaths of free-ranging monk seals were attributable to diseases not previously found in the species: leptospirosis and toxoplasmosis (R. Braun, pers. comm.). *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 optimum sustainable population (OSP) and has not recovered from past declines. Therefore, the Hawaiian monk seal is a strategic stock.

Habitat Issues

Poor juvenile survival rates and variability in the relationship between weaning size and survival suggest that prey availability is likely limiting recovery of NWHI monk seals (Baker and Thompson 2007, Baker et al. 2007, Baker 2008). Multiple strategies for improving juvenile survival are being considered and will be developed through an experimental approach in coming years (Baker and Littnan 2008). NMFS has produced a draft Programmatic Environmental Impact Statement on current and future anticipated research and enhancement activities[1]. A major 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). Projected increases in global average sea level may further significantly reduce terrestrial habitat for monk seals in the NWHI (Baker et al. 2006).

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

Degradation of the seawall at Tern Island, French Frigate Shoals, created entrapment hazards for seals and other wildlife and raised concerns about the potential release of toxic wastes into the ocean. The USFWS began construction on the Tern Island sea wall in 2004 to reduce entrapment hazards and protect the island shoreline. Vessel groundings pose a continuing threat to monk seals and their habitat, through potential physical damage to reefs, oil spills, and release of debris into habitats.

Monk seal abundance is increasing in the main Hawaiian Islands (Baker et al. 2011). Further, the excellent condition of pups weaned on these islands suggests that there may be ample prey resources available, perhaps in part due to fishing pressure that has reduced monk seal competition with large fish predators (sharks and jacks) (Baker and Johanos 2004). If the monk seal population continues to expand in the MHI, it may bode well for the species' recovery and long-term persistence. In contrast, there are many challenges that may limit the potential for growth in this region. The human population in the MHI is approximately 1.2 million compared to fewer than 100 in the NWHI, so that the potential impact of disturbance in the MHI is great. Intentional killing of seals (noted above) poses a very serious new concern. Also, the same fishing pressure that may have reduced the monk seal's competitors, is a source of injury and mortality. Finally, vessel traffic in the populated islands carries the potential for collision with seals and impacts from oil spills. Thus, issues surrounding monk seals in the main Hawaiian Islands will likely become an increasing focus for management and recovery of this species.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

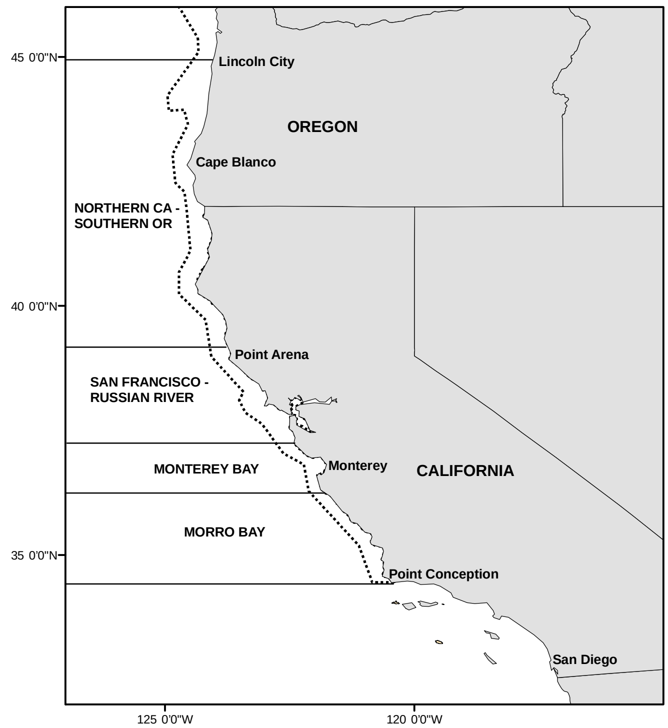

Figure 1. Stock boundaries and distributional range of harbor porpoise along the California and southern Oregon coasts. Dashed line represents harbor porpoise habitat (0-200 m) in this region.

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

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

POPULATION SIZE

Previous estimates of abundance for California harbor porpoise were based on aerial surveys conducted between the coast and the 50-fm isobath during 1988-95 (Barlow and Forney 1994, Forney 1999a). These estimates did not include an unknown number of animals found in deeper waters. Barlow (1988) found that the vast majority of harbor porpoise in California were within the 0-50-fm depth range; however, Green et al. (1992) found that 24% of harbor porpoise seen during aerial surveys of Oregon and Washington were between the 100m and 200m isobaths (55 to 109 fathoms). A systematic ship survey of depth strata out to 90 m in northern California showed that porpoise abundance declined significantly in waters deeper than 60 m (Carretta *et al.* 2001b). A recent analysis of harbor porpoise trends including oceanographic data suggests that the proportion of California harbor porpoise in deeper waters may vary between years (Forney 1999b). Since 1999 aerial surveys have extended farther offshore (to the 200m depth contour or a minimum of 10 nmi from shore in the region of the Morro Bay stock) to provide a more complete abundance estimate. Based on 2002-2007 aerial surveys conducted under good survey conditions (Beaufort ≤2, cloud cover ≤25%) the estimate of abundance for this stock is 2,044 animals (CV = 0.40) (Carretta et al., 2009.).

Minimum Population Estimate

The minimum population estimate for the Morro Bay harbor porpoise stock is taken as the lower 20th percentile of the log-normal distribution of the abundance estimated from the 2002-2007 aerial surveys, or 1,478 animals.

Current Population Trend

There has been an increasing trend in porpoise abundance in the Morro Bay stock since 1988, which is statistically significant ($p < 0.002$), Figure 2. The observed increase in abundance estimates for this stock since 1988 implies an annual population growth rate of approximately 13%, which is consistent with the median growth rate of 10% reported by Caswell et al. (1998) for Atlantic harbor porpoise and high reproductive rates reported for this species by Read and Hohn (1995). It is possible that some of the observed growth of the Morro Bay stock is partly due to emigration of animals from the Monterey Bay stock.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

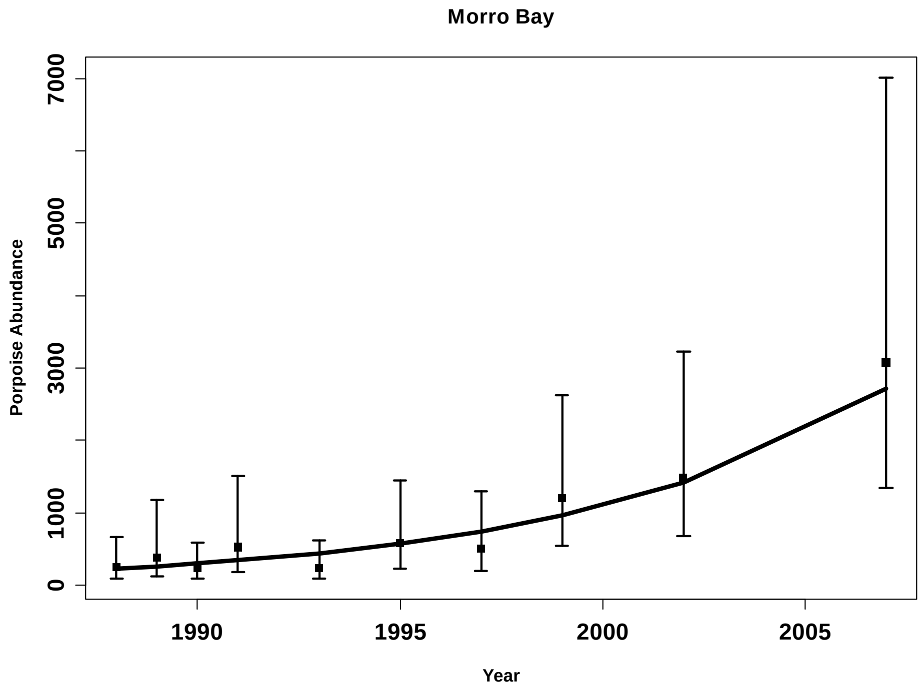

Figure 2. Aerial survey annual estimates of abundance for the Morro Bay stock of harbor porpoise (inshore stratum only), 1988-2007. Error bars represent lower and upper 95% confidence intervals. Solid line represents a linear regression on the natural logarithm of abundance over time. The slope of this regression is statistically significant ($p < 0.002$, $r^2 = 0.83$).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (1,478) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.5 (for a stock of unknown status ; Wade and Angliss 1997), resulting in a PBR of 15.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Gillnet fisheries for halibut and white seabass that historically operated in the vicinity of Morro Bay were eliminated in this stock's range in 2002 by a ban on gillnets inshore of 60 fathoms (~110 m) from Point Arguello to Point Reyes, California. The large-mesh drift gillnet fishery for swordfish and thresher shark operates too far offshore to interact with harbor porpoise in this region. Since 2002, fishery-related strandings of harbor porpoise have been recorded north of this stock's range. The responsible fisheries have not been identified and the locations of the strandings indicate that the animals are from stocks to the north (see Monterey Bay, San Francisco – Russian River, and Northern California/Southern Oregon stock assessments).

STATUS OF STOCK

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

No fishery-related mortality of harbor porpoise has been documented within this stock's range between 2003 and 2007. Current fishery mortality is zero and can be considered insignificant and approaching zero mortality rate. The stock is considered non-strategic and the population appears to have grown at approximately 11% annually since surveys began in the late 1980s. There are no known habitat issues that are of particular concern for this stock.

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STOCK DEFINITION AND GEOGRAPHIC RANGE

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

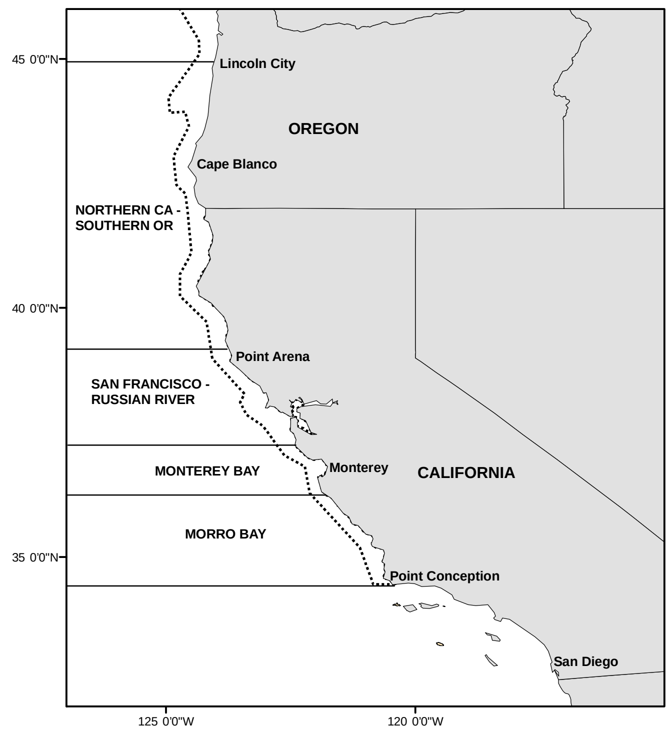

Figure 1. Stock boundaries and distributional range of harbor porpoise along the California/southern Oregon coast. Dashed line represents harbor porpoise habitat (0-200 m) along the U.S. west coast.

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

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

POPULATION SIZE

Previous estimates of abundance for California harbor porpoise were based on aerial surveys conducted between the coast and the 50-fm isobath during 1988-95 (Barlow and Forney 1994, Forney 1999a). These estimates did not include an unknown number of animals found in deeper waters. Barlow (1988) found that the vast majority of harbor porpoise in California were within the 0-50-fm depth range; however, Green et al. (1992) found that 24% of harbor porpoise seen during aerial surveys of Oregon and Washington were between the 100m and 200m isobaths (55 to 109 fathoms). A systematic ship survey of depth strata out to 90 m in northern California showed that porpoise abundance declined significantly in waters deeper than 60 m (Carretta et al. 2001b). A recent analysis of harbor porpoise trends including oceanographic data suggests that the proportion of California harbor porpoise in deeper waters may vary between years (Forney 1999b). Starting in 1999, aerial surveys extended farther offshore (to the 200m depth contour or a minimum of 15 nmi from shore in the region of the Monterey Bay stock) to provide a more complete abundance estimate. Based on 2002-2007 aerial surveys under good survey conditions (Beaufort ≤ 2, cloud cover $\leq 25\%$) the estimate of abundance for this stock is 1,492 animals (CV=0.40) (Carretta et al., 2009).

Minimum Population Estimate

The minimum population estimate for the Monterey Bay harbor porpoise stock is taken as the lower 20th percentile of the log-normal distribution of the abundance estimated from the 2002-2007 aerial surveys, or 1,079 animals.

Current Population Trend

Abundance estimates from aerial surveys conducted between 1988 and 2007 show evidence of a declining trend, though this decline is not statistically significant and it should be noted that survey effort in 2007 was sparse compared to previous years (Figure 2).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (1,079) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.45 (for a stock of unknown status with known fishery mortality and unknown fishery mortality CV; Wade and Angliss 1997), resulting in a PBR of 10.

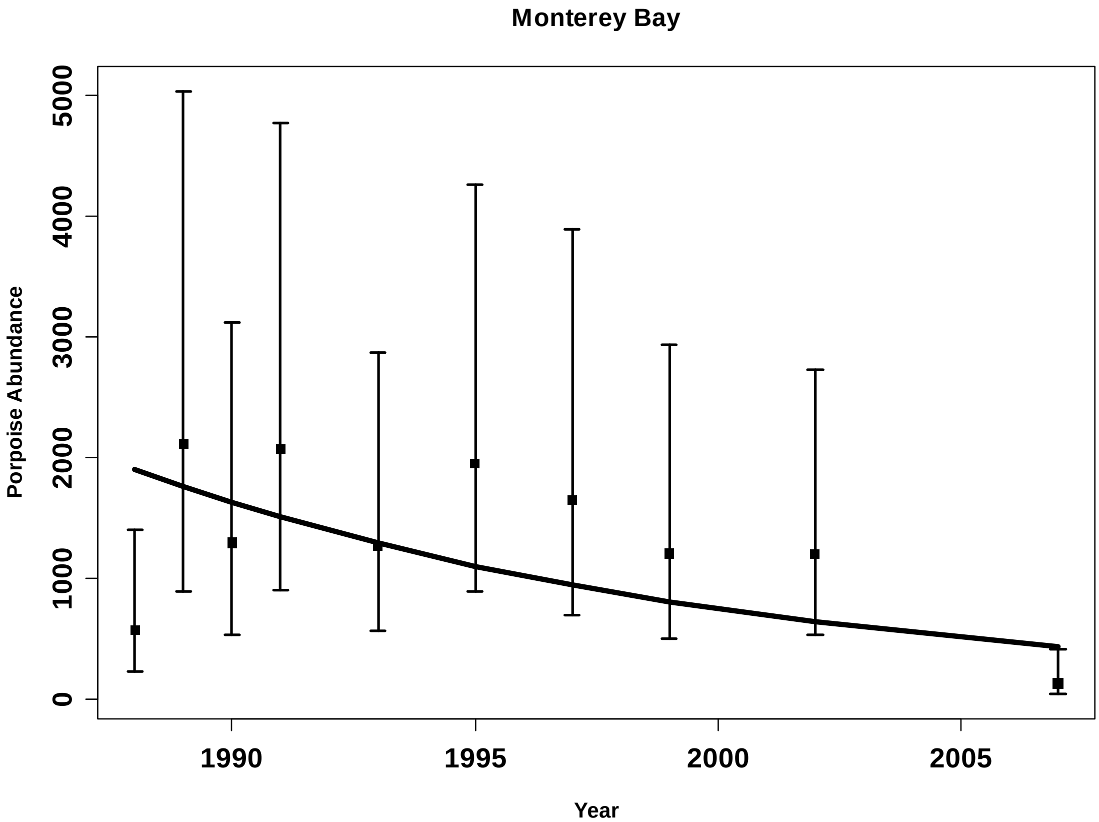

Figure 2. Aerial survey annual estimates of abundance for the Monterey Bay stock of harbor porpoise, 1988- 2007 (inshore stratum only). Error bars represent lower and upper 95% confidence intervals. Solid line represents a linear regression of the natural logarithm of abundance over time. The slope of this regression is not statistically significant ($p = 0.08$, $r^2 = 0.24$).

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

A 2002 ban on gillnets inshore of the 60 fathom (110 m) isobath was thought to eliminate the potential for harbor porpoise mortality to near zero in this stock's range. However, there have been five observed harbor porpoise strandings in this stock's range between 2003 and 2007 (three in 2004 and two in 2005) that showed evidence of fishery interactions, such as gillnet-like markings on the carcass or fishing line and hooks wrapped around the body. The responsible fisheries are unknown.

Table 1. Summary of available on incidental mortality and injury of harbor porpoise in commercial fisheries that might take this species. Mean annual takes are based on 2003-2007 data. n/a indicates that data are not available.

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed Mortality	Kill/Day	Estimated Mortality (CV in parentheses)	Mean Annual Takes (CV in parentheses)
Unidentified fisheries	2003-2007	Stranding	n/a	5	n/a	≥5	≥ 1.0 (n/a)
Minimum total annual takes							≥ 1.0 (n/a)

STATUS OF STOCK

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

Fishery-related mortality of harbor porpoise still occurs in this stock's range, though the bycatch levels and responsible fisheries are unknown. Because the overall level of fishery mortality is unknown relative to the PBR it cannot be considered to be insignificant and approaching zero mortality and injury rate. Although there is uncertainty regarding the observed levels of fishery-related mortality for this stock, documented mortality is less than the PBR, thus this stock is not considered "strategic" under the MMPA. Research activities will continue to monitor the population size and to investigate population trends. There are no known habitat issues that are of particular concern for this stock.

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Revised 10/15/2009

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

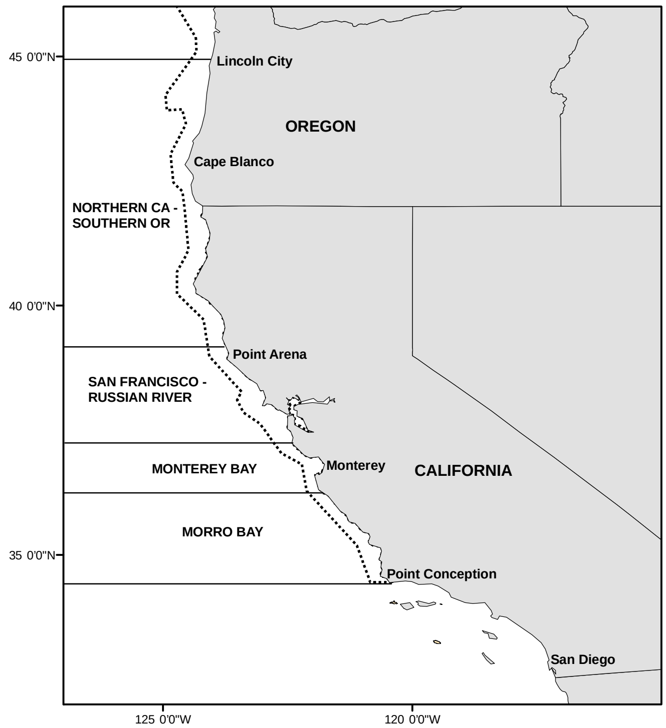

Figure 1. Stock boundaries and distributional range of harbor porpoise along the California and southern Oregon coasts. Dashed line represents harbor porpoise habitat (0-200 m) along the U.S. west coast.

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

POPULATION SIZE

Previous estimates of abundance for California harbor porpoise were based on aerial surveys conducted between the coast and the 50-fm isobath during 1988-95 (Barlow and Forney 1994, Forney 1999a). These estimates did not include an unknown number of animals found in deeper waters. Barlow (1988) found that the vast majority of harbor porpoise in California were within the 0-50-fm depth range; however, Green et al. (1992) found that 24% of harbor porpoise seen during aerial surveys of Oregon and Washington were between the 100m and 200m isobaths (55 to 109 fathoms). A systematic ship survey of depth strata out to 90 m in northern California showed that porpoise abundance declined significantly in waters deeper than 60 m (Carretta *et al.* 2001b). A recent analysis of harbor porpoise trends including oceanographic data suggests that the proportion of California harbor porpoise in deeper waters may vary between years (Forney 1999b). Since 1999, aerial surveys extended farther offshore (to the 200m depth contour or a minimum of 15 nmi from shore in the region of the San Francisco-Russian River stock) to provide a more complete abundance estimate. Based on 2002-2007 aerial surveys under good survey conditions (Beaufort ≤2, cloud cover ≤25%) the estimate of abundance for this stock is 9,189 animals (CV= 0.38) (Carretta et al., 2009).

Minimum Population Estimate

The minimum population estimate for the San Francisco-Russian River harbor porpoise stock is taken as the lower 20th percentile of the log-normal distribution of the abundance estimated from 2002-2007 aerial surveys, or 6,745 animals.

Current Population Trend

Abundance of the San Francisco - Russian River harbor porpoise stock appeared to be stable or declining between 1988-1991 and has steadily increased since 1993, however the slope of the linear regression on the natural logarithm of abundance over time is not statistically significant ($p = 0.14$, Figure 2).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (6,745) <u>times</u> one half the default maximum net growth rate for cetaceans (½ of 4%) <u>times</u> a recovery factor of 0.5 (for a species of unknown status; Wade and Angliss 1997), resulting in a PBR of 67.

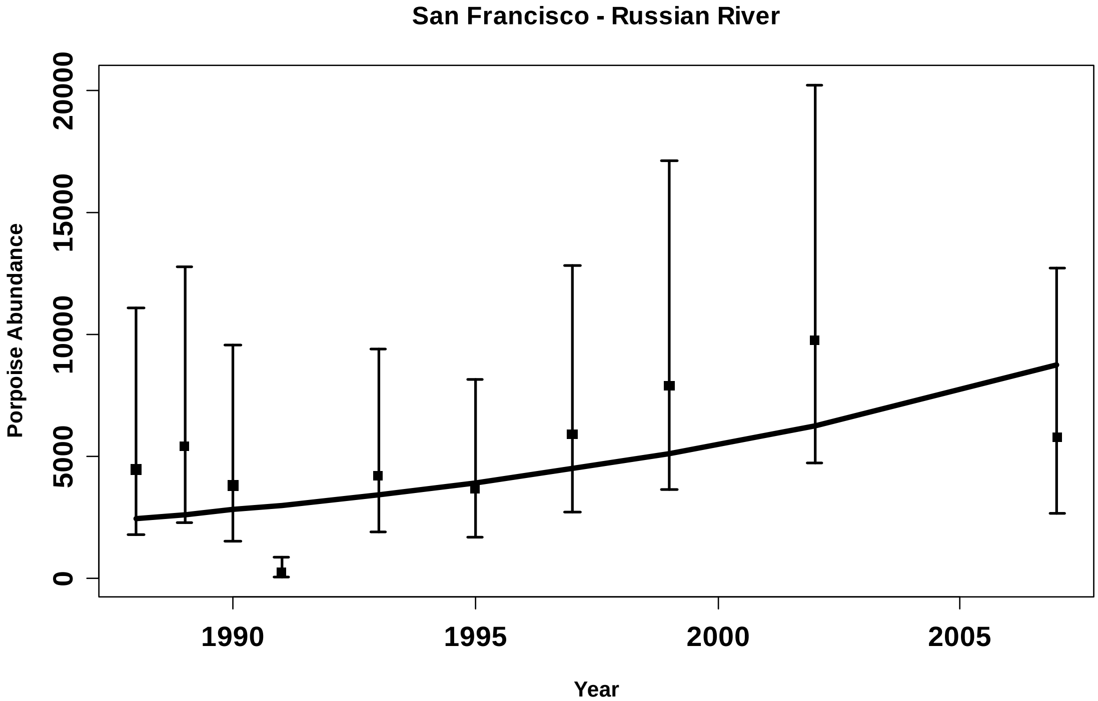

Figure 2. Aerial survey annual estimates of abundance for the San Francisco – Russian River stock of harbor porpoise (inshore stratum only), 1988- 2007. Error bars represent lower and upper 95% confidence intervals. Solid line represents a linear regression of the natural logarithim of abundance over time. The slope of this regression line is not statistically significant ($p = 0.24$, $r^2=0.17$)

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Although coastal gillnets are prohibited throughout this stock's range, there have been fishery-related strandings in past years. No fishery-related strandings occurred during the most recent five-year period (2003-2007) but did occur to the north and south of this stock's range. It is possible that some of the fishery-related strandings recorded in the Monterey Bay area during the most recent five-year period were killed in the San Francisco – Russian River stratum and drifted south to their observed stranding locations.

Table 1. Summary of available information on incidental mortality and injury of harbor porpoise (San Francisco-Russian River stock) in commercial fisheries that might take this species. No fishery takes or fishery-related strandings were reported in this region between 2003 and 2007. n/a indicates that data are not available.

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed Mortality	Kill/Day	Estimated Mortality (CV in parentheses)	Mean Annual Takes (CV in parentheses)
Unknown fishery	2003-2007	stranding	n/a	none	n/a	n/a	0 (n/a)
Minimum total annual takes							0 (n/a)

STATUS OF STOCK

Harbor porpoise in California are not listed as threatened or endangered under the Endangered Species Act nor as depleted under the Marine Mammal Protection Act. Barlow and Hanan (1995) calculate the status of harbor porpoise relative to historic carrying capacity (K) using a technique called back-projection. They calculate that the central California population (including Morro Bay, Monterey Bay, and San Francisco-Russian River stocks) could have been reduced to between 30% and 97% of K by incidental fishing mortality, depending on the choice of input parameters. They conclude that there is no practical way to reduce the range of this estimate. New information does not change this conclusion, and the status of central California harbor porpoise populations relative to their Optimum Sustainable Population (OSP) levels must be treated as unknown. There are no known habitat issues that are of particular concern for this stock. Because the known human-caused mortality or serious injury (zero harbor porpoise per year) is less than the PBR (67), this stock is not considered a "strategic" stock under the MMPA. Because average annual fishery mortality is less than 10% of the PBR, the fishery mortality can be considered insignificant and approaching zero mortality and serious injury rate.

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Revised 10/15/2009

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

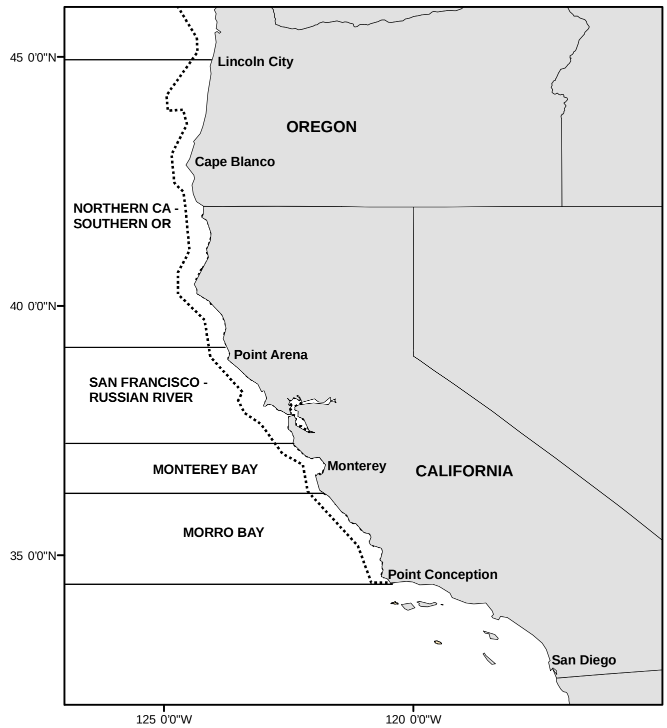

Figure 1. Stock boundaries and distributional range of harbor porpoise along the California/southern Oregon coasts. Dashed line represents harbor porpoise habitat (0-200 m) along the U.S. west coast.

In their assessment of harbor porpoise, Barlow and Hanan (1995) recommended that the animals inhabiting central California (defined to be from Point Conception to the Russian River) be treated as a separate stock. Their justifications for this were: 1) fishery mortality of harbor porpoise is limited to central California, 2) movement of individual animals appears to be restricted within California, and consequently 3) fishery mortality could cause the local depletion of harbor porpoise if central California is not managed separately. Although geographic structure exists along an almost continuous distribution of harbor porpoise from California to Alaska, stock boundaries are difficult to draw because any rigid line is (to a greater or lesser extent) arbitrary from a biological perspective. Nonetheless, failure to recognize geographic structure by defining management stocks can lead to depletion of local populations. Based on recent genetic findings (Chivers *et al.*, 2002, 2007), California coast stocks were re-evaluated and significant genetic differences were found among four identified sampling sites. Revised stock boundaries are presented here based on these genetic data and density discontinuities identified from aerial surveys, resulting in six west coast stocks where previously there had been four (Carretta *et al*. 2001a). These new stock boundaries are shown in Figure 1. The northern boundary of the Northern California/Southern

Oregon stock of harbor porpoise has been moved north to approximately the latitude of Lincoln City, Oregon, based on additional genetic analyses and a recommendation from the Pacific Regional Scientific Review Group to revise the boundary. For the 2002 Marine Mammal Protection Act (MMPA) Stock Assessment Reports, other Pacific coast harbor porpoise stocks include: 1) a Morro Bay stock, 2) a Monterey Bay stock, 3) a San Francisco-Russian River stock, 4) an Oregon/Washington coast stock, 5) an Inland Washington stock, 6) a Southeast Alaska stock, 7) a Gulf of Alaska stock, and 8) a Bering Sea stock. The stock assessment reports for Morro Bay, Monterey Bay, and San Francisco-Russian River, harbor porpoise appear in this volume. The three Alaska harbor porpoise stocks are reported separately in the Stock Assessment Reports for the Alaska Region.

POPULATION SIZE

Previous estimates of abundance for California harbor porpoise were based on aerial surveys conducted between the coast and the 50-fm isobath during 1988-95 (Barlow and Forney 1994, Forney 1999a). These estimates did not include an unknown number of animals found in deeper waters. Barlow (1988) found that the vast majority of harbor porpoise in California were within the 0-50-fm depth range; however, Green et al. (1992) found that 24% of harbor porpoise seen during aerial surveys of Oregon and Washington were between the 100m and 200m isobaths (55 to 109 fathoms). A systematic ship survey of depth strata out to 90 m in northern California showed that porpoise abundance declined significantly in waters deeper than 60 m (Carretta et al. 2001b). A recent analysis of harbor porpoise trends including oceanographic data suggests that the proportion of California harbor porpoise in deeper waters may vary between years (Forney 1999b; see Current Population Trend below). Since 1999, aerial surveys extended farther offshore (to the 200m depth contour or 15 nmi distance, whichever is farther) to provide a more complete abundance estimate. Based on pooled 2002-2007 aerial survey data including data from both inshore and offshore areas, an updated estimate of abundance for the northern California/southern Oregon harbor porpoise stock is 39,581 harbor porpoise (CV=0.39). This estimate represents a combined estimate of aerial surveys completed between 2002-2007 by SWFSC (Carretta et al.2009) and unpublished data from the National Marine Mammal Laboratory.

Minimum Population Estimate

The minimum population estimate for harbor porpoise in northern California/southern Oregon is taken as the lower 20th percentile of the log-normal distribution of the abundance estimate obtained from 2002-2007 aerial surveys, or 28,833 animals. . This estimate includes harbor porpoise within an area extending to the 200m isobath or 15 nmi, whichever is farther from shore.

Current Population Trend

Because the northern boundary of this stock has changed two times in recent years, trends in abundance have been examined only for the northern California portion of this stock. A possible increasing trend in abundance is apparent from surveys conducted between 1989 and 2007, but the trend is not statistically significant (Figure 2).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (28,833) <u>times</u> one half the default maximum net growth rate for cetaceans (½ of 4%) <u>times</u> a recovery factor of 1.0 (for a species within its Optimal Sustainable Population; Wade and Angliss 1997), resulting in a PBR of 577 .

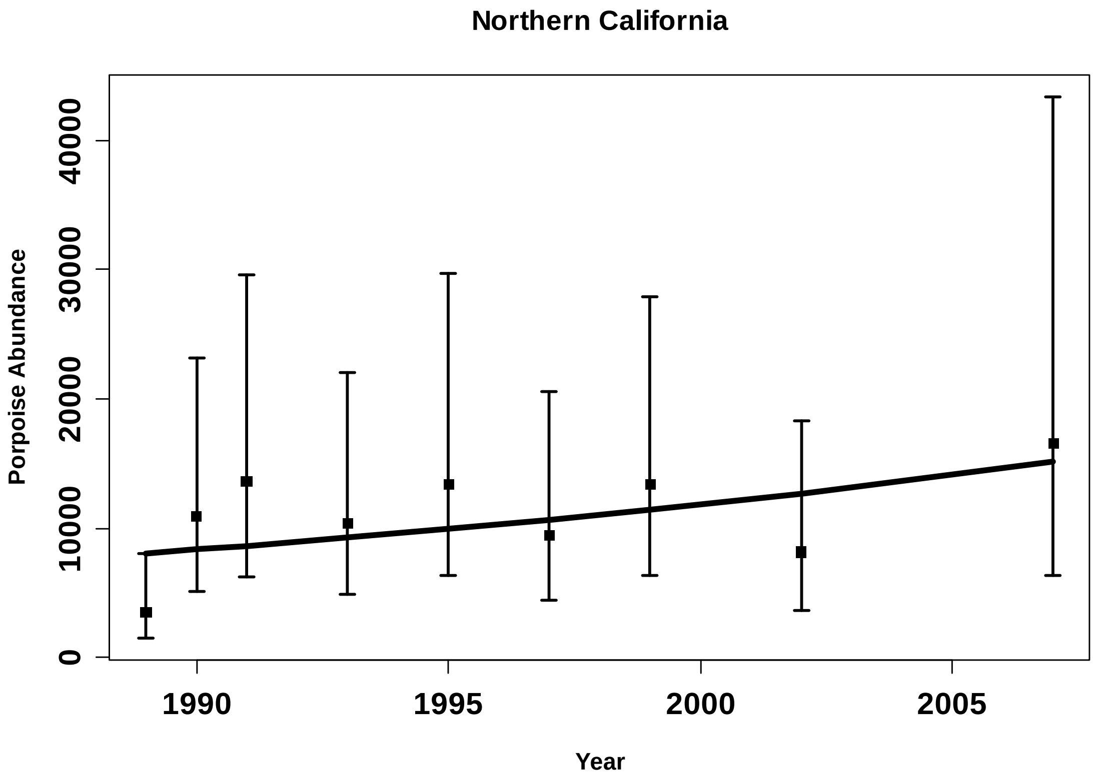

Figure 2. Aerial survey annual estimates of harbor porpoise abundance for the northern California inshore stratum, 1989-2007. Solid line represents a linear regression on the natural logarithim of abundance over time. The slope of this regression is not statistically significant ($p = 0.21$, r^2=0.22).

HUMAN-CAUSED MORTALITY

Fishery Information

There were 4 harbor porpoise strandings in this stock's range that showed evidence of interactions with entangling net fisheries between 2003 and 2007. At least two of these were reported to be entangled in river salmon gillnet gear. There has been documented harbor porpoise mortality in the Klamath River tribal salmon gillnet fisheries as recently as 1995. It is possible that recent gillnet-related strandings in this area are attributable to that fishery.

Table 1. Summary of available information on incidental mortality and injury of harbor porpoise (northern CA stock) in fisheries that might take this species. n/a indicates that data are not available.

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed Mortality	Estimated Mortality (CV in parentheses)	Mean Annual Takes (CV in parentheses)
Unknown fishery	2003-2007	Stranding	n/a	4	n/a	≥0.8 (n/a)
Minimum total annual takes						≥0.8 (n/a)

STATUS OF STOCK

Harbor porpoise in northern California/southern Oregon are not listed as threatened or endangered under the Endangered Species Act nor as depleted under the Marine Mammal Protection Act. There are no known habitat issues that are of particular concern for this stock. Because of the lack of recent or historical sources of human-caused mortality, the harbor porpoise stock in northern California has been concluded to be within their Optimum Sustainable Population (OSP) level (Barlow and Forney 1994). Because the known human-caused mortality or serious injury (≥0.8 harbor porpoise per year) is less than the PBR (577), this stock is not considered a "strategic" stock under the MMPA. Because average annual fishery mortality is less than 10% of the PBR, the fishery mortality can be considered insignificant and approaching zero mortality and serious injury rate.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

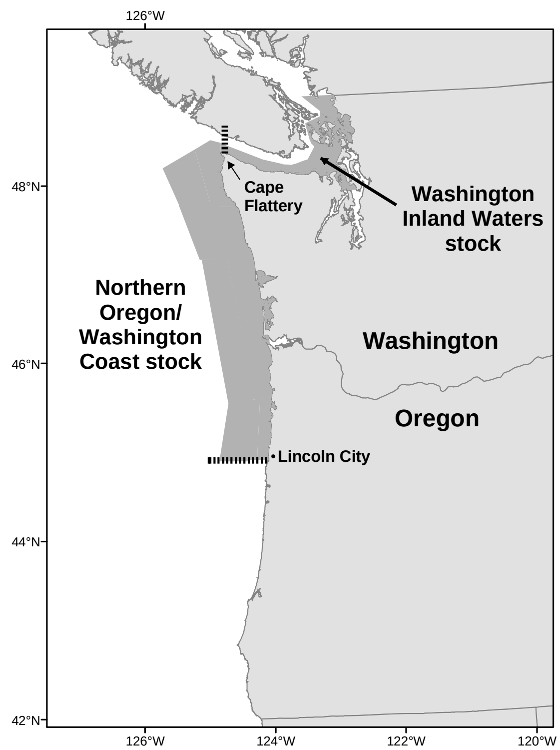

Figure 1. Stock boundaries (dashed lines) and approximate distribution (shaded areas) of harbor porpoise along the coasts of Washington and northern Oregon.

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

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

Waters stock (in waters east of Cape Flattery). Additional analyses are needed to determine whether to adjust the stock boundaries for harbor porpoise in Washington inland waters (Chivers *et al*. 2007).

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

POPULATION SIZE

In August and September 2002, an aerial survey of Oregon, Washington, and southern British Columbia coastal waters, from shore to 200 m depth, resulted in an uncorrected abundance estimate of 4,583 (CV=0.145) harbor porpoise in U.S. waters between Lincoln City, Oregon, and Cape Flattery, Washington (J. Laake, unpublished data). Using a correction factor of 3.42 (1/g(0); g(0)=0.292, CV=0.366) (Laake *et al*. 1997a), to adjust for groups missed by aerial observers, the corrected estimate of abundance for harbor porpoise in the coastal waters of northern Oregon (north of Lincoln City) and Washington in 2002 is 15,674 (CV=0.394). However, because the most recent abundance estimate is >8 years old, there is no current estimate of abundance available for this stock.

Minimum Population Estimate

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

Current Population Trend

There are no reliable data on population trends of harbor porpoise for coastal Oregon, Washington, or British Columbia waters; however, the uncorrected estimates of abundance for the Northern Oregon/Washington Coast stock in 1997 (6,406; SE=826.5) and 2002 (4,583) were not significantly different (Z=-1.73, P=0.08), although the survey area in 1997 (Regions I-S through III) was slightly larger than in 2002 (Strata D-G) (Laake *et al*. 1998a; J. Laake, unpublished data).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

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

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Within the EEZ boundaries of the coastal waters of northern Oregon and Washington, harbor porpoise deaths are known to occur in the northern Washington marine set gillnet tribal fishery. Total fishing effort in this fishery is conducted within the range of both harbor porpoise stocks (Northern Oregon/Washington Coast and Washington Inland Waters) occurring in Washington State waters (Gearin *et al* 1994). Some movement of harbor porpoise between Washington's coastal and inland waters is likely, but it is currently not possible to quantify the extent of such movements. For the purposes of this stock assessment report, the animals taken in waters south and west of Cape Flattery, WA, are assumed to have belonged to the Northern Oregon/Washington Coast stock, and Table 1 includes data only from that portion of the fishery. Fishing effort in the coastal marine set gillnet tribal fishery has declined since 2004. A test set gillnet fishery, with 100% observer coverage, was conducted in coastal waters in 2008. This test fishery required the use of nets equipped with acoustic alarms, and no harbor porpoise deaths were reported (Makah Fisheries Management, unpublished data). The mean estimated mortality for this fishery in 2005-2009 is 0 (CV=0) harbor porpoise per year from observer data.

Table 1. Summary of incidental mortality and serious injury of harbor porpoise (Northern Oregon/Washington Coast stock) in commercial and tribal fisheries that might take this species and calculation of the mean annual mortality rate; n/a indicates that data are not available. Mean annual takes are based on 2005-2009 data unless noted otherwise.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean annual takes (CV in parentheses)
Northern WA marine set gillnet (tribal test fishery in coastal waters)[1]	2005 2006 2007 2008 2009	observer data	no fishery no fishery no fishery 100% no fishery	0 0 0 0 0	0 (0) 0 (0) 0 (0) 0 (0) 0 (0)	0 (0)
Grays Harbor/Chehalis River tribal steelhead gillnet fishery[1]	2006	fisherman self-report		1	n/a	≥0.2 (n/a)
Unknown West Coast fisheries	2005-2009	stranding data		0, 0, 2, 2, 3	n/a	≥1.4 (n/a)
Minimum total annual takes						≥1.6 (n/a)

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

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

A harbor porpoise death was reported in a Grays Harbor/Chehalis River tribal steelhead gillnet fishery in 2006 (NMFS, Northwest Regional Office, unpublished data), resulting in an average annual mortality of 0.2 harbor porpoise for this fishery.

According to Northwest Marine Mammal Stranding Network records, maintained by the NMFS Northwest Region (NMFS, Northwest Regional Office, unpublished data), there were seven fishery-related strandings of harbor porpoise from this stock reported on the northern Oregon/Washington coast in 2005-2009 (2 in 2007, 2 in 2008, and 3 in 2009), resulting in an average annual mortality of 1.4 harbor porpoise in 2005-2009. Evidence of fishery interactions included net marks, rope marks, and knife cuts. Since these deaths could not be attributed to a particular fishery, and were the only confirmed fishery-related deaths in this area in 2005-2009, they are listed in Table 1 as occurring in unknown West Coast fisheries. Six additional strandings reported in 2005-2009 (1 in 2006, 3 in 2007, and 2 in 2009) were considered possible fishery-related strandings but were not included in the estimate of average annual mortality. This estimate is considered a minimum because not all stranded animals are found, reported, or examined for cause of death (via necropsy by trained personnel).

Other Mortality

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

STATUS OF STOCK

Harbor porpoise are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Based on currently available data, the total level of human-caused mortality and serious injury is 1.6 harbor porpoise per year. A PBR cannot be calculated for this stock because there is no current abundance estimate. The previous estimate of PBR was 114 (Carretta *et al*. 2009). Human-caused mortality relative to PBR is unknown, but it is considered to be small relative to the stock size. Therefore, the Northern Oregon/Washington Coast stock of harbor porpoise is not classified as "strategic." The total fishery mortality and serious injury for this stock (based on recent observer data (0) and self-reported fisheries information (0.2) and stranding data (1.4) where observer data were not available or failed to detect harbor porpoise deaths) is 1.6 harbor porpoise per year. Since a PBR cannot be calculated for this stock, fishery mortality relative to PBR is unknown. The status of this stock relative to its Optimum Sustainable Population (OSP) level and population trends is unknown.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

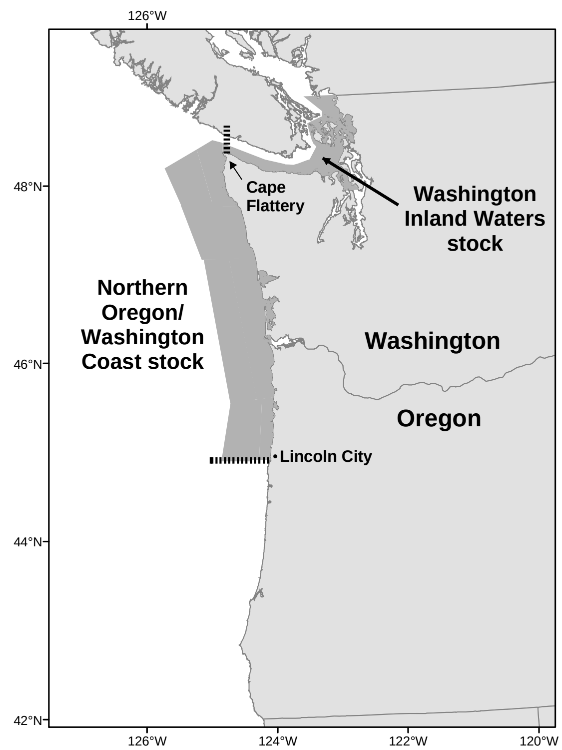

Figure 1. Stock boundaries (dashed lines) and approximate distribution (shaded areas) of harbor porpoise along the coasts of Washington and northern Oregon.

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

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

Waters stock (in waters east of Cape Flattery). Additional analyses are needed to determine whether to adjust the stock boundaries for harbor porpoise in Washington inland waters (Chivers et al. 2007).

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

POPULATION SIZE

Aerial surveys of the inside waters of Washington and southern British Columbia were conducted during August of 2002 and 2003 (J. Laake, unpublished data). These aerial surveys included the Strait of Juan de Fuca, San Juan Islands, Gulf Islands, and Strait of Georgia, which includes waters inhabited by the Washington Inland Waters stock of harbor porpoise as well as harbor porpoise from British Columbia. An average of the 2002 and 2003 estimates of abundance in U.S. waters results in an uncorrected abundance of 3,123 (CV= 0.10) harbor porpoise in Washington inland waters (J. Laake, unpublished data). When corrected for availability and perception bias, using a correction factor of 3.42 (1/g(0); g(0)=0.292, CV=0.366) (Laake et al. 1997), the estimated abundance for the Washington Inland Waters stock of harbor porpoise in 2002/2003 is 10,682 (CV=0.38) animals (J. Laake, unpublished data). However, because the most recent abundance estimate is >8 years old, there is no current estimate of abundance available for this stock.

Minimum Population Estimate

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

Current Population Trend

There are no reliable data on long-term population trends of harbor porpoise for most waters of Oregon, Washington, or British Columbia, however, the uncorrected estimate of abundance in Washington inland waters was significantly greater in 2002/2003 than in 1996 (3,123 vs. 1,025; Z=6.16, P<0.0001) (Calambokidis et al. 1997; J. Laake, unpublished data).

In southern Puget Sound, harbor porpoise were common in the 1940s (Scheffer and Slipp 1948), but marine mammal surveys (Everitt et al. 1980), stranding records since the early 1970s (Osmek et al. 1995), and harbor porpoise surveys in 1991 (Calambokidis et al. 1992) and 1994 (Osmek et al. 1995) indicated that harbor porpoise abundance had declined in southern Puget Sound. In 1994, a total of 769 km of vessel survey effort and 492 km of aerial survey effort conducted during favorable sighting conditions produced no sightings of harbor porpoise in southern Puget Sound. Reasons for the apparent decline are unknown, but it may have been related to fishery interactions, pollutants, vessel traffic, or other factors (Osmek et al. 1995). In 2009 and 2010, however, increased numbers of harbor porpoise have been sighted during vessel surveys throughout Puget Sound and increased numbers of strandings have also been documented, suggesting a return of animals to this region (J. Calambokidis, unpublished data; B. Hanson, unpublished data).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

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

Fisheries Information

Fishing effort in the northern Washington marine gillnet tribal fishery is conducted within the range of both harbor porpoise stocks (Northern Oregon/Washington Coast and Washington Inland Waters) occurring in Washington State waters (Gearin et al. 1994). Some movement of harbor porpoise between Washington's coastal and inland waters is likely, but it is currently not possible to quantify the extent of such movements. For the purposes of this stock assessment report, the animals taken in waters east of Cape Flattery, WA, are assumed to have belonged to the Washington Inland Waters stock, and Table 1 includes data only from that portion of the fishery. There was no observer coverage in the northern Washington marine set gillnet tribal fishery in inland waters in 2005-2009; however, there were two fisherman self-reports of harbor porpoise deaths in 2008 and both deaths occurred in nets that were equipped with alarms (Makah Fisheries Management, unpublished data). The mean estimated mortality for this fishery in 2005-2009 is 0.4 harbor porpoise per year from fisherman self-reports. Fishing effort in the northern Washington marine drift gillnet tribal fishery in inland waters is also conducted within the range of the Washington Inland Waters stock of harbor porpoise. This fishery is not observed; however, there was one fisherman self-report of a harbor porpoise death in 2008 (Makah Fisheries Management, unpublished data). The mean estimated mortality for this fishery in 2005-2009 is 0.2 harbor porpoise per year from fisherman self-reports. There were also fisherman self-reports of six unidentified small odontocete deaths in this fishery in 2005 (Makah Fisheries Management, unpublished data); these animals may have been harbor porpoise, but they are not included in the mortality estimate for this fishery.

In 1993, as a pilot for future observer programs, NMFS in conjunction with the Washington Department of Fish and Wildlife (WDFW) monitored non-treaty components (areas 7, 7A, 7B/7C, 8A/8D, 10/11, and 12/12A/12B) of the Washington Puget Sound Region salmon gillnet fishery (Pierce et al. 1994). Observer coverage was 1.3% overall, ranging from 0.9% to 7.3% for the various components of the fishery. No harbor porpoise deaths were reported. Pierce et al. (1994) cautioned against extrapolating this mortality to the entire Puget Sound fishery due to the low observer coverage and potential biases inherent in the data. The area 7/7A sockeye landings represented the majority of the non-treaty salmon landings in 1993, approximately 67%. Results of this pilot study were used to design the 1994 observer programs discussed below.

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

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

It should be noted that the 1994 observer programs did not sample all segments of the entire Washington Puget Sound Region salmon set/drift gillnet fishery and, further, the extrapolations of total kill did not include effort for the unobserved segments of this fishery. Although the percentage of the overall Washington Puget Sound Region salmon set/drift gillnet fishery effort that was observed in 1994 was not quantified, the observer programs covered those segments of the fishery which had the highest salmon catches, the majority of vessel participation, and the highest likelihood of interaction with harbor porpoise (J. Scordino, pers. comm.). Harbor porpoise takes in the Washington Puget Sound Region salmon drift gillnet fishery are unlikely to have increased since the fishery was last observed in 1994, due to reductions in the number of participating vessels and available fishing time (see details in Appendix 1). Fishing effort and catch have declined throughout all salmon fisheries in the region due to management efforts to recover ESA-listed salmonids.

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

Table 1. Summary of incidental mortality and serious injury of harbor porpoise (Washington Inland Waters stock) in commercial and tribal fisheries that might take this species and calculation of the mean annual mortality rate; n/a indicates that data are not available. Mean annual takes are based on 2005-2009 data unless noted otherwise.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean annual takes (CV in parentheses)
Northern WA marine set gillnet (tribal fishery in inland waters)[1]	2005 2006 2007 2008 2009	observer data	0% 0% 0% 0% 0%	n/a n/a n/a n/a n/a	n/a n/a n/a n/a n/a	n/a
	2008	fisherman self-reports		2	n/a	≥0.4 (n/a)
Northern WA marine drift gillnet (tribal fishery in inland waters)[1]	2008	fisherman self-reports		1	n/a	≥0.2 (n/a)
WA Puget Sound Region salmon set/drift gillnet (observer programs listed below covered segments of this fishery):	-	-	-	-	-	-
Puget Sound non-treaty salmon gillnet (all areas and species)	1993	observer data	1.3%	0	0	see text[2]
Puget Sound non-treaty chum salmon gillnet (areas 10/11 and 12/12B)	1994	observer data	11%	0	0	see text[2]
Puget Sound treaty chum salmon gillnet (areas 12, 12B, and 12C)	1994	observer data	2.2%	0	0	see text[2]
Puget Sound treaty chum and sockeye salmon gillnet (areas 4B, 5, and 6C)	1994	observer data	7.5%	0	0	see text[2]
Puget Sound treaty and non-treaty sockeye salmon gillnet (areas 7 and 7A)	1994	observer data	7%	1	15	see text[2]
Puget Sound non-treaty salmon drift gillnet (area 5)	2006	fisherman self-reports		2	n/a	≥0.4 (n/a)
Unknown Puget Sound Region fishery	2005-2009	stranding data		0, 1, 1, 0, 4	n/a	≥1.2 (n/a)
Minimum total annual takes						≥2.2 (n/a)

[1]This is a tribal fishery; therefore, it is not listed in the NMFS list of commercial fisheries.
[2]This fishery has not been observed since 1994 (see text); these data are not included in the calculation of recent minimum total annual takes.

There were two fisherman self-reports of harbor porpoise deaths in the Puget Sound Region salmon drift gillnet fishery in area 5 in 2006, resulting in an estimated mean annual mortality rate of 0.4 harbor porpoise from fisherman self-reports. There was also a fisherman self-report of an unidentified neonate or juvenile porpoise death in the Puget Sound Region drift gillnet fishery in 2006; this animal may have been a harbor porpoise, but it was not included in the mortality estimate for the fishery.

Combining estimates from the northern Washington marine set gillnet tribal fishery (0.4), the northern Washington marine drift gillnet tribal fishery (0.2), and the Puget Sound Region drift gillnet fishery (0.4) results in an estimated mean annual mortality rate of 1.0 harbor porpoise from this stock from fisherman self-reports.

Strandings of harbor porpoise wrapped in fishing gear or with serious injuries caused by interactions with gear are a final source of fishery-related mortality information. According to Northwest Marine Mammal Stranding Network records, maintained by the NMFS Northwest Region (NMFS, Northwest Regional Office, unpublished data), there were six fishery-related strandings of harbor porpoise from this stock in 2005-2009 (1 in 2006, 1 in 2007, and 4 in 2009), resulting in an average annual mortality of 1.2 harbor porpoise. Evidence of fishery interactions included entanglement in gillnet, net marks, and rope marks. Since these deaths could not be attributed to a particular fishery, and were the only confirmed fishery-related deaths in this area in 2005-2009, they are listed in Table 1 as occurring in an unknown Puget Sound Region fishery. One additional harbor porpoise stranding reported in 2007 was considered a possible fishery-related death, but it was not included in the estimate of average annual mortality. This estimate is considered a minimum because not all stranded animals are found, reported, or examined for cause of death (via necropsy by trained personnel).

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

Other Mortality

According to Northwest Marine Mammal Stranding Network records, maintained by the NMFS Northwest Region (NMFS, Northwest Regional Office, unpublished data), two human-caused harbor porpoise deaths were reported from non-fisheries sources in 2005-2009. One animal was struck by a ship in 2007 and one was entangled in rope in 2009, resulting in an estimated mortality of 0.4 harbor porpoise per year from this stock.

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

STATUS OF STOCK

Harbor porpoise are not listed as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act. Based on currently available data, the total level of human-caused mortality and serious injury is 2.6 (2.2 + 0.4) harbor porpoise per year. A PBR cannot be calculated for this stock because there is no current abundance estimate. The previous estimate of PBR was 63 (Carretta et al. 2009). Human-caused mortality relative to PBR is unknown, but it is considered to be small relative to the stock size. Therefore, the Washington Inland Waters harbor porpoise stock is not classified as “strategic.” The minimum total fishery mortality and serious injury for this stock is 2.2 harbor porpoise per year (based on self-reported fisheries information (1.0) and stranding data (1.2) where observer data were not available or failed to detect harbor porpoise mortality). Since a PBR cannot be calculated for this stock, fishery mortality relative to PBR is unknown. The status of this stock relative to its Optimum Sustainable Population (OSP) level and population trends is unknown.

Although harbor porpoise sightings in southern Puget Sound declined from the 1940s through the 1990s, harbor porpoise have been sighted in southern Puget Sound in recent vessel surveys.

This stock is not recognized as "strategic," however, the current mortality rate is based on fisherman self-reports and stranding data, since the Washington Puget Sound Region salmon set/drift gillnet fishery has not been observed since 1994. Evaluation of the estimated take level is complicated by a lack of knowledge about the extent to which harbor porpoise from U.S. waters frequent the waters of British Columbia and are, therefore, subject to fishery-related mortality. It is appropriate to consider whether the current take level is different from the take level in 1994, when the fishery was last observed. No new information is available about mortality per set, but 1) fishing effort has decreased in recent years and 2) analysis of data from aerial surveys in 2002 and 2003 indicates that abundance has increased since 1996.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Dall's porpoises are endemic to temperate waters of the North Pacific Ocean. Off the U.S. west coast, they are commonly seen in shelf, slope and offshore waters (Figure 1; Morejohn 1979). Sighting patterns from aerial and shipboard surveys conducted in California, Oregon and Washington 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 porpoises is not known, but based on patterns of stock differentiation in the western North Pacific, where they have been more intensively studied, it is expected that separate stocks will emerge when data become available (Perrin and Brownell 1994). Although Dall's porpoises are not restricted to U.S. territorial waters, there are no cooperative management agreements with Mexico or Canada for fisheries which may take this species (e.g. gillnet fisheries). For the Marine Mammal Protection Act (MMPA) stock assessment reports, Dall's porpoises within the Pacific U.S. Exclusive Economic Zone are divided into two discrete, non-contiguous areas: 1) waters off California, Oregon and Washington (this report), and 2) Alaskan waters.

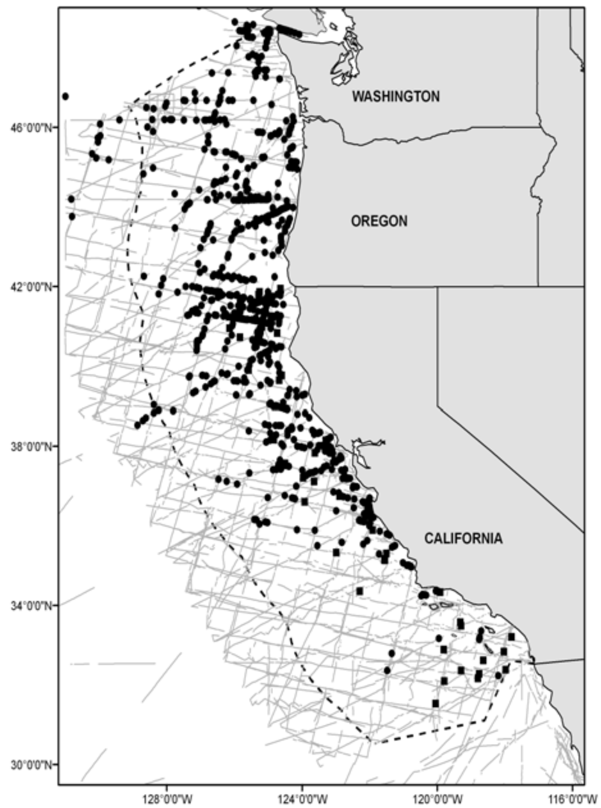

Figure 1. Dall's porpoise sightings based on aerial and shipboard surveys off California, Oregon, and Washington, 1991-2008 (see Appendix 2 for data sources and information on timing and location of survey effort). Dashed line represents the U.S. EEZ, thin lines represent completed transect effort of all surveys combined. Key: ● = summer/autumn ship-based sightings; ■ = winter/spring aerial-based sightings.

POPULATION SIZE

Dall's porpoise distribution in this region is highly variable between years and appears to be affected by oceanographic conditions (Forney 1997; Forney and Barlow 1998). Because animals may spend time outside the U.S. Exclusive Economic Zone as oceanographic conditions change, a multi-year average abundance estimate is the most appropriate for management within U.S. waters. The most recent estimate of Dall's porpoise abundance is the geometric mean of estimates from 2005 (Forney 2007) and 2008 (Barlow 2010) summer/autumn vessel-based line transect surveys of California, Oregon, and Washington waters, or 42,000 (CV = 0.33) animals. Additional numbers of Dall's porpoises occur in the inland waters of Washington state, but the most recent abundance estimate obtained in 1996 (900 animals, CV=0.40) is over 8 years old (Calambokidis et al. 1997) and is not included in the overall estimate of abundance for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2005-2008 average abundance estimate for the outer coast of California, Oregon and Washington waters is 32,106 Dall's porpoises.

Current Population Trend

No information is available regarding trends in abundance of Dall's porpoises 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 (32,106) <u>times</u> one half the default maximum net growth rate for cetaceans (½ of 4%) <u>times</u> a recovery factor of 0.40 (for a species of unknown status and mortality rate CV; Wade and Angliss 1997), resulting in a PBR of 257 Dall's porpoises per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

A summary of recent fishery mortality and injury for this stock of Dall's porpoises is given in Table 1. More detailed information on these fisheries is provided in Appendix 1. Mean annual takes for all fisheries for which mortality data are available are ≥0.4 animals per year. Mortality estimates for the California drift gillnet fishery are included for the five most recent years of monitoring, 2004-2008 (Carretta et al. 2005, Carretta and Enriquez 2006, 2007, 2009a, 2009b). 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.

Mortality of Dall's porpoises has also been documented in the California/Oregon/Washington domestic groundfish trawl fisheries (Perez and Loughlin 1991; Perez 2003). Between 2002 and 2006 with 100% of the fishing effort observed, one Dall's porpoise was reported killed in the at-sea processing portion of the Pacific hake trawl fishery. 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 of Dall's porpoises (California/ Oregon/Washington Stock) in commercial fisheries that might take this species. Coefficients of variation for mortality estimates are provided in parentheses; n/a = not available. Mean annual takes are based on 2004-2008 data for the CA/OR swordfish drift gillnet fishery and 2002-2006 for groundfish fisheries.

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	2004	20.6%	0	0	0 (n/a)
		2005	20.9%	0	0	
		2006	18.5%	0	0	
		2007	16.4%	0	0	
		2008	13.5%	0	0	
WA/OR/CA domestic groundfish trawl (At-sea processing Pacific hake fishery).	observer	2002	100%	1	1	0.2 (n/a)
		2003	100%	0	0	
		2004	100%	0	0	
		2005	100%	0	0	
		2006	100%	0	0	
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						≥0.4 (n/a)

STATUS OF STOCK

The status of Dall's porpoises in California, Oregon and Washington relative to OSP is not known, and there are insufficient data to evaluate potential trends in abundance. No habitat issues are known to be of concern for this species. It is not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. The average annual human-caused mortality (≥0.4 animals) is estimated to be less than the PBR (257), and therefore they are not classified as a "strategic" stock under the MMPA. The total fishery mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate.

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Revised 01/15/2011

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 (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).

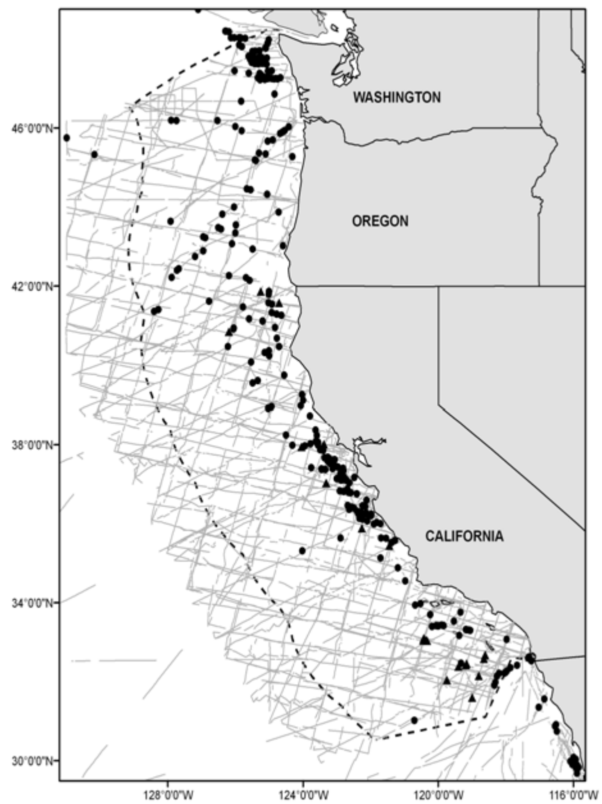

Figure 1. Pacific white-sided dolphin sightings based on aerial and shipboard surveys off California, Oregon, and Washington, 1991-2008 (see Appendix 2 for data sources and information on timing and location of survey effort). Dashed line represents the U.S. EEZ, thin lines indicate completed transect effort of all surveys combined. 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 most recent estimates of abundance for Pacific white-sided dolphins are based on two summer/autumn shipboard surveys conducted within 300 nmi of the coasts of California, Oregon, and Washington in 2005 (Forney 2007) and 2008 (Barlow 2010). 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 2005-2008 geometric mean abundance estimate for California, Oregon and Washington waters based on the two most recent ship surveys is 26,930 (CV=0.28) Pacific white-sided dolphins (Forney 2007, Barlow, 2010).

Minimum Population Estimate

The log-normal 20th percentile of the 2005-2008 average abundance estimate is 21,406 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 and Forney 2007, Forney 2007).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (21,406) <u>times</u> one half the default maximum net growth rate for cetaceans (½ of 4%) <u>times</u> a recovery factor of 0.45 (for a species of unknown status with a mortality rate CV $>$ 0.60 and $\leq$0.80; Wade and Angliss 1997), resulting in a PBR of 193 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. Including mortality from drift gillnet, groundfish trawl, and unknown fisheries, the average annual fishery-related mortality of Pacific white-sided dolphins is 10.5 (CV = 0.65) animals. Mortality estimates for the California drift gillnet fishery are included for the five most recent years of monitoring, 2004-2008 (Carretta et al. 2005 Carretta and Enriquez 2006, 2007, 2009a, 2009b). 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.

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 2004-2008 data unless noted otherwise.

Fishery Name	Data Type	Year(s)	Percent Observer Coverage	Observed Mortality	Estimated Annual Mortality	Mean Annual Takes (CV in parentheses)
CA/OR thresher shark/swordfish drift gillnet fishery	observer	2004 2005 2006 2007 2008	20.6% 20.9% 18.5% 16.4% 13.5%	0 0 0 1 5	0 0 0 6 (1.00) 37 (0.70)	8.6 (0.77)
WA/OR/CA domestic groundfish trawl (At-sea processing Pacific hake fishery).	observer	2002 2003 2004 2005 2006	100% 100% 100% 100% 100%	0 1 0 0 0	0 1 (n/a) 0 0 0	0.2 n/a)
West Coast limited entry bottom trawl fishery	observer	2002 2003 2004 2005	10-33%, varies by reporting area	1 in 2003	7.5 (0.93)	1.9 (0.93)
Unknown fishery	stranding	2004 2005 2006 2007 2008		1 0 0 0 0	n/a	≥0.2 (n/a)
Minimum total annual takes						10.5 (0.65)

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; Northwest Fisheries Science Center 2008). Between 2004-2008, with 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). One white-sided dolphin death was reported in the limited entry bottom trawl fishery in 2003, resulting in a bycatch estimate of 7.5 animals (Table 1).

Other removals

In 2008, fifteen Pacific white-sided dolphin were incidentally killed in California waters during scientific sardine trawling operations conducted by NMFS (Southwest Regional Office Stranding Program, unpublished data). Three mortality events occurred in April trawls, after which NMFS scientists met to discuss & implement a mitigation plan to avoid future mortality events. The initial mitigation plan included use of 162 dB acoustic pingers, a marine mammal watch, and scheduling trawls to occur when the ship first arrived on station to avoid attracting animals to a stationary vessel. During August 2008 trawls, twelve additional Pacific white-sided dolphin were killed. One trawl caught 11 Pacific white-sided dolphins and six northern right whale dolphins. In 2009, a marine mammal excluder device was added to the trawls. In 2009, no additional mortality was observed during 42 trawls. However, a group of three Pacific white-sided dolphin became entangled in the trawl during retrieval. Two animals were brought aboard alive and immediately released, while a third animal escaped through the excluder device. Eight additional Pacific white-sided dolphins were killed in research surface trawls between 2005 and 2006 (NMFS Northwest Region, unpublished data). The average annual research-related mortality of Pacific white-sided dolphin from 2004 to 2008 is 4.6 animals.

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 commercial fishery (10.5/yr) and research-related mortality (4.6/yr), the average annual mortality for the 5-year period 2004-2008 is 15.1 animals. The average annual human-caused mortality in 2004-2008 (15.1 animals) is estimated to be less than the PBR (193), 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 previous surveys have shown a conspicuous 500 nmi distributional gap between these animals and Risso's dolphins sighted south of Baja California and in the Gulf of California (Mangels and Gerrodette 1994). Thus this population appears distinct from animals found in the eastern tropical Pacific and the Gulf of California. Although Risso's dolphins are not restricted to U.S. waters, cooperative management agreements with Mexico exist only for the tuna purse seine fishery and not for other fisheries which may take this species (e.g. gillnet fisheries). For the Marine Mammal Protection Act (MMPA) stock assessment reports, Risso's dolphins within the Pacific U.S. Exclusive Economic Zone are divided into two discrete, non-contiguous areas: 1) waters off California, Oregon and Washington (this report), and 2) Hawaiian waters.

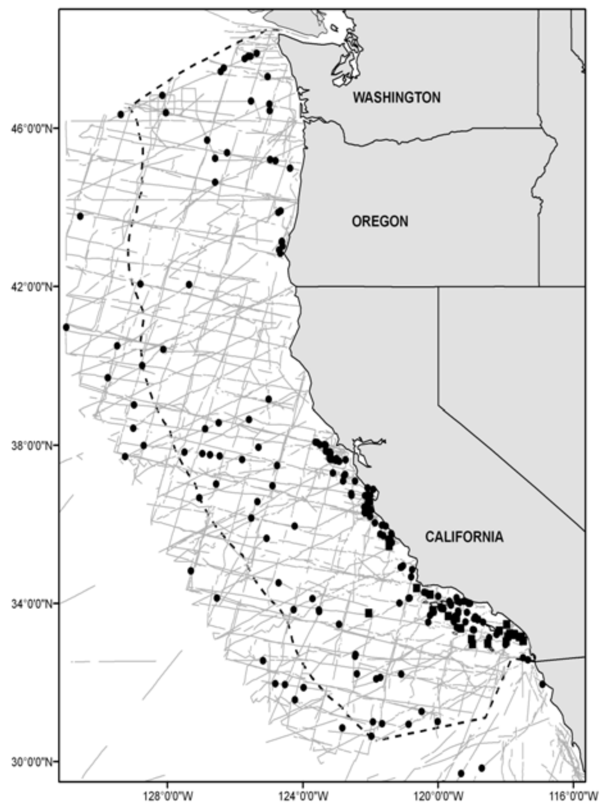

Figure 1. Risso's dolphin sightings based on aerial and shipboard surveys off California, Oregon, and Washington, 1991-2008 (see Appendix 2 for data sources and information on timing and location of survey effort). Dashed line represents the U.S. EEZ, thin lines indicate completed transect effort of all surveys combined. Key: • = summer/autumn ship-based sightings; ■ = winter/spring aerial-based sightings.

POPULATION SIZE

Current estimates of population size are derived from two shipboard surveys within 300 nmi of the coasts of California, Oregon, and Washington in summer/autumn of 2005 (Forney 2007) and 2008 (Barlow 2010). 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 2005-2008 geometric mean abundance estimate for California, Oregon and Washington waters based on the two most recent ship surveys is 6,272 (CV=0.30) Risso's dolphins (Forney, 2007, Barlow 2010).

Minimum Population Estimate

The log-normal 20th percentile of the 2005-2008 geometric mean abundance estimate is 4,913 Risso's dolphins.

Current Population Trend

Barlow and Forney (2007) and Barlow (2010) report abundance estimates ranging from approximately 4,000 to 11,000 animals in California waters for five separate surveys conducted between 1991 and 2008, with no apparent trend in abundance. 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.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (4,913) 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 39 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, 2004-2008 (Carretta et al. 2005, Carretta and Enriquez 2006, 2007, 2009a, 2009b). After the 1997 implementation of a Take Reduction Plan, which included skipper education workshops and required the use of pingers and minimum 6-fathom extenders, overall cetacean entanglement rates in the drift gillnet fishery dropped considerably (Barlow and Cameron 2003). However, because of interannual variability in entanglement rates and the relative rarity of Risso's dolphin entanglements, additional years of data will be required to fully evaluate the effectiveness of pingers for reducing mortality of this particular species. Mean annual takes in Table 1 are based on 2004-2008 data. This results in an average estimate 1.6 (CV = 0.99) Risso's 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).

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

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 2004-2008 data unless noted otherwise.

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	2004	20.6%	0	0	1.4 (0.99)
		2005	20.9%	0	0	
		2006	18.5%	0	0	
		2007	16.4%	0	0	
		2008	13.5%	1	7 (0.99)	
CA shallow set longline fishery	observer	2004 No fishery in 2005	< 10%		0	0
CA deep set longline fishery	observer	2005-2008	100%	0	0	0
Market squid purse seine	observer	2004-2008	<10%	0	0	0
Unknown fishery	Stranding	2004-2008		1	≥1	≥0.2
Minimum total annual takes						1.6 (0.99)

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 (2004-2008), the average annual human-caused mortality (1.6 animals) is estimated to be less than the PBR (39), and therefore they are not classified as a "strategic" stock under the MMPA. The total fishery mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate.

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Revised 12/15/2008

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bottlenose dolphins are distributed world-wide in tropical and warm-temperate waters. In many regions, including California, separate coastal and offshore populations are known (Walker 1981; Ross and Cockcroft 1990; Van Waerebeek et al. 1990). Based on nuclear and mtDNA analyses, Lowther (2006) identified 5 haplotypes from 29 coastal animals and 25 haplotypes from 40 offshore animals from the U.S. west coast. There were no shared haplotypes between coastal and offshore animals and significant genetic differentiation between the two ecotypes was evident. California coastal bottlenose dolphins are found within about one kilometer of shore (Figure 1; Hansen, 1990; Carretta et al. 1998; Defran and Weller 1999) primarily from Point Conception south into Mexican waters, at least as far south as San Quintin, Mexico. In southern California, animals are found within 500 m of the shoreline 99% of the time and within 250 m 90% of the time (Hanson and Defran 1993). Oceanographic events appear to influence the distribution of animals along the coasts of California and Baja California, Mexico, as indicated by a change in residency patterns along Southern California and a northward range extension into central California after the 1982-83 El Niño (Hansen and Defran 1990; Wells et al. 1990). Since the 1982-83 El Niño, which increased water temperatures off California, they have been consistently sighted in central California as far north as San Francisco. Photo-identification studies have documented north-south movements of coastal bottlenose dolphins (Hansen 1990; Defran et al. 1999), and monthly counts based on surveys between the U.S./Mexican border and Point Conception are variable (Carretta et al. 1998), indicating that animals are moving into and out of this area. There is little site fidelity of coastal bottlenose dolphins along the California coast; over 80% of the dolphins identified in Santa Barbara, Monterey, and Ensenada have also been identified off San Diego (Defran et al. 1999, Feinholz 1996, Defran, unpublished data). Although coastal bottlenose dolphins are not restricted to U.S. waters, cooperative management agreements with Mexico exist only for the tuna purse seine fishery and not for other fisheries which may take this species. Therefore, the management stock includes only animals found within U.S. waters. For the Marine Mammal Protection Act (MMPA) stock assessment reports, bottlenose dolphins within the Pacific U.S. Exclusive Economic Zone are divided into three stocks: 1) California coastal stock (this report), 2) California, Oregon and Washington offshore stock, and 3) Hawaiian stock.

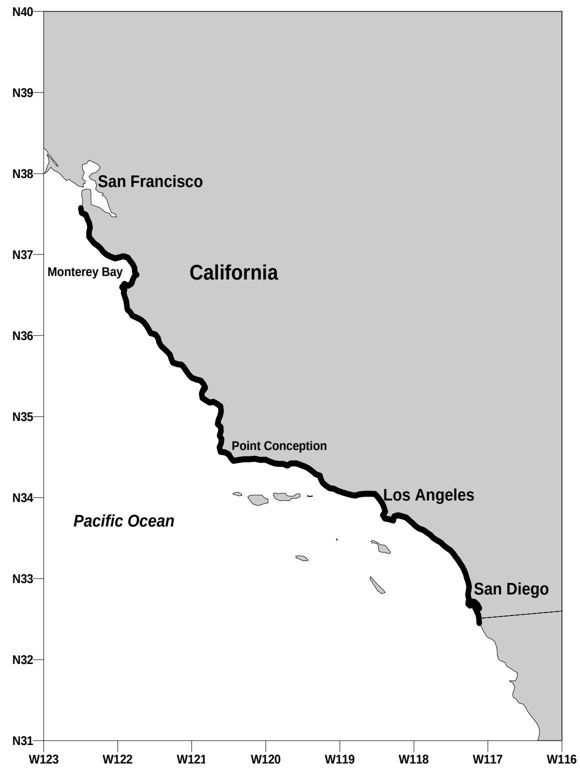

Figure 1. Approximate range (in bold) of California coastal bottlenose dolphins based on aerial surveys along the coast of California from 1990-2000. This population of bottlenose dolphins is found within about 1 km of shore.

POPULATION SIZE

Based on photographic mark-recapture surveys conducted along the San Diego coast in 2004 and 2005, the most recent estimate of population size is 323 dolphins (CV = 0.13, 95% CI 259-430; Dudzik et al. 2006). This estimate does not reflect that approximately 35% of dolphins encountered lack identifiable dorsal fin marks (Defran and Weller 1999). If 35% of all animals lack distinguishing marks, then the true population size would be closer to 450-500 animals. Comparing the most recent population size estimate with those obtained from 1987-89 (354 dolphins, 95% CI 330 – 390) and 1996-98 (356 dolphins, 95% CI 306 – 437; Dudzik 1999) suggests that the population size has been stable for approximately 20 years. Older estimates of population size for this stock range from 234 (95% CI 205-263) to 285 (95% CI 265-306) animals for the period 1985-89 (Defran and Weller 1999). Because coastal bottlenose dolphins spend an unknown amount of time in Mexican waters, where they may be subject to mortality in Mexican fisheries, an average abundance estimate for California only is the most appropriate for U.S. management of this stock.

Minimum Population Estimate

The minimum number of dolphins photographically identified during 2004-2005 field studies was 164, however, the discovery curve for new animals had not yet reached an asymptote during that study (Dudzik et al. 2006). The minimum population estimate for this stock is therefore taken as the lower 20th percentile of the log-normal distribution of abundance obtained from the photographic mark-recapture estimate (Dudzik et al. 2006), or approximately 290 dolphins.

Current Population Trend

Based on a comparison of mark-recapture abundance estimates for the periods 1987-89 ($\hat{N}$= 354), 1996-98 ($\hat{N}$= 356), and 2004-05 ($\hat{N}$= 323), Dudzik et al. (2006) stated that the population size had remained stable over this period.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (290) <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 estimated fishery mortality; Wade and Angliss 1997), resulting in a PBR of 2.9 coastal bottlenose dolphins per year. Not all California coastal bottlenose dolphins are present in U.S. waters at any given moment and approximately 18% of the stock's range occurs in Mexican waters. Thus, the PBR is prorated by a minimum factor of 0.82 to account for time that animals spend outside of U.S. waters. Without additional data on the residence times of dolphins in Mexican waters, this factor cannot be improved upon. Because this stock spends some of its time outside the U.S. EEZ, the PBR allocation for U.S. waters is 2.9 x 0.82 = 2.4 dolphins per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Due to its exclusive use of coastal habitats, this bottlenose dolphin population is susceptible to fishery-related mortality in coastal set net fisheries. A summary of information on fishery mortality and injury for this stock of bottlenose dolphin is shown in Table 1. More detailed information on the set gillnet fishery is provided in Appendix 1. From 1991-94, no bottlenose dolphins were observed taken in this fishery with 10-15% observer coverage (Julian and Beeson 1998). The observer program was discontinued at the end of 1994, when coastal set gillnet fishing was banned within 3 nmi of the southern California coast. In 2002, a ban on set gill and trammel nets inshore of 60 fathoms from Point Reyes to Point Arguello became effective. Because of these closures, the potential for mortality of coastal bottlenose dolphins in the California set gillnet fishery has been greatly reduced. Fisher self-report data and 36 stranding records for 1997-2001 do not include any evidence of fishery interactions for this stock. A renewed observer program began in the halibut set gillnet fishery in 2006. Through late 2007, a total of 260 sets were observed without a cetacean interaction. In 2003, an immature female bottlenose dolphin stranded dead in San Diego, California, with 3.5-inch mesh gillnet wrapped around its tailstock (SWFSC stranding KXD0048). Perforation of the animal's skin suggests the net was on the animal for some time. Mitochondrial DNA analysis showed that the haplotype for this animal matches that of known *coastal* animals (Lowther 2006; Lowther et al. in prep). The fishery responsible for this mortality is unknown, but the location and type of gillnet found suggests either a set or drift gillnet targeting yellowtail, white seabass, or barracuda. In 2004, a bottlenose dolphin with missing flukes washed ashore near Newport Beach, California, 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). Coastal gillnet fisheries exist in Mexico and may take animals from this population, but no details are available.

Table 1. Summary of available information on the incidental mortality and serious injury of bottlenose dolphins (California Coastal Stock) in commercial fisheries that might take this species. A renewed observer program began in the halibut set gillnet fishery in 2006 (12 sets observed total, <1% observer coverage).

Fishery Name	**Data Type**	**Year(s)**	**Percent Observer Coverage**	**Observed Mortality**	**Estimated Annual Mortality**	**Mean Annual Takes (CV in parentheses)**
CA angel shark/ halibut and other species large mesh (>3.5in) set gillnet fishery	observer	2002 2003 2004 2005 2006	0% 0% 0% 0% <1%	0	0	0
Unknown fishery	stranding	2002-2006	One bottlenose dolphin with a coastal stock haplotype stranded entangled in 3.5-inch mesh gillnet in 2003			≥0.2 (n/a)
Minimum total annual takes						≥0.2 (n/a)

Other removals

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

STATUS OF STOCK

The status of coastal bottlenose dolphins in California relative to OSP is not known, and there is no evidence of a trend in abundance. They are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. Coastal bottlenose dolphins are not classified as a "strategic" stock under the MMPA because total annual fishery mortality and serious injury for this stock (≥0.2 per year) is less than the PBR (2.4). The total human-caused 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.

Habitat Issues

Pollutant levels, especially DDT residues, found in Southern California coastal bottlenose dolphins have been found to be among the highest of any cetacean examined (O'Shea et al. 1980; Schafer et al. 1984). Although the effects of pollutants on cetaceans are not well understood, they may affect reproduction or make the animals more prone to other mortality factors (Britt and Howard 1983; O'Shea et al. 1999). This population of bottlenose dolphins may also be vulnerable to the effects of morbillivirus outbreaks, which were implicated in the 1987-88 mass mortality of bottlenose dolphins on the U.S. Atlantic coast (Lipscomb et al. 1994).

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Revised 01/15/2011

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bottlenose dolphins are distributed world-wide in tropical and warm-temperate waters. In many regions, including California, separate coastal and offshore populations are known (Walker 1981; Ross and Cockcroft 1990; Van Waerebeek et al. 1990; Lowther 2006; 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.

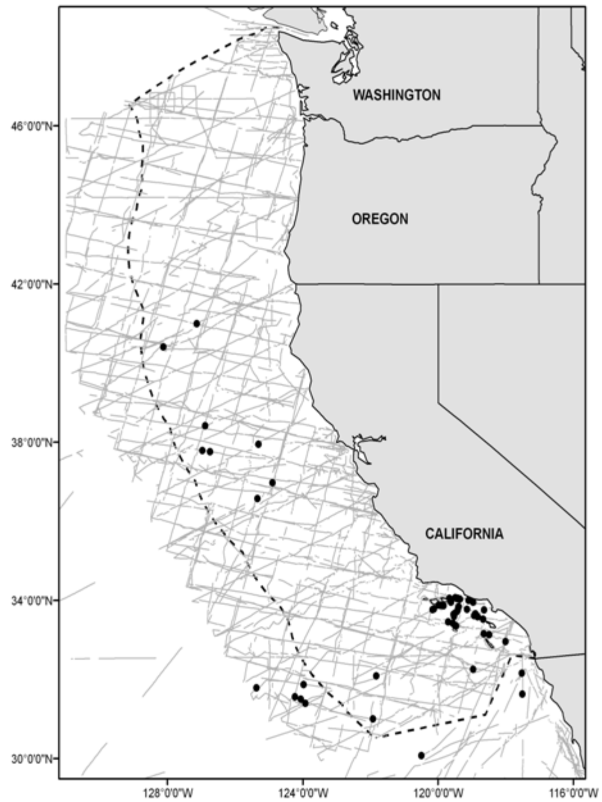

Figure 1. Offshore bottlenose dolphin sightings based on shipboard surveys off California, Oregon, and Washington, 1991-2008 (see Appendix 2 for data sources and information on timing and location of survey effort). Dashed line represents the U.S. EEZ, thin lines indicate completed transect effort of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

POPULATION SIZE

The most recent shipboard surveys conducted within 300 nmi of the coasts of California, Oregon, and Washington were in 2005 (Forney 2007) and 2008 (Barlow 2010). 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 geometric mean abundance estimate for California, Oregon and Washington waters based on the 2005 and 2008 ship surveys, or 1,006 (CV=0.48) offshore bottlenose dolphins (Forney 2007, Barlow 2010).

Minimum Population Estimate

The log-normal 20th percentile of the 2005-2008 average abundance estimate is 684 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 (684) 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 an unknown fishery mortality CV ; Wade and Angliss 1997), resulting in a PBR of 5.5 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, 2004-2008 (Carretta et al. 2005, Carretta and Enriquez 2006, 2007, 2009a, 2009b). 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 2004-2008 data. This results in an average estimate of 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 2004-2008 data unless noted otherwise.

Fishery Name	Data Type	Year(s)	Percent Observer Coverage	Observed Mortality	Estimated Annual Mortality	Mean Annual Takes (CV in parentheses)
CA/OR thresher shark/swordfish drift gillnet fishery	observer	2004 2005 2006 2007 2008	20.6% 20.9% 18.5% 16.4% 13.5%	0 0 0 0 0	0 0 0 0 0	0
Unknown fishery	strandings	2004-2008		1	≥1	≥0.2 (n/a)
Minimum total annual takes						≥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 average annual fishery takes (0.2/year) are less than the calculated PBR (5.5), offshore bottlenose dolphins are not classified as a "strategic" stock under the MMPA. The total fishery mortality and serious injury for this stock is less than 10% of the PBR and thus can be considered to be insignificant and approaching zero.

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Revised 01/15/2011

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.

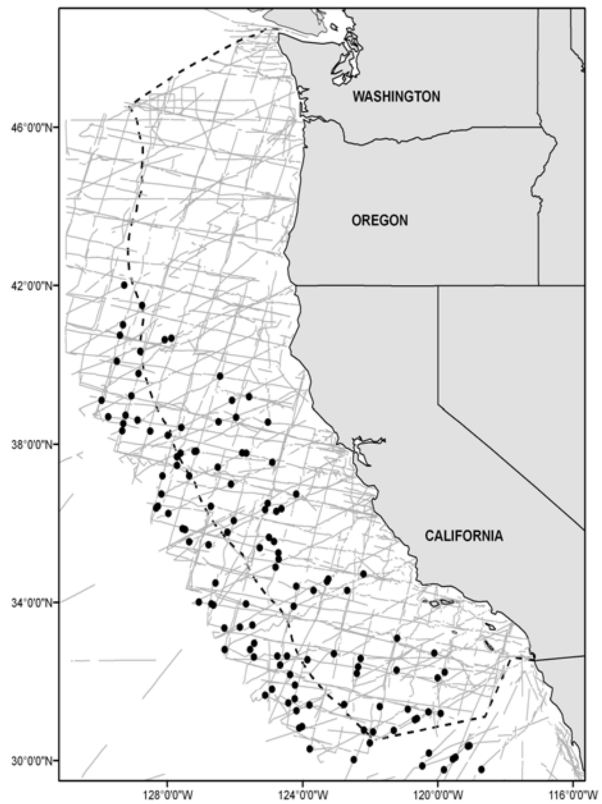

Figure 1. Striped dolphin sightings based on aerial and shipboard surveys off California, Oregon, and Washington, 1991-2008 (see Appendix 2 for data sources and information on timing and location of survey effort). Dashed line represents the U.S. EEZ, thin lines indicate the completed transect effort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

POPULATION SIZE

Abundance is estimated from two summer/fall shipboard surveys conducted within 300 nmi of the coasts of California, Oregon and Washington in 2005 (Forney 2007) and 2008 (Barlow 2010). 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 2005-2008 geometric mean abundance estimate for California, Oregon and Washington waters based on the 2005 and 2008 ship surveys is 10,908 (CV=0.34) striped dolphins (Barlow and Forney 2007 , Forney 2007, Barlow 2010).

Minimum Population Estimate

The log-normal 20th percentile of the 2005-2008 mean abundance estimate is 8,231 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. Barlow and Forney (2007) reported striped dolphin abundance estimates of 32,370, 14,622, 4,796, 12,570, and 25,561 for the years 1991, 1993, 1996, 2001, and 2005, respectively. The estimate from the most recent 2008 ship survey is 4,655 (CV=0.30) (Barlow 2010). 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 (8,231) <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 82 striped dolphins per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

A summary of recent fishery mortality and injury for this stock of striped dolphin is shown in Table 1. More detailed information on these fisheries is provided in Appendix 1. Mortality estimates for the California drift gillnet fishery are included for the five most recent years of monitoring, 2004-2008 (Carretta et al. 2005, Carretta and Enriquez 2006, 2007, 2009a, 2009b). 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 2004-2008 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.

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	2004-2008	13-21%	0	0	0
Minimum total annual takes						0

Other mortality

One striped dolphin stranded in Oregon in 2006 with “bruising and trauma, possible impact or fisheries interaction” evidence. This results in a human-caused average annual mortality of 0.2 striped dolphins per year for the period 2004-2008.

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. The average annual human-caused mortality in 2004-2008 is 0.2. Because recent fishery and human-caused mortality is less than 10% of the PBR (82), striped dolphins are not classified as a "strategic" stock under the MMPA, and the total fishery mortality and serious injury for this stock can be considered to be insignificant and approaching zero.

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Revised 01/15/2011

SHORT-BEAKED COMMON DOLPHIN (*Delphinus delphis 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 have been commonly sighted as far north as 42°N during 1991-2008 NMFS line-transect vessel surveys (Figure 1). Four strandings of common dolphins have been reported in Oregon and Washington since 1942 (B. Norberg, pers. comm.), but three of these could not be identified to species. One animal, which stranded in 1983, was identified as a short-beaked common dolphin (J. Hodder, pers. comm.). Significant seasonal shifts in the abundance and distribution of common dolphins have been identified based on winter/spring 1991-92 and summer/fall 1991 surveys (Forney and Barlow 1998). Their distribution is continuous southward into Mexican waters to about 13°N (Perrin et al. 1985; Wade and Gerrodette 1993; Mangels and Gerrodette 1994), and short-beaked common dolphins off California may be an extension of the "northern common dolphin" stock defined for management of eastern tropical Pacific tuna fisheries (Perrin et al. 1985). However, preliminary data on variation in dorsal fin color patterns suggest there may be multiple stocks in this region, including at least two possible stocks in California (Farley 1995). The less abundant long-beaked common dolphin has only recently been recognized as a different species (Heyning and Perrin 1994; Rosel et al. 1994), and much of the available information has not differentiated between the two types of common dolphin. Although short-beaked common dolphins are not restricted to U.S. waters, cooperative management agreements with Mexico exist only for the tuna purse seine fishery and not for other fisheries which may take this species (e.g. gillnet fisheries). Under the Marine Mammal Protection Act (MMPA), short-beaked common dolphins involved in tuna purse seine fisheries in international waters of the eastern tropical Pacific are managed separately, and they are not included in the assessment reports. For the MMPA stock assessment reports, there is a single Pacific management stock including only animals found within the U.S. Exclusive Economic Zone of California, Oregon and Washington.

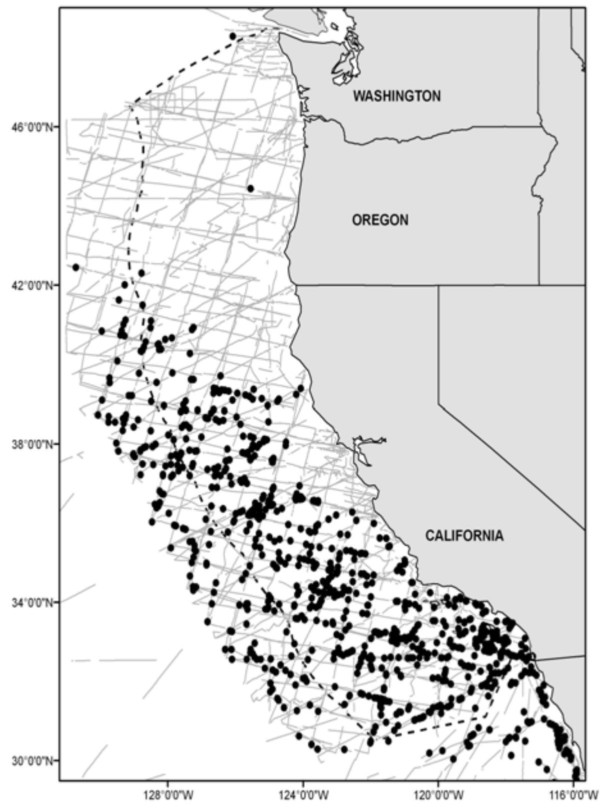

Figure 1. Short-beaked common dolphin sightings based on shipboard surveys off California, Oregon, and Washington, 1991- 2008 (see Appendix 2, for data sources and information on timing and location of survey effort). Dashed line represents the U.S. EEZ, thin lines indicate completed transect effort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

POPULATION SIZE

The most recent estimates of abundance estimates are based on two summer/fall shipboard surveys that were conducted within 300 nmi of the coasts of California, Oregon and Washington in 2005 (Forney 2007) and 2008 (Barlow 2010.). 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 2005-2008 geometric mean abundance estimate for California, Oregon and Washington waters based on the two ship surveys is 411,211 (CV= 0.21) short-beaked common dolphins .

Minimum Population Estimate

The log-normal 20th percentile of the 2005-2008 abundance estimate is 343,990 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). 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 (343,990) 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 3,440 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. Mean annual takes in Table 1 are based on 2004-2008 data. This results in an average estimate of 64 (CV=0.29) short-beaked common dolphins taken annually. 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, 2004-2008 (Carretta et al. 2005, Carretta and Enriquez 2006, 2007, 2009a, 2009b). 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). Since the initial pinger experiments in 1996, 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 (Figure 2). Prior to the use of acoustic pingers in the fishery, short-beaked common dolphin were observed entangled at a rate of 6.7 animals per 100 sets (125 entanglements in 1,848 sets) in sets south of Point Conception. In the same region, sets with twenty or more pingers have an entanglement rate of 4.4 animals per 100 sets (137 entanglements in 3,104 sets). The difference between the two entanglement rates is statistically significant (Poisson probability < 0.002).

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. Coefficients of variation for mortality estimates are provided in parentheses; n/a = not available. Mean annual takes are based on 2004-2008 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	2004 2005 2006 2007 2008	20.6% 20.9% 18.5% 16.4% 13.5%	7 12 6 9 8	34 (0.49) 57 (0.30) 32 (0.52) 54 (0.41) 59 (0.43)	47 (0.19)
CA squid purse seine	observer	2004 2005 2006 2007 2008	unknown 1.1% unknown <5% <5%	0 1 0 0 0	0 87 (0.98) 0 0 0	17 (0.98)
CA halibut /white seabass and other species set gillnet fishery[2]	Self-report Self-report Observer Observer Observer	2004 2005 2006 2007 2008	- - - n/a n/a ~1% 17% not observed	1 0 0 0 0	≥1 0 0 0 0	≥1 (n/a)

Fishery Name	Data Type	Year	Percent Observer Coverage	Observed Mortality	Estimated Annual Mortality	Mean Annual Takes (CV in parentheses)
Unknown fishery	strandings	2004-2008	Two unidentified common and three short-beaked common dolphin stranded with evidence of fishery interactions. Evidence of fishery interactions included net marks and/or positive metal detector scans. None of the strandings could be linked to a specific commercial fishery. These strandings may have come from observed fisheries that already have bycatch estimates and thus are not included in the annual average to prevent double-counting of fishery mortality. Mean annual takes are therefore based on stranded animals only if the stranding can be attributed to a fishery lacking an observer program or cases where stranded animals represent the only documented fishery-related deaths in a given year.			≥ 0 (n/a)
Minimum total annual takes						64 (0.29)

[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. There are no estimates of common dolphin mortality in this fishery because of a lack of recent observer effort. Observer coverage in this fishery resumed in 2006 (12 sets observed) and continued into 2007 (248 sets observed).

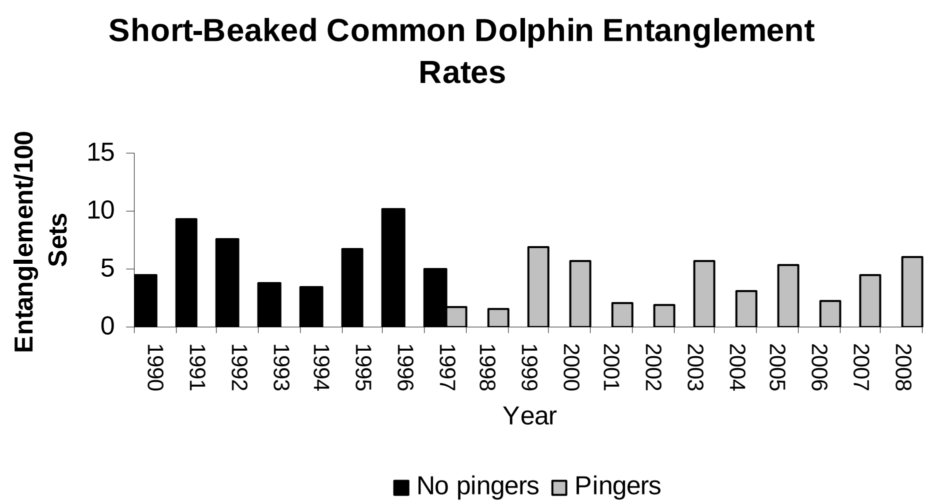

Figure 2. Entanglement rates of short-beaked common dolphin per set fished in the California drift gillnet fishery for swordfish and thresher shark, 1990-2008. Entanglement rates include observations from pingered and unpingered sets. Pingers were not used from 1990-95 and were used experimentally in 1996 and 1997. In 1996, no short-beaked common dolphin were observed killed in 146 pingered sets. For the period 1998- 2008, more than 99% of all observed sets utilized pingers.

Common dolphin mortality has also been reported in halibut set gillnets in California (Julian and Beeson 1998). The fishery has been observed only four times since 1994 (in 1999, 2000, 2006, and 2007), at low levels of observer coverage (< 20% of fishing effort). No common dolphins were observed entangled in 2007, when the fishery had approximately 18% observer coverage (248 sets observed).

There were 377 sets observed in the squid purse seine fishery from 2004-2008. One short-beaked common dolphin mortality was observed in 2005, with a resulting mortality estimate of 87 (CV=0.98) animals (Carretta and Enriquez 2006). In addition, there was one squid purse seine set in 2006 where 8 unidentified dolphins were encircled. Seven were released alive and the eighth was seriously injured.

One unidentified and three short-beaked common dolphin stranded with evidence of fishery interaction (NMFS, Southwest Region, unpublished data) between 2004-2008. It is not known which fisheries were responsible for these deaths.

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

Other Mortality

In the eastern tropical Pacific, 'northern common dolphins' have been incidentally killed in international tuna purse seine fisheries since the late 1950's. Cooperative international management programs have dramatically reduced overall dolphin mortality in these fisheries during the last decade (Joseph 1994). Between 2000-2004, annual fishing mortality of northern common dolphins (potentially including both short-beaked and long-beaked common dolphins) ranged between 54 and 159 animals, with an average of 102 (IATTC, 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. The average annual human-caused mortality in 2004-2008 (64 animals) is estimated to be less than the PBR (3,440), and therefore they are not classified as a "strategic" stock under the MMPA. The total estimated fishery mortality and injury for short-beaked common dolphins is less than 10% of the calculated PBR and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate.

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Revised 12/15/2012

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

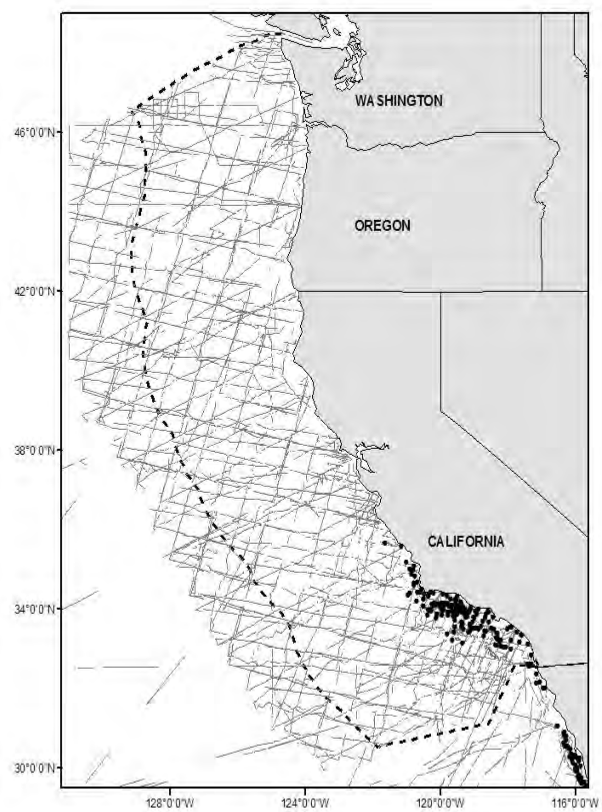

Figure 1. Long-beaked common dolphin sightings based on shipboard surveys off California, Oregon, and Washington, 1991- 2010 (see Appendix 2 for information on timing and location of survey effort). No Delphinus sightings have been made off Washington. Dashed line represents the U.S. EEZ, thin lines indicate completed transect effort of all surveys combined.

POPULATION SIZE

The most recent abundance estimates for this stock are 62,447 (CV=0.80) and 183,396 (CV=0.41) dolphins, based on 2008 and 2009 ship line-transect surveys, respectively (Barlow 2010; Carretta *et al*. 2011). The distribution and abundance of long-beaked common dolphins off California varies inter-annually and seasonally (Heyning and Perrin 1994). As oceanographic conditions change, long-beaked common dolphins may move between Mexican and U.S. waters, and therefore a multi-year average abundance estimate is the most appropriate for management within the U.S. waters. The geometric mean abundance estimate for California, Oregon and Washington waters based on two ship surveys conducted in 2008 and 2009 (Barlow 2010; Carretta *et al*. 2011) is 107,016 (0.42) long-beaked common dolphins.

Minimum Population Estimate

The log-normal 20th percentile of the weighted average abundance estimate is 76,224 long-beaked common dolphins.

Current Population Trend

California waters represent the northern limit for this stock and animals likely move between U.S. and Mexican waters. While no formal statistical trend analysis exists for this stock of long-beaked common dolphin, abundance estimates for California waters from a 2009 vessel-based line-transect survey were the highest of any survey dating back to 1991 (Carretta *et al*. 2011). The ratio of strandings of long-beaked to short-beaked common dolphin in southern California increased following a strong 1982-1983 El Niño (Heyning and Perrin 1994). Within San Diego County, dramatic increases in the ratio of long-beaked to short-beaked common dolphin strandings were observed between 2006 and 2008 (Danil *et al*. 2010), with higher numbers of long-beaked strandings persisting through 2010 (NMFS unpublished stranding data). During a 2009 ship-based survey of California and Baja California waters, the ratio of long-beaked to short-beaked common dolphin sightings was nearly 1:1, whereas during previous surveys conducted from 1986 to 2008 in the same geographic strata, the ratio was approximately 1:3.5 (Carretta *et al*. 2011). There appears to be an increasing trend of long-beaked common dolphins in California waters over the last 30 years.

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 (76,224) <u>times</u> one half the default maximum net growth rate for cetaceans (½ of 4%) <u>times</u> a recovery factor of 0.40 (for a species of unknown status with a mortality rate CV > 0.80 ; Wade and Angliss 1997), resulting in a PBR of 610 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, 2006-2010 (Carretta and Enriquez 2007, 2009a, 2009b, 2012). Acoustic pingers have been shown to significantly reduce the bycatch rates of short-beaked common dolphins (*Delphinus delphis*) (Barlow and Cameron 2003, Carretta and Barlow 2011). The effectiveness of pingers on reducing bycatch of long-beaked common dolphins is expected to be similar to that shown for short-beaked common dolphins but is unknown, because long-beaked common dolphins are rarely observed entangled in this fishery.

Long-beaked common dolphin mortality has also been reported in halibut set gillnets in California (Julian and Beeson 1998, Carretta and Enriquez 2012, Table 1).

Thirty-six common dolphins (two unidentified common dolphins and 34 long-beaked common dolphins) stranded with evidence of fishery interactions (NMFS, Southwest Region, unpublished data) between 2006-2010. Most strandings showed evidence of an interaction with an unknown entangling net fishery (severed flukes, knife cuts, net marks, or net fragments wrapped around the animal). Mean annual takes in Table 1 are based on 2006-2010 data.

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

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 (Joseph 1994). Between 2004-2008, annual fishing mortality of northern common dolphins (potentially including both short-beaked and long-beaked common dolphins) ranged between 55 and 156 animals, with an average of 112 (IATTC 2010). Although it is unclear whether any long-beaked dolphins are taken in international purse seine fisheries in the eastern tropical Pacific, common dolphins in this region are managed separately under a section of the MMPA written specifically for the management of dolphins involved in eastern tropical Pacific tuna fisheries.

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. Coefficients of variation for mortality estimates are provided in parentheses, when available. Mean annual takes are based on 2006-2010 data unless noted otherwise. n/a = information not available.

Fishery Name	Data Type	Year(s)	Percent Observer Coverage	Observed (or self-reported)	Estimated Annual Mortality	Mean Annual Takes (CV in parentheses)
CA thresher shark/swordfish drift gillnet fishery	observer	2006 2007 2008 2009 2010	18.5% 16.4% 13.5% 13.3% 11.9%	1 0 1 0 1	5 (1.04) 0 7 (1.08) 0 8 (1.00)	4.0 (1.01)
CA small mesh drift gillnet fishery for white seabass, yellowtail, barracuda, and tuna	observer	2006 2007 2008 2009 2010	17.6% not observed not observed not observed not observed	1 n/a n/a n/a n/a	5 (1.18) n/a n/a n/a n/a	5 (1.18)
CA halibut/white seabass and other species set gillnet fishery	Self report & observer	2006 2007 2008 2009 2010	~1% 17% not observed not observed 12.5%	0 0 0 0 1	0 0 0 0 7 (1.07)	1.4 (1.07)
Undetermined	strandings	2006-2010	36 common dolphins (two unidentified and 34 longbeaked common dolphins) stranded with evidence of fishery interactions. Evidence of fishery interactions included severed flukes, net fragments, net marks, positive metal detector scans, and knife marks or cuts. Some strandings may have come from observed fisheries that already have bycatch estimates and these are not included in the annual average to prevent double-counting of fishery mortality. Mean annual takes are therefore based on stranded animals only if the stranding can be attributed to a fishery lacking an observer program or cases where stranded animals represent the only documented fishery-related deaths in a given year. This results in a minimum of 13 long-beaked common dolphin strandings over the 5 year period, or 2.6 animals annually.			≥ 2.6 (n/a)
Minimum total annual takes						13.0 (0.55)

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

Three long-beaked common dolphins died near San Diego in 2011 as the result of blast trauma associated with underwater detonations conducted by the U.S. Navy. Three days later, a fourth animal stranded approximately 70 km north of that location with similar injuries (Danil and St. Leger 2011).

STATUS OF STOCK

The status of long-beaked common dolphins in California waters relative to OSP is not known, and there are insufficient data to evaluate potential trends in abundance. Exposure to blast trauma resulting from underwater detonations is a local concern for this stock, but population level impacts from such activities are unclear. In response to the 2011 event, the U.S. Navy has implemented new training protocols to reduce the probability of blast trauma events occurring (Danil and St. Leger 2011). Long-beaked common dolphins are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. Including past mortality both from commercial fisheries between 2006 and 2010 (13.0 animals per year) and the average annual mortality resulting from the single blast trauma event of 2011 (0.8 animals per year for the 5-yr period 2007 to 2011), the average annual human-caused mortality is 13.8 long-beaked common dolphins. This does not exceed the PBR (610), 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 (13.0) is less than 10% of the PBR and therefore, is considered to be insignificant and approaching zero mortality and serious injury rate.

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Revised 01/15/2011

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.

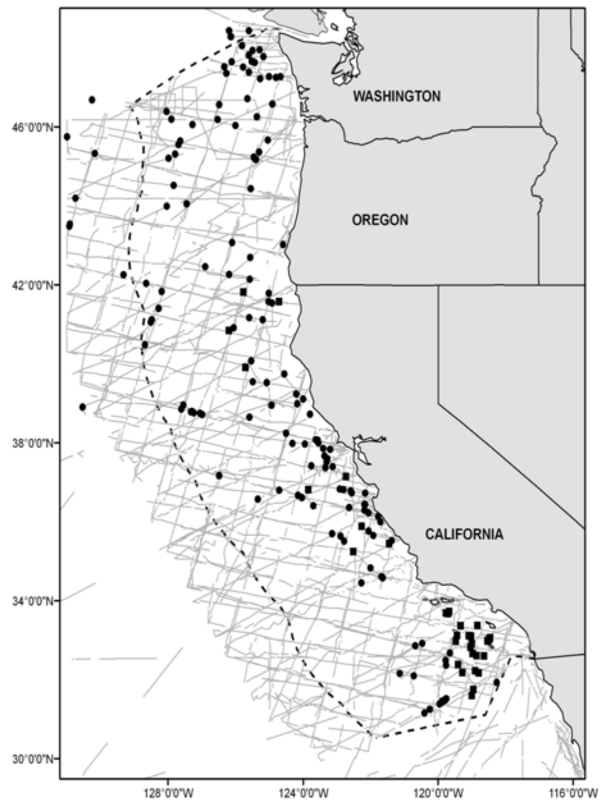


Figure 1. Northern right whale dolphin sightings based on aerial and shipboard surveys off California, Oregon, and Washington, 1991-2008 (see Appendix 2 for data sources and information on timing and location of survey effort). Dashed line represents the U.S. EEZ, thin lines indicates completed transect 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 2005 (Forney 2007) and 2008 (Barlow 2010). 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 2005-2008 geometric mean abundance estimate for California, Oregon and Washington waters based on the two ship surveys is 8,334 (CV=0.40) northern right-whale dolphins (Forney 2007, Barlow 2010).

Minimum Population Estimate

The log-normal 20th percentile of the 2005-2008 average abundance estimate is 6,019 northern right-whale dolphins.

Current Population Trend

Abundance estimates for all California, Oregon, and Washington waters from 1996, 2001, 2005, and 2008 surveys were 11,347 (CV = 0.27), 14,937 (0.21), 11,100 (0.60), and 6,258 (CV=0.58), respectively (Barlow and Forney 2007, Forney 2007, Barlow 2010). 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 (6,019) <u>times</u> one half the default maximum net growth rate for cetaceans (½ of 4%) <u>times</u> a recovery factor of 0.40 (for a species of unknown status with a mortality rate CV >0.80; Wade and Angliss 1997), resulting in a PBR of 48 northern right-whale dolphins per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

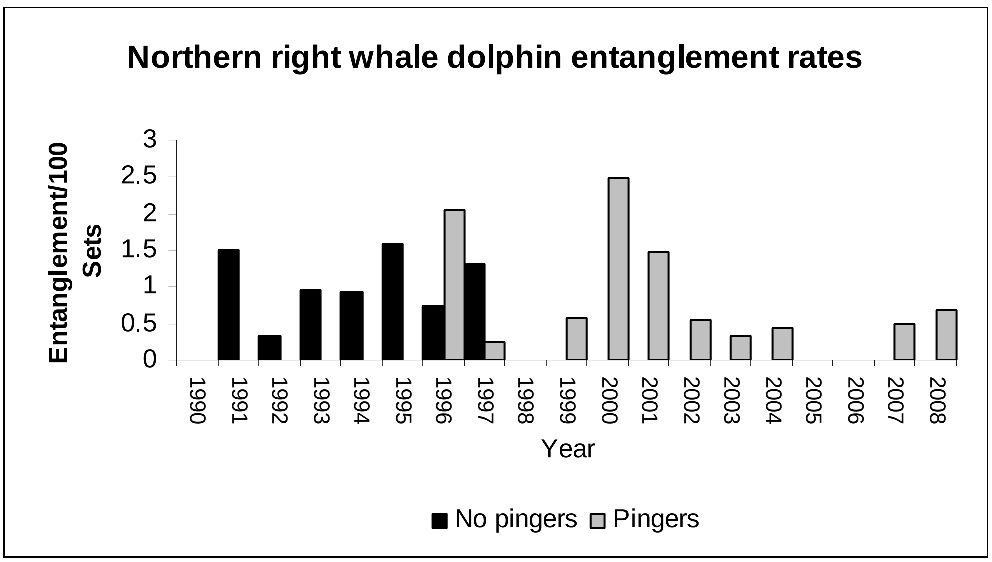
A summary of recent fishery mortality and injury for this stock of northern right-whale dolphin is shown in Table 1. More detailed information on these fisheries is provided in Appendix 1. Mortality estimates for the California drift gillnet fishery are included for the five most recent years of monitoring, 2004-2008 (Carretta et al. 2005 Carretta and Enriquez 2006, 2007, 2009a, 2009b). 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 2004-2008 data. This results in an average estimate of 3.6 (CV= 0.96) northern right-whale 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 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 2004-2008 data unless noted otherwise.

Fishery Name	Data Type	Year(s)	Percent Observer Coverage	Observed Mortality	Estimated Annual Mortality	Mean Annual Takes (CV in parentheses)
CA/OR thresher shark/swordfish drift gillnet fishery	observer data	2004 2005 2006 2007 2008	20.6% 20.9% 18.5% 16.4% 13.5%	1 0 0 1 1	5 (0.99) 0 0 6 (1.00) 7 (0.99)	3.6 (0.96)
Minimum total annual takes						3.6 (0.96)

Figure 2. Entanglement rates of northern right whale dolphin per set fished in the California drift gillnet fishery for swordfish and thresher shark, 1990-2008. 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 1998-2008, over 99% of all observed sets utilized pingers.



Other removals

In 2008, six northern right whale dolphins were incidentally killed in California waters during scientific sardine trawling operations conducted by NMFS (Southwest Regional Office Stranding Program, unpublished data). All six animals were killed in a single trawl where 11 Pacific white-sided dolphin were also killed (see Pacific white-sided dolphin stock assessment). The average annual research-related mortality of northern right whale dolphin from 2004 to 2008 is 1.2 animals.

STATUS OF STOCK

The status of northern right-whale dolphins in California, Oregon and Washington relative to OSP is not known, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this species. They are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. The average annual human-caused mortality in 2004-

2008 (4.8 animals) is estimated to be less than the PBR (48), and therefore they are not classified as a "strategic" stock under the MMPA. The total fishery mortality and serious injury for northern right-whale dolphins does not exceed 10% of the calculated PBR and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

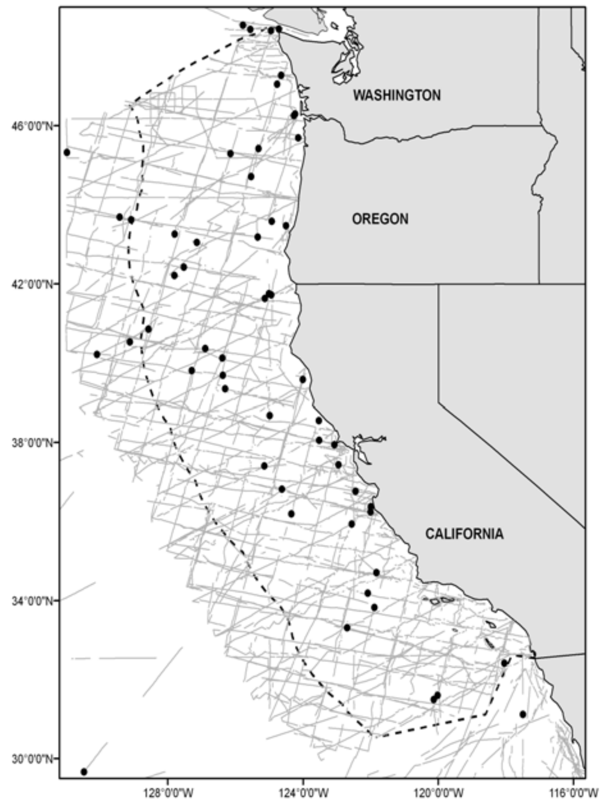

Figure 1. Killer whale sightings based on shipboard surveys off California, Oregon and Washington, 1991-2008 (see Appendix 2 for data sources and information on timing and location of survey effort). Sightings include killer whales from all stocks found in this region. Dashed line represents the U.S.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

Offshore killer whales have more recently also been identified off the coasts of California, Oregon, and rarely, in Southeast Alaska (Ford et al. 1994, Black et al. 1997, Dahlheim et al. 1997). They apparently do not mix with the transient and resident killer whale stocks found in these regions (Ford et al. 1994, Black et al. 1997). Studies indicate the 'offshore' type, although distinct from the other types ('resident' and 'transient'), appears to be more closely related genetically, morphologically, behaviorally, and vocally to the 'resident' type killer whales (Black et al. 1997, Hoelzel et al. 1998; J. Ford, pers. comm.; L. Barrett-Lennard, pers. comm.). Based on data regarding association patterns, acoustics, movements, genetic differences, and potential fishery interactions, 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 2005 (Forney 2007) and 2008 (Barlow 2010), the total number of killer whales within 300 nmi of the coasts of California, Oregon and Washington is estimated to be 691 animals (CV=0.49). There is currently no way to reliably distinguish the different stocks of killer whales from sightings at sea, but photographs of individual animals can provide a rough estimate of the proportion of whales in each stock. A total of 161 individual killer whales photographed off California and Oregon have been determined to belong to the transient (105 whales) and offshore (56 whales) stocks (Black et al. 1997). Using these proportions to prorate the line transect abundance estimate yields an estimate of 56/161 * 691 = 240 offshore killer whales along the U.S. west coast. This is expected to be a conservative estimate of the number of offshore killer whales, because offshore whales apparently are less frequently seen near the coast (Black et al. 1997), and therefore photographic sampling may be biased towards transient whales. For stock assessment purposes, this combined value is currently the best available estimate of abundance for offshore killer whales off the coasts of California, Oregon and Washington.

Minimum Population Estimate

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

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

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

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

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

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

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

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

STATUS OF STOCK

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

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Killer whales have been observed in all oceans and seas of the world (Leatherwood and Dahlheim 1978). Although reported from tropical and offshore waters, killer whales prefer 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 intra-coastal waterways of British Columbia and Washington State, where pods have been labeled as 'resident,' 'transient,' and 'offshore' (Bigg et al. 1990, Ford et al. 1994) based on aspects of morphology, ecology, genetics, and behavior (Ford and Fisher 1982, Baird and Stacey 1988, Baird et al. 1992, Hoelzel et al. 1998). Through examination of photographs of recognizable individuals and pods, movements of whales between 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).

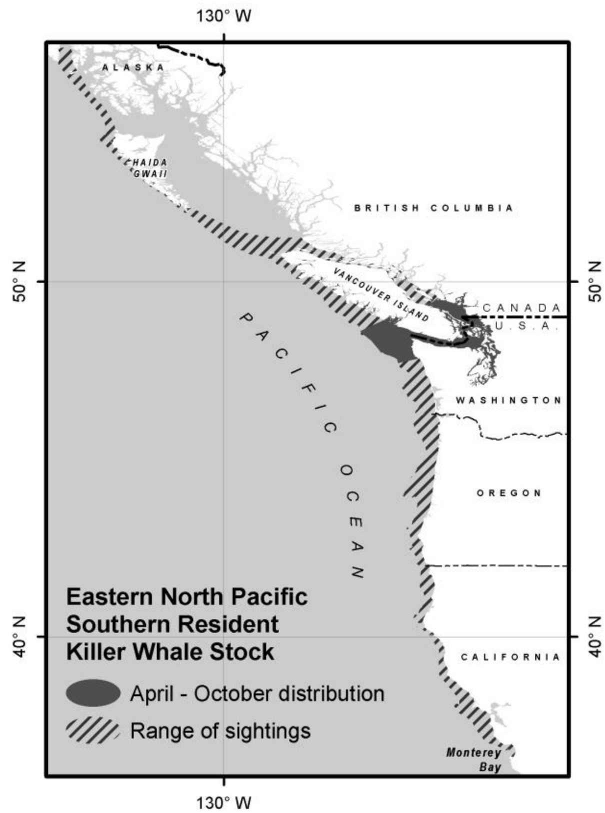

Figure 1. Approximate April - October distribution of the Eastern North Pacific Southern Resident killer whale stock (shaded area) and range of sightings (diagonal lines).

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 species 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). Krahn et al. (2004) summarized additional lines of evidence supporting subspecies status of resident and transient killer whales in the North Pacific, including differences in 1) acoustic dialects; 2) skull features; 3) morphology; 4) feeding specializations; and 5) a lack of intermingling between the two sympatric ecotypes.

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 June 2007, whales from L-pod were sighted off Chatham Strait, Alaska, the farthest north they have ever been documented (J. Ford, pers. comm.).

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

POPULATION SIZE

The Eastern North Pacific Southern Resident stock is a trans-boundary stock including killer whales in inland Washington and southern British Columbia waters. Photo-identification of individual whales through the years has advanced knowledge of this stock's structure, behaviors, and movements. In 1993, the three pods comprising this stock totaled 96 killer whales (Ford et al. 1994). The population increased to 99 whales in 1995, then declined to 79 whales in 2001, and most recently numbered 87 whales in 2011 (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. L-98 has been subtracted from the official 2006 and subsequent population censuses. The most recent census spanning 1 July -2010 through 1 July 2011 includes four new calves and the deaths of a post-reproductive adult female, a subadult male, and an adult male. It does not include a stillborn calf observed in September 2010 (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 87 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). Since the first complete census of this stock in 1974 when 71 animals were identified, the number of southern resident killer whales has fluctuated annually. Between 1974 and 1993 the Southern Resident stock increased approximately 35%, from 71 to 96 individuals (Ford et al. 1994), representing a net annual growth rate of 1.8% during those years. Following the peak census count of 99 animals in 1995, the population size has fluctuated and currently stands at 87 animals as of the 2011 census (Ford et al. 2000; Center for Whale Research, unpubl. data).

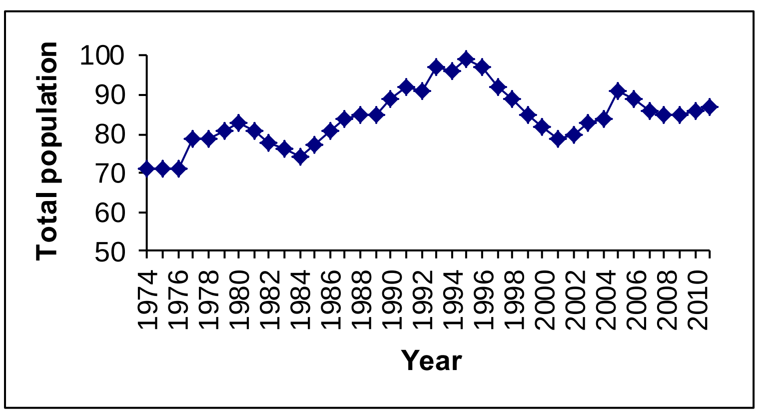

Figure 2. Population of Eastern North Pacific Southern Resident stock of killer whales, 1974-2011. Each year's count includes animals first seen and first missed; a whale is considered first missed the year after it was last seen alive (Ford et al. 2000; Center for Whale Research, unpubl. data).

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 3.6%/year from 2002 to 2005 (Center for Whale Research, unpubl. data). A recent analysis of the long-term trend of southern resident population growth (1979-2011) indicated that there was a 5% probability of the maximum growth (R_{max}) exceeding 2.8% and a 1% chance of it exceeding 3.2% (Ward 2012). Hence, R_{max} is estimated to be 3.2% for southern resident killer whales and this value will be used for this stock.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (87) <u>times</u> one-half the default maximum net growth rate for cetaceans (½ of 3.2%) <u>times</u> a recovery factor of 0.1 (for an endangered stock, Wade and Angliss 1997), resulting in a PBR of 0.14 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 to 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 mortality has 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 mortality was 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 mortality in 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 are 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 (Angliss and Lodge 2002).

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.

During the 1990s there were no reported takes from this stock incidental to commercial fishing operations (D. Ellifrit, pers. comm.), 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 mortality 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 death of animal L98 in 2006).

STATUS OF STOCK

Southern Resident killer whales were listed as endangered under the ESA in 2005. Total annual fishery mortality and serious injury for this stock (0) is not known to exceed 10% of the calculated PBR (0.14) and, therefore, appears to be insignificant and approaching zero mortality and serious injury rate. The estimated annual level of human-caused mortality and serious injury of 0.2 animals per year exceeds the PBR (0.14). Southern Resident killer whales are formally listed as "endangered" under the ESA and consequently the stock is automatically considered as a "strategic" stock under the MMPA. This stock was considered "depleted" prior to its 2005 listing under the ESA.

Habitat Issues

Several of the potential risk factors identified for this population have habitat implications. The summer range of this population, the inland waters of Washington and British Columbia, is the home to a large commercial whale watch industry as well as high levels of recreational boating and commercial shipping. There continues to be concern about potential for masking effects by noise generated from these activities on the whales' communication and foraging. In 2011 vessel approach regulations were implemented to restrict vessel from approaching closer than 200m. This population appears to be Chinook salmon specialists (Ford and Ellis 2006, Hanson et al. 2010), although other species, particularly chum, appear to be important in the fall (NWFSC unpubl. data). There is evidence that changes in coast–wide Chinook abundance have affected this population (Ford et al. 2009, Ward et al. 2009). In addition, the high trophic level and longevity of the animals has predisposed them to accumulate levels of contaminants that are high enough to cause potential health impacts. In particular, there is recent evidence of extremely high levels of flame retardants in young animals (Krahn et al. 2007, 2009).

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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 common off Southern California, with an apparently resident population around Santa Catalina Island, as well as seasonal migrants (Dohl et al. 1980). After a strong El Niño event in 1982-83, short-finned pilot whales virtually disappeared from this region, and despite increased survey effort along the entire U.S. west coast, 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 sightings of short-finned pilot whales off the U.S. west coast from 1991-2008. 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.

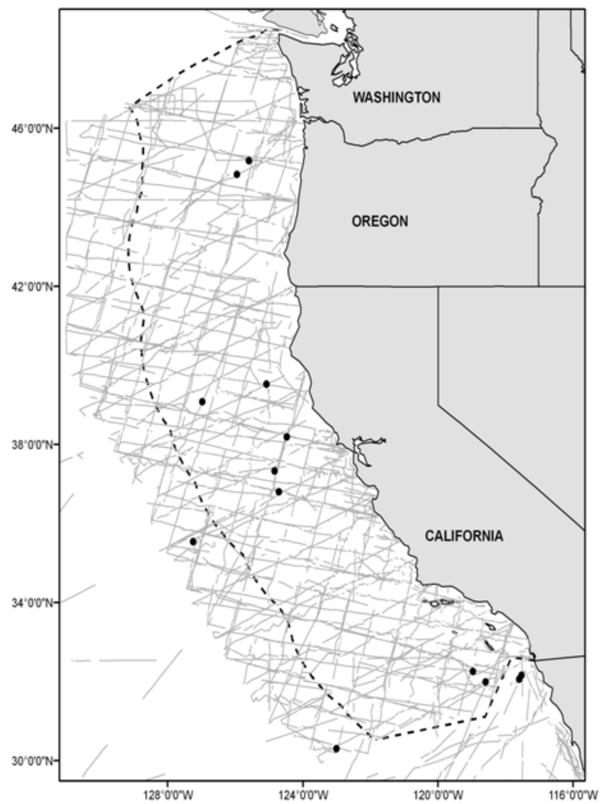

Figure 1. Short-finned pilot whale sightings made during shipboard surveys conducted off California, Oregon, and Washington, 1991-2008. See Appendix 2 for data sources and information on timing and location of survey effort. Dashed line represents the U.S. EEZ, thin lines indicate completed transect effort of all surveys combined.

POPULATION SIZE

Only two groups of pilot whales numbering approximately 26 and 43 animals, respectively were seen during the two most recent ship surveys conducted off California, Oregon, and Washington in 2005 and 2008 (Barlow and Forney 2007; Forney 2007, Barlow 2010). Abundance is estimated at 489 (CV=0.97) and 1,180 (CV=1.00) for the 2005 and 2008 surveys, respectively (Forney 2007, Barlow 2010). The abundance of short-finned pilot whales in this region is variable and may be influenced by prevailing oceanographic conditions (Forney 1997, Forney and Barlow 1998). 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 2005-2008 geometric mean abundance estimate for California, Oregon and Washington waters based on the two ship surveys is 760 (CV=0.64) short-finned pilot whales (Barlow and Forney 2007 ; Forney 2007; Barlow 2010).

Minimum Population Estimate

The log-normal 20th percentile of the 2005-2008 geometric mean abundance estimate is 465 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; Forney 2007; Barlow 2010). 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, or 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 (465) 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 in the last 5 years; Wade and Angliss 1997), resulting in a PBR of 4.6 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, 2004-2008 (Carretta et al. 2005, Carretta and Enriquez 2006, 2007, 2009a, 2009b). 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 deaths observed in this fishery since 1990. In 1993, there were 8 deaths observed, and one each in 1990, 1992, 1997 (in an unpingered net) and 2003. Mean annual takes in Table 1 are based on 2004-2008 data. This results in an average estimate of zero 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), but these deaths occurred when pilot whales were still common in the region. An observer program in the squid purse seine fishery was initiated in 2004 and a total of 377 sets have been observed through 2008 without a pilot whale interaction. Observer coverage in this fishery has been less than 10% of all fishing effort.

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. Coefficients of variation for mortality estimates are provided in parentheses; n/a = not available. Mean annual takes are based on 2004-2008 data unless noted otherwise.

Fishery Name	Data Type	Year(s)	Percent Observer Coverage	Observed Mortality	Estimated Annual Mortality	Mean Annual Takes (CV in parentheses)
CA/OR thresher shark/swordfish drift gillnet fishery	observer	2004	20.6%	0	0	0
		2005	20.9%	0	0	
		2006	18.5%	0	0	
		2007	16.4%	0	0	
		2008	13.5%	0	0	
Market squid purse seine	observer	2004-2008	<10%	0	0	0
Minimum total annual takes						0

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 2004-2008 is zero animals, less than the PBR of 4.6, and therefore they are not classified as a "strategic" stock under the MMPA. Total annual human-caused mortality and serious injury for this stock is estimated at zero animals, therefore, mortality is considered to be approaching a zero mortality and serious injury rate.

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Revised 01/15/2011

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.

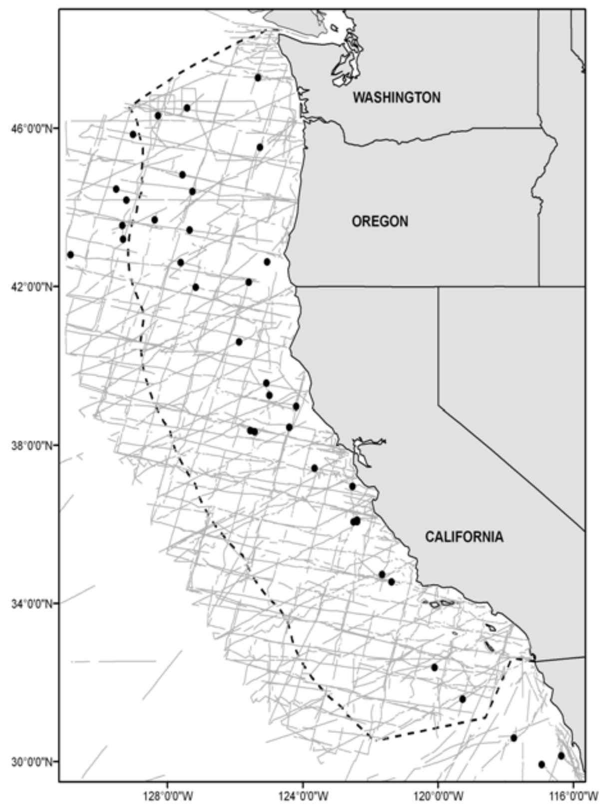

Figure 1. Baird's beaked whale sightings based on shipboard surveys off California, Oregon and Washington, 1991-2008 (see Appendix 2 for data sources and information on timing and location of survey effort). Dashed line represents the U.S. EEZ, thin lines indicate completed transect effort of all surveys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

POPULATION SIZE

Two summer/fall shipboard surveys were conducted within 300 nmi of the coasts of California, Oregon and Washington 2005 (Forney 2007) and 2008 (Barlow 2010). Because the distribution of Baird's beaked whale varies and animals probably spend time outside the U.S. Exclusive Economic Zone, a multi-year average abundance estimate is the most appropriate for management within U.S. waters. The 2005-2008 geometric mean abundance estimate for California, Oregon and Washington waters based on the above two ship surveys is 907 (CV=0.49) Baird's beaked whales (Forney 2007, Barlow 2010). This abundance estimate includes correction factors for the proportion of animals missed, based on a model of their diving behavior, detection distances, and the searching behavior of observers (Barlow 1999). About 96% of all trackline groups are estimated to be seen.

Minimum Population Estimate

The log-normal 20th percentile of the 2005-2008 geometric mean abundance estimate is 615 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 (615) 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 6.2 Baird's beaked whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

The California large mesh drift gillnet fishery has been the only fishery known to interact with this stock. One Baird's beaked whale was incidentally killed in this fishery in 1994 (Julian and Beeson 1998), before acoustic pingers were first used in the fishery in 1996 (Barlow and Cameron 2003). Since 1996, no beaked whale of *any* species have been observed entangled or killed in this fishery (Carretta et al. 2008, Carretta and Enriquez 2009a, 2009b). Mean annual takes in Table 1 are based on 2004-2008 data. This results in an average estimated annual mortality of zero Baird's beaked whales.

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 2004-2008 data unless noted otherwise.

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

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

Other mortality

California coastal whaling operations killed 15 Baird's beaked whales between 1956 and 1970, and 29 additional Baird's beaked whales were taken by whalers in British Columbian waters (Rice 1974). One Baird’s beaked whale stranded in Washington state in 2003 and the cause of death was attributed to a ship strike. No other human-caused mortality has been reported for this stock for the period 2004-2008.

Additional, unknown levels of injury and mortality of Baird’s beaked whales may occur as a result of anthropogenic 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 injury or mortality would rarely be documented, due to the remote nature of many of these activities and the low probability that an injured or dead 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. The average annual human-caused mortality during 2004-2008 is zero animals/year. Because recent fishery and human-caused mortality is less than the PBR (6.2), Baird’s beaked whales are not classified as a "strategic" stock under the MMPA. The total fishery mortality and serious injury for this stock is zero and can be considered to be insignificant and approaching zero.

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Revised 01/15/2011

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.

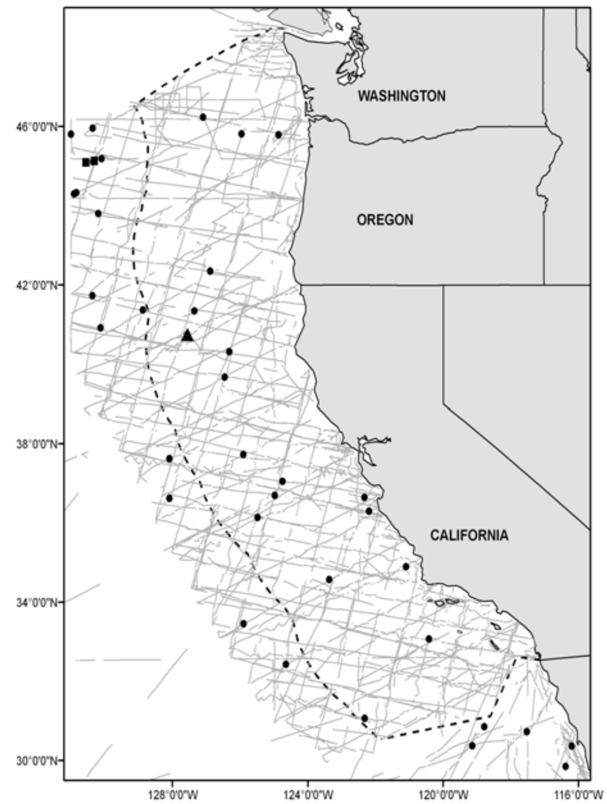

Figure 1. *Mesoplodon* beaked whale sightings based on shipboard surveys off California, Oregon and Washington, 1991-2008 (see Appendix 2 for data sources and information on timing and location of survey effort). Key: ● = *Mesoplodon* spp.; ▲= identified *Mesoplodon densirostris*; ■ = identified *Mesoplodon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

POPULATION SIZE

Although mesoplodont beaked whales have been sighted along the U.S. west coast on several line transect surveys utilizing both aerial and shipboard platforms, sightings have generally been too rare to produce reliable population estimates, and species identification has been problematic (Barlow and Forney 2007, Forney 2007). 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 2005 (Forney 2007) and 2008 (Barlow 2010), 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, based on a model of their diving behavior, detection distances, and the searching behavior of observers (Barlow 1999). About 45% of all trackline groups are estimated to be seen. Of the 5 sightings of *Mesoplodon* made during 2005-2008 surveys [all 5 sightings were made during the 2005 survey] two were identified to the 'probable' species level (one *Mesoplodon densirostris* and one *Mesoplodon carlhubbsi*). 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. An updated estimate of abundance for unidentified mesoplodont beaked whales is also presented, based on 2005-2008 survey effort and 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 2005-2008 surveys is 603 (CV=1.16). The abundance estimate for mesoplodont beaked whales of unknown species, based on the same 2005-2008 surveys is 421 (CV=0.88). 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. This estimate does not include sightings of 'unidentified beaked whales' made during 2005 and 2008, some of which may have included beaked whales of the genus *Mesoplodon* (Forney 2007, Barlow 2010).

Minimum Population Estimate

The minimum population estimate (defined as the log-normal 20th percentile of the abundance estimate) for mesoplodont beaked whales in California, Oregon, and Washington is 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 (576) <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 recent fishery mortality; Wade and Angliss 1997), resulting in a PBR of 5.8 mesoplodont beaked whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

The California large mesh drift gillnet fishery has been the only fishery historically known to interact with *Mesoplodon* beaked whales in this region. Between 1990 and 1995, a total of eight *Mesoplodon* beaked whales (5 Hubb's beaked whales (*Mesoplodon carlhubbsi*), one Stejneger's beaked whale (*Mesoplodon stejnegeri*), and two unidentified whales of the genus *Mesoplodon* were observed entangled in approximately 3,300 sets (Julian and Beeson 1998, Carretta *et al*. 2008). Following the introduction of acoustic pingers into this fishery (Barlow and Cameron 2003), no beaked whales of any species have been observed entangled in over 4,000 observed sets (Carretta *et al*. 2008, Carretta and Enriquez 2009a, 2009b). Mean annual takes in Table 1 are based on 2004-2008 data. This results in an average estimated annual mortality of zero mesoplodont 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 *Mesoplodon* beaked whales (California/Oregon/Washington Stocks) in commercial fisheries that might take these species. Mean annual takes are based on 2004-2008 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	2004 2005 2006 2007 2008	20.6% 20.9% 18.5% 16.4% 13.5%	0 0 0 0 0	0 0 0 0 0	0
Minimum total annual takes of *Mesoplodon* beaked whales						0

Other mortality

Additional, unknown levels of injuries and mortality of mesoplodont beaked whales may occur as a result of anthropogenic 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 mortality 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. The average annual human-caused fishery mortality in 2004-2008 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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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.

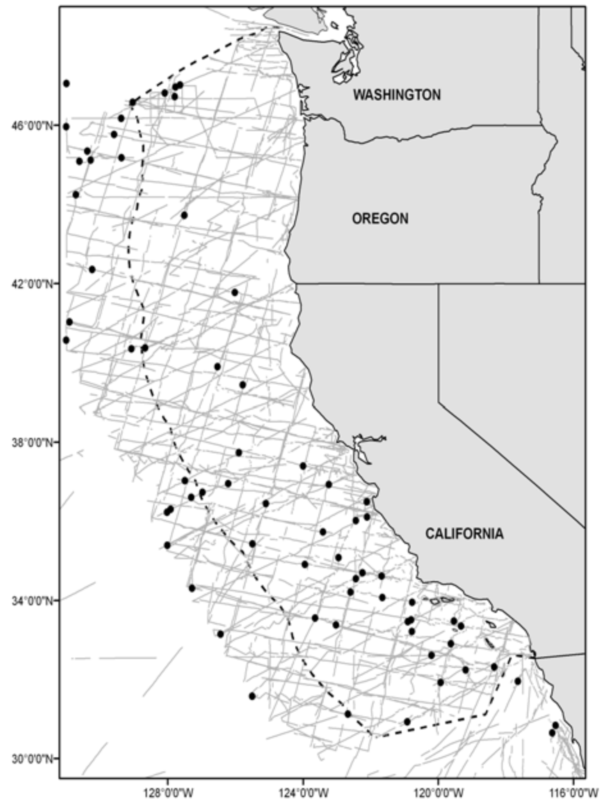

Figure 1. Cuvier's beaked whale sightings based on shipboard surveys off California, Oregon and Washington, 1991-2008 (see Appendix 2, for data sources and information on timing and location of survey effort). Dashed line represents the U.S. EEZ, thin lines indicate completed transect effort of all surveys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

POPULATION SIZE

Although Cuvier's beaked whales have been sighted along the U.S. west coast on several line transect surveys utilizing both aerial and shipboard platforms, 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 2005 (Forney 2007) and 2008 (Barlow 2010), 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, based on a model of their diving behavior, detection distances, and the searching behavior of observers (Barlow 1999). An estimated 23% of trackline 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 2005-2008 geometric mean abundance estimate for California, Oregon and Washington waters based on the above analyses is 2,143 (0.65) 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 1,298 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 (1,298) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no known fishery mortality ; Wade and Angliss 1997), resulting in a PBR of 13 Cuvier’s beaked whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

A summary of recent fishery mortality and injury for Cuvier’s beaked whales in this region is shown in Table 1. The California large mesh drift gillnet fishery has been the only fishery historically known to interact with this stock. There have been no Cuvier’s beaked whales observed entangled in over 4,000 drift gillnet fishery sets since acoustic pingers were first used in this fishery in 1996 (Barlow and Cameron 2003, Carretta et al. 2008, Carretta and Enriquez 2009a, 2009b). Prior to 1996, there were a total of 21 Cuvier’s beaked whales entangled in approximately 3,300 drift gillnet fishery sets: 1992 (six animals), 1993 (three), 1994 (six) and 1995 (six) (Julian and Beeson 1998). Mean annual takes in Table 1 are based only on 2004-2008 data. This results in an average estimated annual mortality of zero Cuvier’s beaked whales.

Table 1. Summary of available information on the incidental mortality and injury of Cuvier's beaked whales (California/ Oregon/Washington Stock) in commercial fisheries that might take this species. Mean annual takes are based on 2004-2008 data unless noted otherwise.

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

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

Other mortality

Additional, unknown levels of injuries and mortality of Cuvier's beaked whales may occur as a result of anthropogenic 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 mortality 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 2004-2008 is zero. Because recent human-caused mortality is less than the PBR, Cuvier's beaked whales are not classified as a "strategic" stock under the MMPA. The total fishery mortality and serious injury for this stock is less than 10% of the PBR and 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 probably reflects their pelagic distribution, small body size and cryptic behavior, rather than a measure of rarity. Strandings of pygmy sperm whales in this region are known from California, Oregon and Washington (Roest 1970; Caldwell and Caldwell 1989; NMFS, Northwest Region, unpublished data; NMFS, Southwest Region, unpublished data), while strandings of dwarf sperm whales (*Kogia sima*) are rare in this region. At-sea sightings in this region have all been either of pygmy sperm whales or unidentified *Kogia* sp. Available data are insufficient to identify any seasonality in the distribution of pygmy sperm whales, or to delineate possible stock boundaries. For the Marine Mammal Protection Act (MMPA) stock assessment reports, pygmy sperm whales within the Pacific U.S. Exclusive Economic Zone are divided into two discrete, non-contiguous areas: 1) waters off California, Oregon and Washington (this report), and 2) Hawaiian waters.

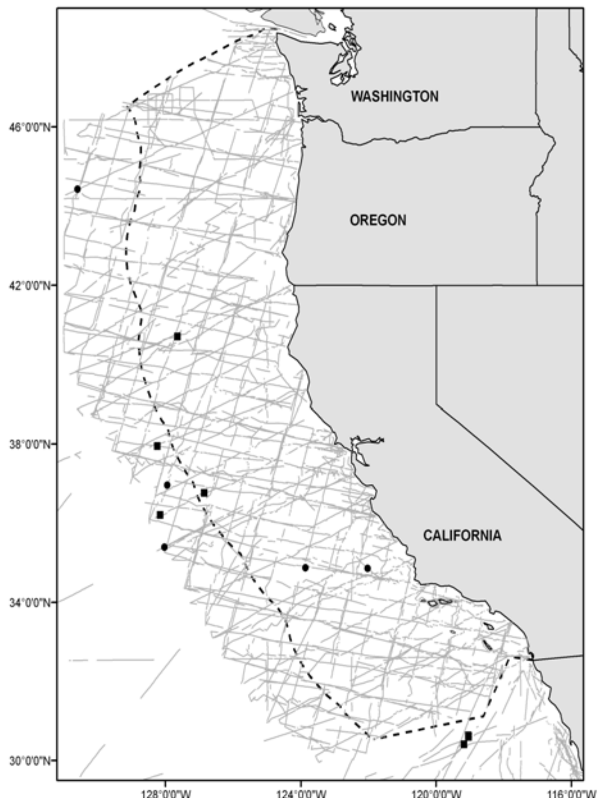

Figure 1. *Kogia* sightings based on shipboard surveys off California, Oregon and Washington, 1991- 2008 (see Appendix 2 for data sources and information on timing and location of survey effort). Key: ■ = *Kogia breviceps*, ● = *Kogia* spp. Dashed line represents the U.S. EEZ, thin lines indicate completed 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, sightings have been too rare to produce reliable population estimates. The most recent abundance estimate of 1,157 (CV=1.02) animals is based on one sighting of an unidentified *Kogia* during a 2008 ship survey of California, Oregon, and Washington waters (Barlow 2010). Based on previous sighting surveys and historical stranding data, it is likely that these sightings were of pygmy sperm whales; *K. breviceps*. The 2008 estimate incorporate a correction factor for animals missed, based on a model of their diving behavior, detection distances, and the searching behavior of observers (Barlow 1999). About 35% of all trackline groups are estimated to be seen. The rarity of sightings likely reflects the cryptic nature of this species (they are detected almost exclusively in extremely calm sea conditions), rather than an absence of animals in the region. The best estimate of abundance for this stock is the mean of 2005 and 2008 shipboard line-transect surveys, or 579 (CV=1.02) animals.

Minimum Population Estimate

The minimum population estimate is taken as the log-normal 20th percentile of the 2005 and 2008 average abundance estimate for California, Oregon, and Washington waters, or 271 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 (271) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no known fishery mortality during the last five years; Wade and Angliss 1997), resulting in a PBR of 2.7 pygmy sperm whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

A summary of recent fishery mortality and injury for pygmy sperm whales and unidentified *Kogia*, which may have been pygmy sperm whales, is shown in Table 1. 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, (Carretta et al. 2005, Carretta and Enriquez 2006, 2007, 2009a, 2009b). 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 2004-2008 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).

One pygmy sperm whale stranded in California in 2002 with evidence that it died as a result of a shooting (positive metal detector scan). Due to the cryptic and pelagic nature of this species, it is likely that the shooting resulted from an interaction with an unknown entangling net fishery.

Other mortality

No human-caused mortality of pygmy sperm whales has been documented during the most recent five-year period (2004-2008). Unknown levels of injuries and mortality of pygmy sperm whales may occur as a result of anthropogenic 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 mortality 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. Given the rarity of sightings and fishery interactions in U.S. west coast waters, pygmy sperm whales are not classified as a "strategic" stock under the MMPA.

Table 1. Summary of available information on the incidental mortality and injury of pygmy sperm whales and unidentified *Kogia* sp. (California/Oregon/Washington Stock) in commercial fisheries that might take this species. Coefficients of variation for mortality estimates are provided in parentheses. Mean annual takes are based on 2004-2008 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	2004 2005 2006 2007 2008	20.6% 20.9% 18.5% 16.4% 13.5%	0 / 0 0 / 0 0 / 0 0 / 0 0 / 0	0 / 0 0 / 0 0 / 0 0 / 0 0 / 0	0
Minimum total annual takes						0

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Revised 01/15/2011

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

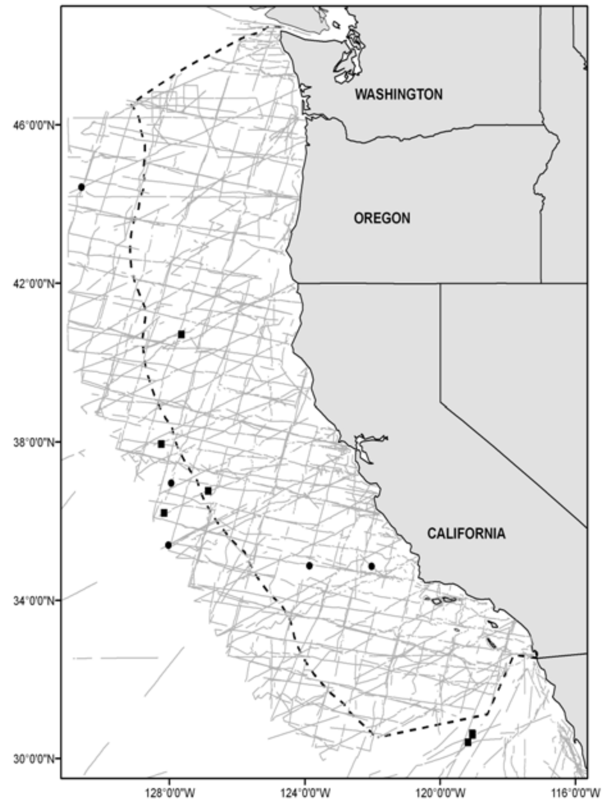

Figure 1. *Kogia* sightings based on shipboard surveys off California, Oregon and Washington, 1991-2008 (see Appendix 2 for data sources and information on timing and location of survey effort). Key: ■ = *Kogia breviceps*; • = *Kogia* spp. Dashed line represents the U.S. EEZ, thin lines indicate completed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

POPULATION SIZE

No information is available to estimate the population size of dwarf sperm whales off the U.S. west coast, as no sightings of this species have been documented despite numerous vessel surveys of this region (Barlow 1995; Barlow and Gerrodette 1996; Barlow and Forney 2007; Forney 2007; Barlow 2010). 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, 2004-2008 (Carretta et al. 2005, Carretta and Enriquez 2006, 2007, 2009a, 2009b). 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 2004-2008 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 2004-2008 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	2004 2005 2006 2007 2008	20.6% 20.9% 18.5% 16.4% 13.5%	0 / 0 0 / 0 0 / 0 0 / 0 0 / 0	0 / 0 0 / 0 0 / 0 0 / 0 0 / 0	0
Minimum total annual takes						0

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Revised 12/04/2012

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Sperm whales are distributed across the entire North Pacific and into the southern Bering Sea in summer, but the majority are thought to be south of 40°N in winter (Rice 1974; Rice 1989; Gosho et al. 1984; Miyashita et al. 1995). The International Whaling Commission (IWC) historically divided the North Pacific into two management regions (Donovan 1991) defined by a zig-zag line which starts at 150°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 recently (Donovan 1991). Sperm whales are found year-round in California waters (Dohl et al. 1983; Barlow 1995; Forney et al. 1995), but they reach peak abundance from April through mid-June and from the end of August through mid-November (Rice 1974). Sperm whales are seen off Washington and Oregon in every season except winter (Green et al. 1992). Of 176 sperm whales that were marked with Discovery tags off southern California in winter 1962-70, only three were recovered by whalers: one off northern California in June, one off Washington in June, and another far off British Columbia in April (Rice 1974). Recent summer/fall surveys in the eastern tropical Pacific (Wade and Gerrodette 1993) show that although sperm whales are widely distributed in the tropics, their relative abundance declines westward towards the middle of the tropical Pacific (near the IWC stock boundary at 150°W) and declines northward towards the tip of Baja California. Sperm whale population structure in the eastern tropical Pacific is unknown, but the only photographic matches of known individuals from this area have been between the Galapagos Islands and coastal waters of South America (Dufault and Whitehead 1995) and between the Galapagos Islands and the southern Gulf of California (Jaquet et al. 2003), suggesting that eastern tropical Pacific animals constitute a distinct stock. No apparent hiatus in distribution between the U.S. EEZ off California and areas farther west, out to Hawaii were found during a survey designed specifically to investigate stock structure and abundance of sperm whales in the northeastern temperate Pacific (Barlow and Taylor 2005). Sperm whales in the California Current have been identified as demographically independent from animals in Hawaii and the Eastern Tropical Pacific, based on genetic analyses of single-nucleotide polymorphisms (SNPs), microsatellites, and mtDNA (Mesnick *et al*. 2011). For the Marine Mammal Protection Act (MMPA) stock assessment reports, sperm whales within the Pacific U.S. EEZ are divided into three discrete, non-contiguous areas: 1) California, Oregon and Washington waters (this report), 2) waters around Hawaii, and 3) Alaska waters.

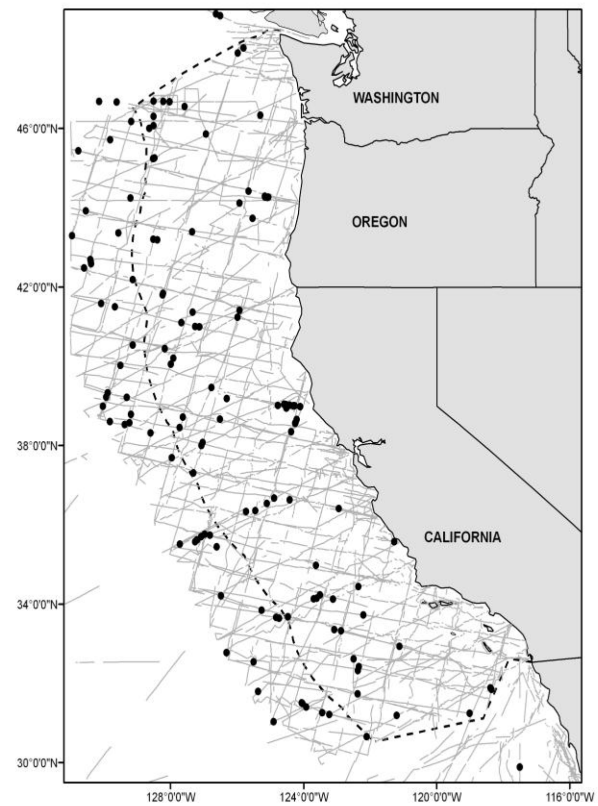

Figure 1. Sperm whale sighting locations from shipboard surveys off California, Oregon, and Washington, 1991-2008. Dashed line represents the U.S. EEZ, thin lines indicate completed transect effort of all surveys combined. See Appendix 2 for data sources and information on timing and location of survey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

POPULATION SIZE

Barlow and Taylor (2001) estimated 1,407 (CV=0.39) sperm whales in California, Oregon, and Washington waters during summer/fall based on pooled 1993 and 1996 ship line transect surveys within 300 nmi of the coast. Barlow and Forney (2007) estimated 2,593 (CV= 0.30) sperm whales from a survey of the same area in 2001. A 2005 survey of this area resulted in an abundance estimate of 3,140 (CV=0.40) whales, which is corrected for diving animals not seen during surveys (Forney 2007). The most recent ship survey of the same area in 2008 resulted in an estimate of only 300 (CV = 0.51) sperm whales (Barlow 2010). The 2008 estimate is lower than all previous estimates within this region and may be due to interannual variability of sperm whale distribution. The most recent estimate of abundance for this stock is the geometric mean of the 2005 and 2008 summer/autumn ship survey estimates, or 971 (CV = 0.31) sperm whales. A combined visual and acoustic line-transect survey conducted in the eastern temperate North Pacific in spring 1997 resulted in estimates of 26,300 (CV=0.81) sperm whales based on visual sightings, and 32,100 (CV=0.36) based on acoustic detections and visual group size estimates (Barlow and Taylor 2005). 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 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.

Large populations of sperm whales exist in waters several thousand miles west and south of California, Oregon, and Washington waters 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 unlikely. There is limited evidence of sperm whale movement from California to northern areas off British Columbia, but there are no abundance estimates for the latter area. The most precise and recent estimate of sperm whale abundance for this stock is therefore 971 (CV = 0.31) animals from the ship surveys conducted in 2005 (Forney 2007) and 2008 (Barlow 2010). This estimate is corrected for diving animals not seen during surveys.

Minimum Population Estimate

The minimum population estimate for sperm whales is taken as the lower 20th percentile of the log-normal distribution of abundance estimated from the 2005-2008 summer/fall ship surveys off California, Oregon and Washington (Barlow and Forney 2007; Forney 2007) or approximately 751.

Current Population Trend

Sperm whale abundance varied off California between 1979/80 and 1991 (Barlow 1994) and between 1991 and 2008 (Barlow and Forney 2007). The most recent estimate from 2008 is the lowest to date, in sharp contrast to the highest abundance estimates obtained from 2001 and 2005 surveys. There is no reason to believe that the population has declined; the most recent survey estimate likely reflects interannual variability in the study area. To date, there has not been a statistical analysis to detect trends in abundance. 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 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 this stock is calculated as the minimum population size (751) <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 with N_{min} <1,500; Taylor et al. 2003), resulting in a PBR of 1.5.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

The fishery most likely to directly take sperm whales from this stock is the California drift gillnet swordfish fishery (Julian and Beeson 1998). A summary of known fishery mortality and injury for this stock of sperm whales from 2006-2010 is given in Table 1. Although acoustic pingers are known to reduce the entanglement of cetaceans in the California drift gillnet swordfish fishery (Barlow and Cameron 2003, Carretta et al. 2008, Carretta and Barlow 2011), it is unknown whether pingers have any effect on sperm whale entanglement in this fishery. Sperm whales have been observed entangled 10 times in over 8,000 observed drift gillnet sets since 1990 (Carretta and Enriquez 2012). Six entanglements occurred prior to pinger use in this fishery. Two entanglements (1996 and 1998) occurred in sets that did not use a full complement of pingers, and two animals were entangled in 2010 in a single net where a full complement of 40 pingers was used (Carretta and Enriquez 2012). Other fisheries may injure or kill sperm whales, in the form of entanglement or ingestion of marine debris. Three separate sperm whale strandings in 2008 showed evidence of fishery interactions (Jacobsen et al. 2010; NMFS, unpublished stranding data). Two whales died from gastric impaction as a result of ingesting multiple types of floating polyethylene netting (Jacobsen *et al*. 2010). The variability in size and age of the ingested net material suggests that it was ingested as surface debris and was not the result of fishery depredation (Jacobsen *et al*. 2010). Net types recovered from the whales' stomachs included portions of gillnet, bait nets, and fish/shrimp trawl nets. A third whale showed evidence of entanglement scars (NMFS, unpublished stranding data). Mean annual takes for all fisheries (Table 1) are based on 2006-2010 observer and stranding data (Carretta and Enriquez 2007, 2009a, 2009b, 2010, 2012, Jacobsen et al. 2010, NMFS unpublished stranding data). This results in an average estimate of 3.8 (CV=0.95) sperm whale deaths 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. n/a indicates that data are not available. Mean annual takes are based on 2006-2010 data unless noted otherwise.

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed mortality (and serious injury in parentheses)	Estimated mortality (CV in parentheses)	Mean annual takes (CV in parentheses)
CA/OR thresher shark/swordfish drift gillnet fishery	2006	observer	18.5%	0	0	3.2 (0.95)
	2007		16.4%	0	0	
	2008		13.5%	0	0	
	2009		13.3%	0	0	
	2010		11.9%	1 (1)	16 (0.95)	
Unknown fishery	2006-2010	stranding	n/a	3	≥ 3	≥ 0.6
Total annual takes						≥ 3.8 (0.95)

Gillnets have been documented to entangle marine mammals off Baja California (Sosa-Nishizaki et al. 1993), but no recent bycatch data from Mexico are available. Sperm whales from the North Pacific stock are known to depredate on longline sablefish catch in the Gulf of Alaska and sometimes incur serious injuries from becoming entangled in gear (Sigler et al. 2008, Allen and Angliss 2011). An unknown number of whales from the CA/OR/WA stock probably venture into waters where Alaska longline fisheries operate, but the amount of temporal and spatial overlap is unknown. Thus, the risk of serious injury to CA/OR/WA stock sperm whales resulting from longline fisheries cannot be quantified.

Ship Strikes

One sperm whale died as the result of a ship strike in Oregon in 2007 (NMFS Northwest Regional Stranding data, unpublished). Sperm whale mortality and serious injuries attributed to ship strikes averaged 0.2 per year for 2006-2010.

STATUS OF STOCK

The only estimate of the status of North Pacific sperm whales in relation to carrying capacity (Gosho et al. 1984) is based on a CPUE method which is no longer accepted as valid. Whaling removed at least 436,000 sperm whales from the North Pacific between 1800 and the end of legal commercial whaling for this species in 1987 (Best 1976; Ohsumi 1980; Brownell 1998; Kasuya 1998). Of this total, an estimated 33,842 were taken by Soviet and Japanese pelagic whaling operations in the eastern North

Pacific from the longitude of Hawaii to the U.S. West coast, between 1961 and 1976 (Allen 1980), and approximately 1,000 were reported taken in land-based U.S. West coast whaling operations between 1919 and 1971 (Ohsumi 1980; Clapham et al. 1997). There has been a prohibition on taking sperm whales in the North Pacific since 1988, but large-scale pelagic whaling stopped in 1980. As a result of this whaling, 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. Including both fishery and ship-strike mortality, the annual rate of kill and serious injury (4.0 per year) is greater than the calculated PBR for this stock (1.5). Total human-caused mortality is greater than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. Increasing levels of anthropogenic sound in the world's oceans has been suggested to be a habitat concern for whales, particularly for deep-diving whales like sperm whales that feed in the ocean's "sound channel".

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Once common throughout the Northern Hemisphere, the gray whale became extinct in the Atlantic by the early 1700s (Fraser 1970; Mead and Mitchell 1984), though one anomalous sighting occurred in the Mediterranean Sea in 2010 (Scheinin *et al.* 2011). Gray whales are now found in the North Pacific where two extant populations are currently recognized (Reilly *et al.* 2008). Recent genetic comparisons suggest that these two stocks, called the "Eastern North Pacific" (ENP) and "Western North Pacific" (WNP) populations, are distinct, with differentiation in both mtDNA haplotype and microsatellite allele frequencies (LeDuc et al. 2002; Lang et al.2011a).

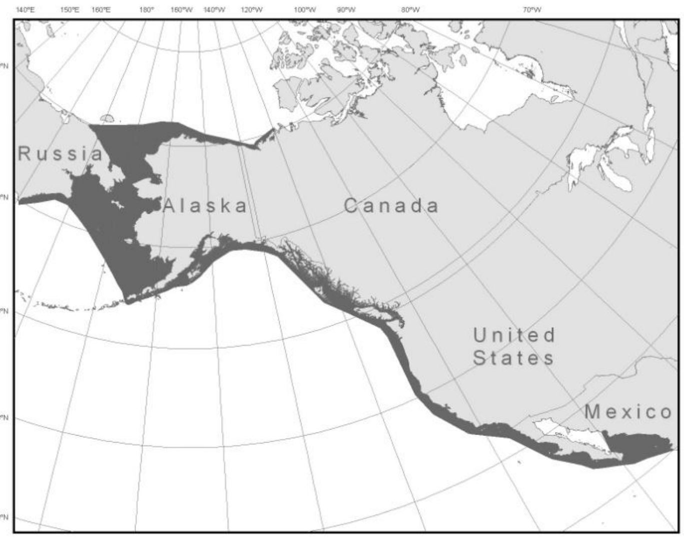

Figure 1. Approximate distribution of the Eastern North Pacific stock of gray whales (shaded area).

During summer and fall most whales in the ENP population feed in the Chukchi, Beaufort and northwestern Bering Seas (Fig. 1). An exception to this generality is the relatively small number (100s) of whales that summer and feed along the Pacific coast between Kodiak Island, Alaska and northern California (Darling 1984; Calambokidis *et al.* 2002, 2010; Gosho *et al.* 2011). By late November, the southbound migration is underway as whales begin to travel from summer feeding areas to winter calving areas off the west coast of Baja California, Mexico, and the southeastern Gulf of California (Rugh *et al*. 2001; Swartz *et al.* 2006). The southbound migration is segregated by age, sex and reproductive condition (Rice and Wolman 1971). The northbound migration begins about mid-February and is also segregated by age, sex and reproductive condition.

Gray whale breeding and calving are seasonal and closely synchronized with migratory timing. Sexual maturity is attained between 6 and 12 years of age (Rice 1990; Rice and Wolman 1971). Gestation is estimated to be 13 months, with calving beginning in late December and continuing to early February (Rice and Wolman 1971). Some calves are born during the southbound migration while others are born near or on the wintering grounds (Sheldon *et al*. 2004). Females produce a single calf, on average, every 2 years (Jones 1990). Calves are weaned and become independent by six to eight months of age while on the summer feeding ground (Rice and Wolman 1971). Three primary calving lagoons in the ENP are utilized during winter, and some females are known to make repeated returns to specific lagoons (Jones 1990). Genetic studies suggest that some substructuring may occur on the wintering grounds, with significant differences in mtDNA haplotype frequencies found between females (mothers with calves) utilizing two of the primary calving lagoons and females sampled in other areas (Goerlitz *et al*. 2003). Other research utilizing both mtDNA and microsatellites identified significant departure from panmixia between two of the lagoons using nuclear data, although no significant differences were identified using mtDNA (Alter *et al.* 2009).

The distribution and migration patterns of gray whales in theWNP are less clear. The main feeding ground is in the Okhotsk Sea off the northeastern coast of Sakhalin Island, Russia, but some animals occur off eastern Kamchatka and in other coastal waters of the northern Okhotsk Sea (Weller *et al*. 2002; Vertyankin *et al*. 2004; Tyurneva *et al*. 2010). Some WNP whales migrate south in autumn, but the migration route(s) and winter breeding ground(s) are poorly known. Information collected over the past century indicates that whales migrate along the coasts of Japan and South Korea (Andrews 1914; Mizue 1951; Omura 1984) to wintering areas somewhere in the South China Sea, possibly near Hainan Island (Wang 1984). No sightings off South Korea have been reported in over a decade, however. Results from photo-identification (Weller *et al*. 2011), genetic (Lang 2010; Lang *et al*. 2011a) and telemetry studies (Mate *et al*. 2011) have documented mixing between the WNP and ENP, including observations of six whales photographically matched from Sakhalin Island to southern Vancouver Island, and two whales genetically matched from Sakhalin to Santa Barbara, California. Combined results from photo-ID and genetics studies reveal that a total of 8 gray whales have been observed in both the WNP and ENP (Weller *et al.* 2011; International Whaling Commission (IWC) 2011a). Despite this level of mixing, significant mtDNA and nuclear genetic differences are found between whales in the WNP and those summering in the ENP.

Population structure within the ENP is less clear. Recent studies provide new information on gray whale stock structure within the ENP, with emphasis on whales that feed during summer off the Pacific coast between northern California and southeastern Alaska, occasionally as far north as Kodiak Island, Alaska (Gosho *et al.* 2011). These whales, collectively known as the "Pacific Coast Feeding Group" (PCFG), are a trans-boundary population with the U.S. and Canada and are defined by the IWC as follows: gray whales observed between 1 June to 30 November within the region between northern California and northern Vancouver Island (from 41°N to 52°N) and photo-identified within this area during two or more years (IWC 2011a; IWC 2011b; IWC 2011c). In 2005, the Makah Indian Tribe requested authorization from NOAA/NMFS, under the MMPA and the Whaling Convention Act, to resume limited hunting of gray whales for ceremonial and subsistence purposes in the coastal portion of their usual and accustomed (U&A) fishing grounds off the coast of Washington State (NMFS 2008). The spatial overlap of the Makah U&A and the summer distribution of PCFG whales has management implications. The proposal by the Makah Tribe includes time/area restrictions designed to reduce the probability of killing a PCFG whale and to focus the hunt on whales migrating to/from feeding areas to the north. Similarly, observations of gray whales moving between the western and eastern North Pacific highlights the need to estimate the probability of a WNP gray whale being taken during a hunt by the Makah Tribe (IWC 2011a; IWC 2011b). NMFS has published a notice of intent to prepare an environmental impact statement (EIS) on the proposed hunt (NMFS 2012) and the IWC is evaluating the potential impacts of a hunt on the PCFG (IWC 2011a; IWC 2011c; IWC 2011b).

Photo-identification studies from 1998 to 2008 between northern California and northern British Columbia provide data on the abundance and population structure of PCFG whales (Calambokidis *et al.* 2010). Gray whales using the Pacific Northwest during summer and autumn include two components: **1)** whales that frequently return to the area, display a high degree of intra-seasonal "residency" and account for a majority of the sightings between 1 June and 30 November. Despite movement and interchange among sub-regions of the study area, some whales are more likely to return to the same sub-region where they were observed in previous years. **2)**"visitors"from the northbound migration that are sighted only in one year, tend to be seen for shorter time periods in that year, and are encountered in more limited areas.

Satellite tagging studies between 3 September and 4 December 2009 off Oregon and California provide movement data for whales considered to be part of the PCFG (Mate *et al.* 2010). Duration of tag attachment differed between individuals, with some whales remaining in relatively small areas within the larger PCFG seasonal range and others traveling more widely. All six individuals whose tags continued to transmit through the southbound migration utilized the wintering area within and adjacent to Laguna Ojo de Liebre (Scammon´s lagoon). Three whales were tracked north from Ojo de Liebre: one traveled at least as far as Icy Bay, Alaska, while the other two were tracked to coastal waters off Washington (Olympic Peninsula) and California (Cape Mendocino). In addition to satellite tag data, photographic evidence has shown that some presumed PCFG whales move at least as far north as Kodiak Island, Alaska (Calambokidis *et al.*2010; Gosho *et al.* 2011). The satellite tag and photo-ID data suggest that the range of the PCFG may, at least for some individuals, exceed the pre-defined 41°N to 52°N boundaries that have been used in PCFG-related analyses (e.g. abundance estimation).

Previous genetic studies of PCFG whales focused on evaluating recruitment patterns, with simulations indicating detectable mtDNA genetic differentiation would result if the PCFG originated from a single colonization event in the past 40 to 100 years, without subsequent external recruitment (Ramakrishnan and Taylor, 2001). Subsequent empirical analysis, however, failed to detect differences when 16 samples collected from known PCFG whales utilizing Clayoquot Sound, British Columbia, were compared with samples (n=41) collected from individuals presumably feeding farther north (Steeves *et al.* 2001). Additional genetic analysis with an extended set of samples (n=45) collected from whales within the PCFG range indicated that genetic diversity and the number of mtDNA haplotypes were greater than expected (based on simulations) if recruitment into the PCFG were exclusively internal (Ramakrishnan *et al.* 2001). However, both simulation-based studies focused on evaluating only the hypothesis of founding by a single and recent colonization event and did not evaluate alternative scenarios, such as recruitment of whales from other areas into the PCFG (Ramakrishnan and Taylor 2001; Ramakrishnan *et al.* 2001). More recently, Frasier *et al.* (2011) compared mtDNA sequence data from 40 individuals within the seasonal range of the PCFG with published sequences generated from 105 samples collected from ENP gray whales, most of which stranded along the migratory route (LeDuc *et al.,* 2002). The mtDNA haplotype diversity found among samples of the PCFG was high and similar to the larger ENP samples, but significant differences in mtDNA haplotype distribution and in estimates of long-term effective population size were found. Based on these results, Frasier *et al.* (2011) concluded that the PCFG qualifies as a separate management unit under the criteria of Moritz

(1994) and Palsbøll *et al.* (2007). The authors noted that the PCFG likely mates with the rest of the ENP population and that their findings were the result of maternally-directed site fidelity of whales to different feeding grounds.

A subsequent study by Lang *et al.* (2011b) assessed stock structure of whales utilizing feeding grounds in the ENP using both mtDNA and eight microsatellite markers. Significant mtDNA differentiation was found when samples from individuals (n=71) sighted over two or more years within the seasonal range of the PCFG were compared to samples from whales feeding north of the Aleutians (n=103) as well as when the PCFG samples were compared to the subset of samples collected off Chukotka, Russia (n=71). No significant differences were found when these same comparisons were made using microsatellite data. The authors concluded that (1) the significant differences in mtDNA haplotype frequencies between the PCFG and whales sampled in the northern areas indicates that the utilization of some feeding areas is being influenced by internal recruitment (e.g., matrilineal fidelity), and (2) the lack of significance in nuclear comparisons suggests that individuals from different feeding grounds may interbreed. The level of mtDNA differentiation identified, while statistically significant, was low and the mtDNA haplotype diversity found within the PCFG was similar to that found in the northern strata. Lang *et al.* (2011b) suggested that these findings could be indicative of relatively recent colonization of the PCFG but could also be consistent with a scenario in which external recruitment into the PCFG is occurring.

After reviewing results from photo-identification, telemetry, and genetic studies available in 2010 (i.e. Calambokidis *et al.* 2010; Mate *et al.* 2010; Frasier *et al.* 2011), the IWC agreed that the hypothesis of the PCFG being a demographically distinct feeding group was plausible and warranted further investigation (IWC 2011a). Recent research by Lang *et al.* (2011b) provided further support for recognition of the PCFG as a distinct feeding aggregation. Because the PCFG appears to be a distinct feeding aggregation and may warrant consideration as a distinct stock in the future, separate PBRs are calculated for the PCFG within this report. Calculation of a PBR for this feeding aggregation allows NMFS to assess whether levels of human-caused mortality are likely to cause local depletion within this population.

POPULATION SIZE

Systematic counts of gray whales migrating south along the central California coast have been conducted by shore-based observers at Granite Canyon most years since 1967 (Fig. 2). The most recent southbound counts were made during the 2007/2008, 2009/2010, and 2010/2011 surveys, from which abundance estimates are not yet available.

The most recent estimate of abundance is from the 2006/2007 southbound survey, or 19,126 (CV=7.1%) whales (Laake *et al.* 2009). Because of observed interannual differences in correction factors used to correct for bias in estimating pod size (Rugh *et al.* 2008), the time series of abundance estimates dating back to 1967 was reanalyzed. Laake *et al.* (2009) developed a more consistent approach to abundance estimation that used a better model for pod size bias and applied their estimation approach to re-estimate abundance for all 23 surveys.

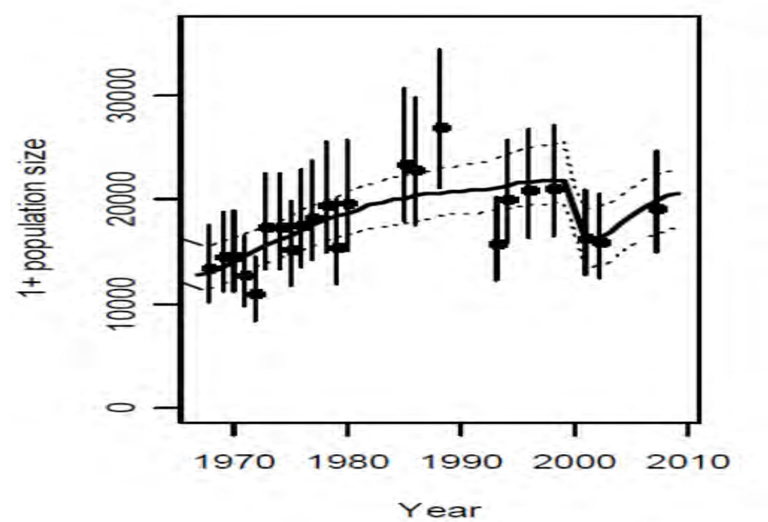

Figure 2. Estimated abundance of Eastern North Pacific gray whales from NMFS counts of migrating whales past Granite Canyon, California. Error bars indicated 90% probability intervals. The solid line represents the estimated trend of the population with 90% intervals as dashed lines (after Punt and Wade 2010).

The new abundance estimates between 1967 and 1987 were generally larger than previous abundance estimates; differences by year between the new abundance estimate and the old estimate range from -2.5% to 21%. However, the opposite was the case for survey years 1992 to 2006, with estimates smaller (-4.9% to -29%) than previous estimates. This is largely explained by differences in the correction for pod size bias, because the pod sizes in the calibration data were positively-biased. Re-evaluation of the correction for pod size bias and the other changes made to the estimation procedure yielded a somewhat different trajectory for population growth. The estimates still show the population increased steadily from the 1960s until the 1980s. Previously, the peak abundance estimate was in 1998 followed by a large drop in numbers (Rugh *et al*. 2008). Now the peak estimate is a decade earlier in 1987/88. The revised estimates for the most recent years are 16,369 (CV=6.1%) in 2000/01, 16,033 (CV=6.9%) in 2001/02, and 19,126 (CV=7.1%) in 2006/07. Revised estimates from the three years prior are 20,103 (CV=5.6%) in 1993-94, 20,944 (CV=6.1%) in 1995-96, and 21,135 (CV=6.8%) in 1997-98 (Laake *et al.* 2009).

Gray whale counting methods were updated with a new counting technique during the 2006/2007 migration where two observers and a computer are used to log and track individual pods (Durban *et al.* 2010). This replaces a long-used method of a single observer recording sightings on paper forms. The two-observer method allows for a higher frequency of observations of each whale pod, because one observer is dedicated solely to observing pods, while a second observer's primary role is data recording and software tracking of pods. Evaluations of both counting techniques during simultaneous (2006/2007 and 2007/2008) and independent (2006/2007, 2007/2008, 2009/2010, and 2010/2011) trials have been completed (Durban *et al*. 2010, 2011) and correction factors for the new approach are presently being estimated (Durban *et al*. 2011).

Photographic mark-recapture abundance estimates for PCFG gray whales between 1998 and 2008, including estimates for a number of smaller geographic areas within the more broadly defined PCFG region, are reported in Calambokidis *et al*. (2010). These estimates were further refined during an inter-sessional workshop of the IWC (IWC 2011b). The 2008 abundance estimate for the defined range of the PCFG between 41°N to 52°N is 194 (SE = 17.0) whales.

Eastern North Pacific gray whales experienced an unusual mortality event in 1999 and 2000, when large numbers stranded along the west coast of North America (Moore *et al*., 2001; Gulland *et al*., 2005). Over 60% of the dead whales were adults, and more adults and subadults stranded in 1999 and 2000 relative to years prior to the mortality event (1996-98), when calf strandings were more common. Many stranded whales were emaciated and aerial photogrammetry documented that gray whales were thinner in 1999 relative to previous years (Perryman and Lynn, 2002). Several factors suggest that the high mortality rate was a short-term, acute event and not a chronic situation or trend: 1) in 2001 and 2002, strandings of gray whales along the coast decreased to levels that were below their pre-1999 level (Gulland *et al*., 2005); 2) average calf production in 2002-2004 returned to levels seen before 1999; and 3) in 2001, living whales no longer appeared to be emaciated. A Working Group on Marine Mammal Unusual Mortality Events (Gulland *et al*., 2005) concluded that the emaciated condition of many stranded whales supported the idea that starvation could have been a significant contributing factor to the higher number of strandings in 1999 and 2000. Unusual oceanographic conditions in 1997 may also have decreased productivity in the Bering Sea (Minobe 2002). Regardless of the mechanism, visibly emaciated whales (LeBoeuf *et al*. 2000; Moore *et al*. 2001) suggest a decline in available food resources, and it is clear that ENP gray whales were substantially affected in those years; whales were skinnier, they had a lower survival rate (particularly of adults), and calf production was dramatically lower. A modeling analysis estimates that 15.3% of the non-calf population died in each of the years of the mortality event, compared to about 2% in a normal year (Punt and Wade 2010). The most recent abundance estimate from 2006/07 suggests the population has nearly increased back to levels seen in the 1990s before the mortality event in 1999 and 2000 (Figure 2).

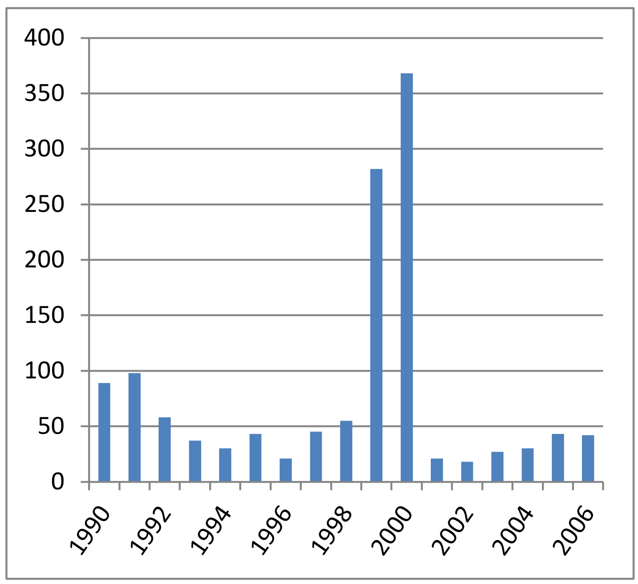

Figure 3. Number of stranded gray whales recorded along the west coast of North America between 1990 and 2006 (data from Brownell et al. 2007).

Gray whale calves were counted from Piedras Blancas, a shore site in central California, in 1980-81 (Poole 1984a) and each year since 1994 (Perryman *et al*. 2002, 2004, 2011). In 1980 and 1981, calves passing this site comprised 4.7% to 5.2% of the population (Poole 1984b). Estimates for the total number of northbound calves in 2001 to 2010 were 256, 842, 774, 1528, 945, 1020, 404, 553, 312 and 254, respectively (Perryman *et al*. 2011).

These calf estimates were highly variable between years. Calf production indices, as calculated by dividing the estimates of northbound calves by estimates of abundance for the population (Laake *et al*. 2009), ranged between 1.3 - 8.8% with a mean of 4.1% during the 17-year time series (1994-2010). Annual indices of calf production include impacts of early postnatal mortality but may overestimate recruitment because they exclude possibly significant levels of killer whale predation on gray whale calves north of the survey site. The relatively low reproductive output is consistent with reports of little or no population growth over the same time period (Laake *et al*. 2009; Punt and Wade 2010). Comparisons of sea ice cover in the Bering Sea with estimates of northbound calves revealed that average ice cover in the Bering Sea explains roughly 70% of the inter-annual variability in estimates of northbound calves the following spring (Perryman *et al*. 2011). In other words, a late retreat of seasonal ice may impact access to prey for pregnant females and reduce the probability that existing pregnancies will be carried to term.

Gray whale calves have also been counted from shore stations along the California coast during the southbound migration (Shelden *et al*. 2004). Those results have indicated significant increases in average annual calf counts near San Diego in the mid- to late-1970s compared to the 1950s and 1960s, and near Carmel in the mid-1980s through 2002 compared to late-1960s through 1980 (Shelden *et al*. 2004). This increase may be related to a trend toward later migrations over the observation period (Rugh *et al*. 2001, Buckland and Breiwick 2002), or it may be due to an increase in spatial and temporal distribution of calving as the population increased (Shelden *et al*. 2004).

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for the ENP stock is calculated from Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1 + [CV(N)]^2)]^{½})$. Using the 2006/07 abundance estimate of 19,126 and its associated CV of 0.071, N_{MIN} for this stock is 18,017.

The minimum population estimate for PCFG gray whales is calculated as the lower 20th percentile of the log-normal distribution of the 2008 mark-recapture estimate given above, or 180 animals.

Current Population Trend

The population size of the ENP gray whale stock has been increasing over the past several decades despite an unusual mortality event in 1999 and 2000. The estimated annual rate of increase, based on the unrevised abundance estimates between 1967 and 1988, is 3.3% with a standard error of 0.44% (Buckland *et al*. 1993). Using the revised abundance time series from Laake *et al*. (2009) leads to an annual rate of increase for that same period of 3.2% with a standard error of 0.5% (Punt and Wade 2010).

Abundance estimates of PCFG gray whales reported by Calambokidis *et al*. (2010) from 1999 to 2008 indicate a stable population size over multiple spatial scales. No statistical analysis of trends in abundance is currently available for this population.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The abundance time-series has been revised (Laake *et al.* 2009), so estimates of productivity rates must be based on the revised time-series. Using abundance data through 2006/07, an analysis of the ENP gray whale population led to an estimate of R_{max} of 0.062, with a 90% probability the value was between 0.032 and 0.088 (Punt and Wade 2010). This estimate came from the best fitting age- and sex-structured model, which was a density-dependent Leslie model including an additional variance term, with females and males modeled separately, that accounted for the mortality event in 1999-2000. During review of a draft of this stock assessment report, the Pacific Scientific Review Group recommended using the R_{max} value of 0.062 reported by Punt and Wade (2010), instead of the lower 10th percentile of this estimate. This value of R_{max} is also applied to PCFG gray whales, as it is currently the best estimate of R_{max} available for gray whales in the Eastern North Pacific.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the ENP stock of gray whales is calculated as the minimum population size (18,017), <u>times</u> one-half of the maximum theoretical net population growth rate (½ x 6.2% = 3.1%), times a recovery factor of 1.0 for a stock above MNPL (Punt and Wade 2010), or 558 animals.

The potential biological removal (PBR) level for PCFG gray whales is calculated as the minimum population size (180 animals), <u>times</u> one half the maximum theoretical net population growth rate (½ x 6.2% = 3.1%), <u>times</u> a recovery factor of 0.5 (for a population of unknown status), resulting in a PBR of 2.8 animals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY
Fisheries Information

NMFS observers monitored the California/Oregon thresher shark/swordfish drift gillnet fishery from 2006 to 2010 and the California set gillnet halibut fishery in 2006, 2007, and 2010: no gray whales were observed entangled (Carretta and Enriquez 2007, 2009a, 2009b, 2010, 2012). Observers have not been assigned to most Alaska gillnet fisheries, including those in Bristol Bay known to interact with gray whales. Due to a lack of observer programs, mortality data from Canadian commercial fisheries is not available. Most data on human-caused mortality and serious injury of gray whales is from strandings (including at-sea reports of entangled animals alive or dead). Strandings represent only a fraction of actual gray whale deaths (natural or human-caused), as reported by Punt and Wade (2010), who estimated that only 3.9% to 13.0% of gray whales that die in a given year end up stranding and being reported.

A summary of human-caused mortality and serious injury resulting from unknown fishery sources (predominantly pot/trap or net fisheries) is given in Table 1 for the most recent 5-year period of 2006 to 2010. Total observed human-caused fishery mortality for ENP gray whales for the period 2006 to 2010 is 15 animals or 3.0 whales per year (Table 1). Total observed human-caused fishery mortality and serious injury for PCFG gray whales for the period 2006 to 2010 is one animal, or 0.2 whales per year (Table 1).

Table 1. Human-caused deaths and serious injuries (SI) of gray whales from fishery-related sources for the period 2006 to 2010 as recorded by NMFS stranding networks.

Date of observation	Location	PCFG range N 41- N 52 AND season?	Description	Determination
11-May-10	Orange County CA	No	Free-swimming animal entangled in gillnet; animal first observed inside Dana Point Harbor on 5/11/10; animal successfully disentangled on 5/12/10 & swam out of harbor; animal observed alive in surf zone for several hours on 5/14/10 off Doheny State Beach before washing up dead on beach	Dead
7-May-10	Cape Foulweather OR	No	Entangled in 3 crab pots, whale not relocated	SI
16-Apr-10	Seaside OR	No	27-ft long gray whale stranded dead, entangled in crab pot gear	Dead
8-Apr-10	San Francisco CA	No	Rope wrapped around caudal peduncle; identified as gray whale from photo. Free-swimming, diving. No rescue effort, no resightings, final status unknown	SI
5-Mar-10	San Diego	No	Free-swimming entangled whale reported by member of the public; no rescue effort initiated; no resightings reported; final status unknown	SI
21-Jul-09	Trinidad Head CA	Yes	Free-swimming animal with green gillnet, rope & small black floats wrapped around caudal peduncle; report received via HSU researcher on scene during research cruise; animal resighted on 3 Aug; no rescue effort initiated; final status unknown	SI
25-Mar-09	Seal Beach CA	No	Free-swimming animal with pink gillnet wrapped around head, trailing 4 feet of visible netting; report received via naturalist on local whale watch vessel; no rescue effort initiated; final status unknown	SI
31-Jan-09	San Diego CA	No	Free-swimming animal towing unidentified pot/trap gear; report received via USCG on scene; USCG reported gear as 4 lobster pots; final status unknown	SI
16-Apr-08	Eel River CA	No	Observed 12 miles west of Eel River by Humboldt State University personnel. It was unknown sexwith an estimated length of 20 ft and in emaciated condition. The animal was described as towing 40-50 feet of line & 3 crab pot buoys from the caudal peduncle and moving very slowly. Vessel retrieved the buoys, pulled them and ~20 ft of line onto the deck and cut it loose from the whale. The whale swam away slowly with 20-30 feet of line still entangling the peduncle, outcome unknown. Identification numbers on buoy traced to crab pot fishery gear that was last fished in Bering Sea in December 2007.	SI
26-Jul-07	Seattle WA	No[1]	Some gear was removed from the animal, swam away with gear still attached, tribal fishing nets, animal was not sighted again to remove	SI

[1]For purposes of calculating annual human-caused mortality, this whale is counted as an ENP whale and not part of the PCFG. This determination is based on observations that PCFG whales are not known to enter Puget Sound and current estimates of PCFG population size exclude whales seen in this area (J. Calambokidis, Cascadia Research, personal communication).

			more gear.	
20-Apr-07	Newport OR	No	Entangled in crab gear. skipper of nearby vessel removed 8 pots before he had to return to port due to darkness whale still had 8 buoys and several wraps of line around mid-section, left pectoral flipper, and through mouth	SI
13-Jul-06	Ekuk, AK	No	Stranded animal at Etolin Pt. Observed in commercial salmon set net.	Dead
3-Jul-06	Bristol Bay, AK	No	Animal trailing gear, able to swim but not dive. Ropes, buoys, and single line with buoys reported around mid-section.	SI
29-May-06	Gray's Harbor WA	No	Entangled in crab pot. Rope wrapped around fluke, tailstock, mid-body and through baleen. Rope scarring on head and left side (right side unseen).	Dead
14-May-06	Lakeside OR	No	Live entangled gray whale calf with crab pot and gear wrapped around tail stock and mouth, died on 5/15	Dead
23-Apr-06	Cape Lookout OR	No	Entangled whale close to shore, was behind two other larger whales; whale had netting over snout and long line (8-10 times its body length) and 2 bright orange floats	SI

Subsistence/Native Harvest Information

Subsistence hunters in Russia and the United States have traditionally harvested whales from the ENP stock in the Bering Sea, although only the Russian hunt has persisted in recent years (Reeves 2002). The Makah Tribe of Washington State traditionally hunted gray whales for at least several hundred years until the early 20th century (Huelsbeck 1988) and has requested authorization from NOAA/NMFS, under the MMPA and the Whaling Convention Act, to resume limited hunting of gray whales(see details in Stock Definition and Geographic Range section of this report). In2007, the IWC approved a 5-year quota (2008-2012) of 620 gray whales, with an annual cap of 140, for Russian and U.S. (Makah Indian Tribe) aboriginals based on the aboriginal needs statements from each country. The U.S. and Russia have agreed that the quota will be shared with an average annual harvest of 120 whales by the Russian Chukotka people and 4 whales by the Makah Indian Tribe. Total takes by the Russian hunt were 129 in 2006 (IWC 2008),126 in 2007 (IWC 2009), 127 in 2008 (IWC 2010), 115 in 2009 (IWC 2011c) and 118 in 2010 (IWC 2011a). Based on this information, the annual subsistence take averaged 123 whales during the 5-year period from 2006 to2010.

Other Mortality

Ship strikes are a source of mortality for gray whales (Table 2). For the most recent five-year period, 2006-2010, the total serious injury and mortality of ENP gray whales attributed to ship strikes is 11 animals, or 2.2 whales per year (Table 2). The total serious injury and mortality of PCFG gray whales during this same period is one animal, or 0.2 whales per year (Table 2). Additional mortality from ship strikes probably goes unreported because the whales either do not strand or do not have obvious signs of trauma.

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

One PCFG gray whale was illegally killed by hunters in Neah Bay in September 2007(Calambokidis *et al*. 2009).

Table 2. Summary of gray whale serious injuries (SI) and deaths attributed to vessel strikes for the five-year period 2006-2010.

Date of observation	Location	PCFG range N 41 - N 52 AND season?	Description	Determination
12-Mar-10	Santa Barbara CA	No	21 meter sailboat underway at 13 kts collided with free-swimming animal; whale breached shortly after collision; no blood observed in water; minor damage to lower portion of boat's keel; final status unknown; dna analysis of skin sample confirmed species as gray whale	SI
16-Feb-10	San Diego CA	No	Free-swimming animal with propeller-like wounds to dorsum	SI
9-Sep-09	Quileute River WA	Yes	USCG vessel reported to be traveling at 10 knots when they hit the gray whale at noon on 9/9/2009. The animal was hit with the prop and was reported alive after being hit, blood observed in water.	SI
1-May-09	Los Angeles CA	No	Catalina island transport vessel collided with free-swimming calf accompanied by adult animal; calf was submerged at time of collision; pieces of flesh & blood observed in water; calf never surfaced; presumed mortality	SI

27-Apr-09	Whidbey Is. WA	No	Large amount of blood in body cavity, bruising in some areas of blubber layer and in some internal organs. Findings suggestive of blunt force trauma likely caused by collision with a large ship.	Dead
5-Apr-09	Sunset Beach CA	No	Dead stranding; 3 deep propeller-like cuts on right side, just anterior of genital opening; carcass towed out to sea	Dead
4-Apr-09	Ilwaco WA	No	Necropsied, broken bones in skull; extensive hemorrhage head and thorax; sub-adult male	Dead
1-Mar-08	Mexico	No	Carcass brought into port on bow of cruise ship; collision occurred betweeen ports of San Diego and Cabo San Lucas between 5:00 p.m. On 2/28 & 7:20 a.m. On 3/1	Dead
7-Feb-08	Orange County CA	No	Carcass; propeller-like wounds to left dorsum from mid-body to caudal peduncle; deep external bruising on right side of head; field necropsy revealed multiple cranial fractures	Dead
1-Jun-07	Marin, CA	No	Carcass; 4 propeller-like wounds to body	Dead
20-Apr-06	San Francisco CA	No	Floating carcass; propeller wounds; killer whale rake mark scars	Dead
24-Mar-06	San Diego CA	No	Free-swimming animal struck by 18 foot pleasure craft; blood observed in water; final status of animal unknown	SI

HABITAT CONCERNS

Evidence indicates that the Arctic climate is changing significantly, resulting in a reduction in the extent of sea ice cover in some regions (Johannessen et al. 2004). These changes are likely to affect gray whales due to the impacts on the species' benthic food supply. With the increase in numbers of gray whales (Rugh et al. 2005), in combination with changes in prey distribution (Grebmeier et al. 2006; Moore et al. 2007), some gray whales have moved into new feeding areas, spreading their summer range (Rugh et al. 2001). Moore and Huntington (2008) observed that gray whales are opportunistic foragers, with documented feeding year-round off Kodiak, Alaska. Bluhm and Gradinger (2008) examined the availability of pelagic and benthic prey in the Arctic and concluded that pelagic prey is likely to increase while benthic prey is likely to decrease in response to climate change. They noted that marine mammal species that exhibit trophic plasticity (such as gray whales which feed on both benthic and pelagic prey) will adapt better than trophic specialists.

Global climate change is also likely to increase human activity in the Arctic as sea ice decreases, including oil and gas exploration and shipping (Hovelsrud et al. 2008). Such activity will increase the chance of oil spills and ship strikes in this region. Gray whales have demonstrated avoidance behavior to anthropogenic sounds associated with oil and gas exploration (Malme et al. 1983, 1984) and low-frequency active sonar during acoustic playback experiments (Buck and Tyack 2000, Tyack 2009).

Ocean acidification could reduce the abundance of shell-forming organisms (Fabry et al. 2008, Hall-Spencer et al. 2008), many of which are important in the gray whales' diet (Nerini 1984, Moore and Huntington 2008).

STATUS OF STOCK

In 1994, the ENP stock of gray whales was removed from the List of Endangered and Threatened Wildlife (the List), as it was no longer considered endangered or threatened under the Endangered Species Act (ESA) (NMFS 1994). Punt and Wade (2010) estimated the ENP population was at 91% of carrying capacity (K) and at 129% of the maximum net productivity level (MNPL), with a probability of 0.884 that the population is above MNPL and therefore within the range of its optimum sustainable population (OSP).

Even though the stock is within OSP, abundance will fluctuate as the population adjusts to natural and human-caused factors affecting carrying capacity of the environment (Rugh et al. 2005). It is expected that a population close to or at carrying capacity will be more susceptible to environmental fluctuations (Moore et al. 2001). The correlation between gray whale calf production and environmental conditions in the Bering Sea (Perryman et al. 2002) may reflect this. Overall, the population nearly doubled in size over the first 20 years of monitoring, and has fluctuated for the last 30 years around its average carrying capacity. This is consistent with a population approaching K.

Alter et al. (2007) used estimates of genetic diversity to infer that North Pacific gray whales may have numbered ~96,000 animals in both the western and eastern populations 1,100-1,600 years ago. The authors recommend that because the current estimate of the eastern stock of gray whales is at most 28-56% of this historic abundance, the stock should be designated as "depleted" under the MMPA. NMFS does not accept the recommendation made by Alter et al. (2007) for the following reasons. First, their analysis examines the historic population of the entire Pacific population of gray whales, while MMPA management occurs at the level of a stock, which in this case is the ENP stock. It is speculative to try to determine what proportion of the estimated abundance may have been in the eastern or western populations. It is also uncertain if Alter et al.'s estimates include the Atlantic population (Palsbøll et al. 2007). Second, NMFS relies on current carrying capacity in making MMPA determinations. Ecosystems change over time and with those changes, the carrying capacity of the ecosystem also changes. NMFS interprets carrying capacity to mean "current" carrying capacity in part because it is not reasonable to expect ecosystems to remain static over thousands of years. Thus, an estimate of stock abundance 1,100-1,600 years ago is not relevant to MMPA decision-making, even if such an estimate were available.

Based on 2006-2010 data, the estimated annual level of human-caused mortality and serious injury for ENP gray whales includes Russian harvest (123), mortality from commercial fisheries (3.0), and ship strikes (2.2), totals 128 whales per year, which does not exceed the PBR (558). Therefore, the ENP stock of gray whales is not classified as a strategic stock.

PCFG gray whales do not currently have a formal status under the MMPA, though the population size appears stable, based on photo-ID studies (IWC 2011a; IWC 2011b). Total annual human-caused mortality of PCFG gray whales during the period 2006 to 2010 includes deaths due to commercial fisheries (0.2/yr), ship strikes (0.2/yr), and illegal hunts (0.2/yr), or 0.6 whales annually. This does not exceed the PBR level of 2.8 whales for this population. Levels of human-caused mortality and serious injury resulting from commercial fisheries and ship strikes for both ENP and PCFG whales represent minimum estimates as recorded by stranding networks or at-sea sightings.

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Revised 01/15/2011

HUMPBACK WHALE (*Megaptera novaeangliae*): 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). 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. Alternatively, humpback whales in northern Washington and southern British Columbia may be a distinct feeding population (Calambokidis et al. 2008) and a separate 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.

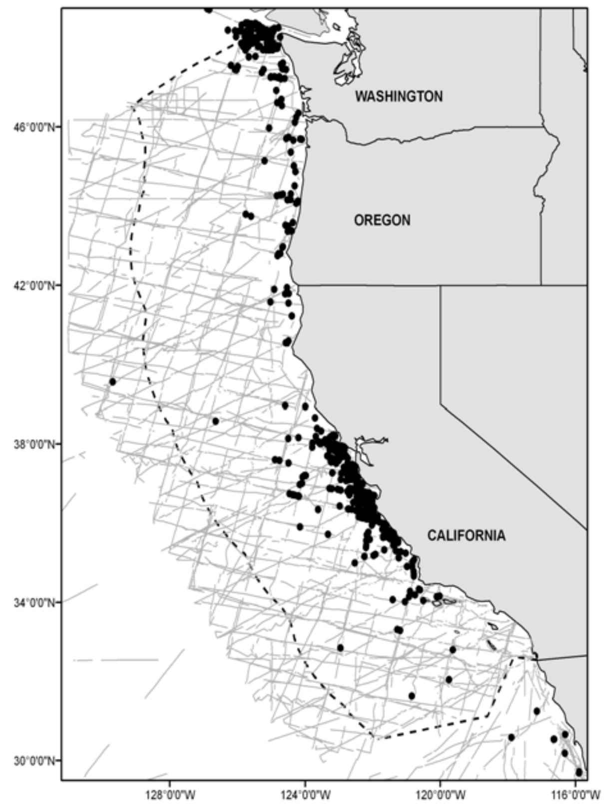

Figure 1. Humpback whale sightings based on shipboard surveys off California, Oregon, and Washington, 1991-2008. Dashed line represents the U.S. EEZ, thin lines indicate completed transect effort of all surveys combined. See Appendix 2 for data sources and information on timing and location of survey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

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. Three other stocks are recognized in the U.S. MMPA Pacific stock assessment reports: the Central North Pacific Stock (with feeding areas from Southeast Alaska to the Alaska Peninsula), the Western North Pacific Stock (with feeding areas from the Aleutian Islands, the Bering Sea, and Russia), and the American Samoa Stock (with largely undocumented feeding areas as far south as the Antarctic Peninsula).

POPULATION SIZE

Based on whaling statistics, the pre-1905 population of humpback whales in the North Pacific was estimated to be 15,000 (Rice 1978), but this population was reduced by whaling to approximately 1,200 by 1966 (Johnson and Wolman 1984). A photo-identification study in 2004-2006 estimated the abundance of humpback whales in the entire Pacific Basin to be approximately 18,000-20,000 (Calambokidis et al. 2008). Estimates of regional abundance in the California/Oregon stratum from that study (1,702) are less precise than estimates from dedicated west-coast studies. Barlow and Forney (2007) estimated 1,096 (CV=0.22) humpbacks in California, Oregon, and Washington waters based on summer/fall ship line-transect surveys in 2001. Forney (2007) estimated 1,769 (CV=0.16) humpbacks in the same region based on a 2005 summer/fall ship line-transect survey, which included additional fine-scale coastal strata not included in the 2001 survey. Barlow (2010) recently estimated 1,090 (CV=0.41) humpback whales from a 2008 summer/fall ship line-transect survey of the same region. The combined 2005 and 2008 line-transect estimate of abundance is the geometric mean of the two annual estimates, or 1,389 (CV=0.21). Calambokidis et al. (2009) estimated humpback whale abundance in these feeding areas from 1991 to 2008 using Petersen mark-recapture estimates based on photo-identification collections in adjacent pairs of years (Figure 2). The 2007/2008 mark-recapture population estimate for California and Oregon (2,043, CV=0.10) is higher than any previous mark-recapture estimates (Calambokidis et al. 2009). 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 a third of the entire population (the 2007/2008 data contained 672 known individuals). The estimate of 2,043 humpback whales in 2007/2008 is also a negatively biased estimate of this stock because it excludes some whales in Washington. The best estimate of abundance for this stock is the mark-recapture estimate of 2,043 (CV=0.10), which is also the most precise estimate.

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 the 2007/2008 mark-recapture estimate (Calambokidis 2009) or 1,878.

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 2005 (Barlow and Forney 2007; Forney 2007), but this increase was not steady, and estimates showed a slight dip in 2001. Mark-recapture population estimates have shown a long-term increase of approximately 7.5% per year (Calambokidis 2009, Figure 2), although there have been short-term declines during this period, probably due to oceanographic variability. Population estimates for the entire North Pacific have also increased substantially from 1,200 in 1966 to approximately 18,000 to 20,000 whales in 2004 to 2006 (Calambokidis et al. 2008). Although these estimates are based on different methods and the earlier estimate is extremely uncertain, the growth rate implied by these estimates (6-7%) is consistent with the recently observed growth rate of the California/Oregon/Washington stock.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

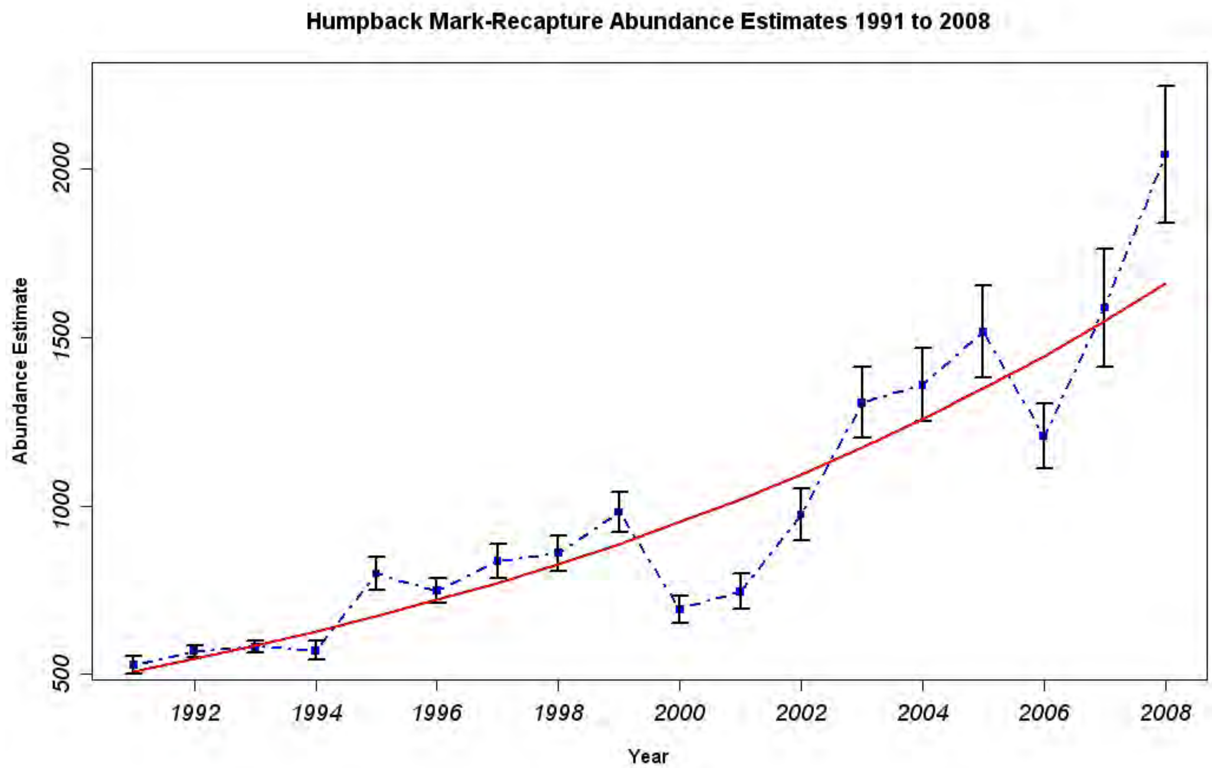

Figure 2. Mark-recapture estimates of humpback whale abundance in California and Oregon, 1991-2008 (Calambokidis 2009). Horizontal bars indicate ±1 standard error of each abundance estimate. Solid line shows a linear regression of the natural logarithim of abundance over time. The slope of this regression is statistically significant ($p < 0.001$) and approximates an annual population growth rate of between 7% and 8%.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (1,878) <u>times</u> one half the estimated population growth rate for this stock of humpback whales (½ of 8%) <u>times</u> a recovery factor of 0.3 (for an endangered species, with $N_{min} > 1{,}500$ and $CV(N_{min}) < 0.50$), resulting in a PBR of 22.5. Because this stock spends approximately half its time outside the U.S. EEZ, the PBR allocation for U.S. waters is 11.3 whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Information on historic whaling has been moved to the Status of Stock section.

Fishery Information

A summary of known fishery mortality and injury for this stock of humpback whales for 2004-2008 is given in Table 1. A total of 18 humpback whales were observed entangled in fishing gear during 2004-2008 in California, Oregon, and Washington (Table 1). No entanglements were reported from the observer program that monitors the large-mesh swordfish and thresher shark drift gillnet fishery (Carretta et al. 2005, Carretta and Enriquez 2006, 2007, 2009a, 2009b); however, a free-swimming humpback was observed entangled in gillnet gear of unknown origin in 2006 (NMFS, Southwest Regional Stranding Program, unpublished data). Of the 18 humpbacks entangled in fishing gear, 11 were reported entangled at sea in trap/pot fishery gear off California and Oregon, including two animals later found dead in Oregon (Northwest Regional Stranding Program, unpublished data). Seven humpbacks were reported entangled in unknown gillnet or other gear, including lines and buoys of unknown origin. Two of the 11 pot/trap gear entanglements could be attributed to specific fisheries: One whale was entangled in sablefish trap gear and another in spot prawn trap gear (NMFS, Southwest Regional Stranding Program, unpublished data). The whale entangled in sablefish trap gear was successfully disentangled by divers who removed all the gear, and the animal swam away immediately following disentanglement. Another whale entangled in crab pot gear in 2008 was successfully disentangled from gear. One of the sightings involving crab pot gear included a cow/calf pair where the cow was entangled. Due to the trailing gear, 14 of the humpbacks are considered as serious injuries in Table 1 (two released animals were not considered seriously injured). Including the 14 serious injuries and two deaths, total mean annual serious injury and mortality for the commercial fisheries listed in Table 1 is 3.2 per year for the period 2004-2008. In addition to the humpback entanglements, there were 12 unidentified whales observed entangled in pot/trap gear or unknown gillnet gear during 2004-2008. Some of these animals may represent re-sightings of entangled humpback whales described above. It is likely that most of the unidentified pot/trap fishery entanglements involved humpback whales.

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).

Ship Strikes

Two humpback whale deaths were attributed to ship strikes during the period 2004-2008 (NMFS, unpublished stranding data). An additional animal that was struck in Washington waters in 2008 was reported to have broken the stabilizer on the vessel that struck it, but the condition of the whale is unknown. During 2004-2008, there were an additional eight injuries of unidentified large whales attributed to ship strikes. Additional mortality from ship strikes probably goes unreported because the whales do not strand or, if they do, they do not 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 documented humpback whale deaths by ship strikes for 2004-2008 is 0.4 per year, but it is apparent that animals struck by ships are unlikely to be reported.

Other human-caused mortality

There was no humpback whale mortality reported from non-commercial fishery sources for the period 2004-2008. The average number of humpback deaths from unknown anthropogenic sources is zero per year from 2004-2008.

STATUS OF STOCK

Approximately 15,000 humpback whales were taken from the North Pacific from 1919 to 1987 (Tonnessen and Johnsen 1982; C. Allison, IWC unpubl. Data), and, of these, approximately 8,000 were taken from the west coast of Baja California, California, Oregon and Washington (Rice 1978), presumably from this stock. Shore-based whaling apparently depleted the humpback whale stock off California twice: once prior to 1925 (Clapham et al. 1997) and again between 1956 and 1965 (Rice 1974). There has been a prohibition on taking humpback whales since 1966. As a result of commercial whaling, humpback whales were listed as "endangered" under the Endangered Species Conservation Act of 1969. This protection was transferred to the Endangered Species Act (ESA) in 1973. The 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 serious injury due to entanglement (3.2/yr), other anthropogenic sources (zero), plus ship strikes (0.4/yr) in California is less than the PBR allocation of 11.3 for U.S. waters. Based on strandings and at sea observations, annual humpback whale mortality and serious injury in commercial fisheries is greater than 10% of the PBR; therefore, total fishery mortality and serious injury is not approaching zero mortality and serious injury rate. The eastern North Pacific stock appears to be increasing in abundance.

Table 1. Summary of available information on the incidental mortality and injury of humpback whales (California/Oregon/Washington stock) for commercial fisheries that might take this species (Carretta et al. 2005, Carretta and Enriquez 2006, 2007, 2009a, 2009b). 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 2004-2008 data unless noted otherwise.

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed Mortality (and serious injury)	Estimated mortality	Mean Annual Takes
CA/OR thresher shark/swordfish drift gillnet fishery	2004 2005 2006 2007 2008	Observer	20.6% 20.9% 18.5% 16.4% 13.5%	0 0 0 0 0	0 0 0 0 0	0 (n/a)
CA halibut and white seabass and other species large mesh (>3.5") set gillnet fishery	2004 2005 2006 2007 2008	observer	0% 0% ~1% 17.8% 0%	n/a n/a n/a 0 (0) n/a	n/a	0 (n/a)
Pot or trap fisheries	2004 2005 2006 2007 2008	Strandings & sightings	n/a	0 (0) 0 (3) 1 (1) 1 (1) 0 (2)	n/a	≥1.8
unidentified fisheries	2004 2005 2006 2007 2008	Strandings & sightings		0 (1) 0 (0) 0 (2) 0 (3) 0 (1)	n/a	≥ 1.4
Total Annual Takes						≥3.2

Habitat Concerns

Increasing levels of anthropogenic 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. Based on vocalizations (Richardson et al. 1995; Au et al. 2006), reactions to sound sources (Lien et al. 1990, 1992; Maybaum 1993), and anatomical studies (Hauser et al. 2001), humpback whales also appear to be sensitive to mid-frequency sounds, including those used in active sonar military exercises (Navy 2007).

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Revised 01/15/2011

BLUE WHALE (*Balaenoptera musculus 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 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). 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, Stafford 2003). 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, though both call types have been recorded concurrently in the Gulf of Alaska (Stafford et al. 2001, Stafford 2003). 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 (2008) showed that blue whales from California to Central America (the eastern North Pacific stock) are on average about two meters shorter than blue whales measured from historic whaling 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 northern British Columbia and to one individual photographed in the northern Gulf of Alaska (Calambokidis et al. 2009).

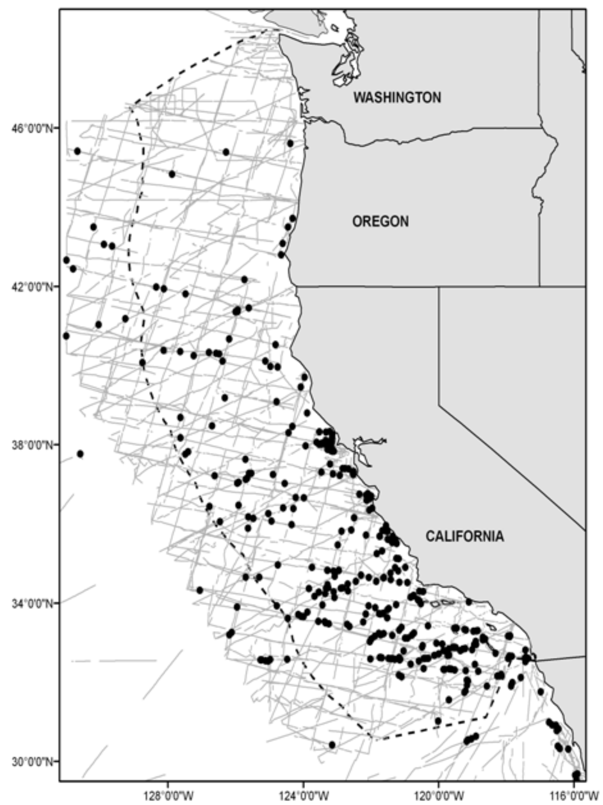

Figure 1. Blue whale sighting locations based on aerial and summer/autumn shipboard surveys off California, Oregon, and Washington, 1991-2008 (see Appendix 2 for data sources and information on timing and location of surveys). Dashed line represents the U.S. EEZ; thin lines represent completed transect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

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

POPULATION SIZE

The size of the feeding stock of blue whales off the U.S. West Coast was estimated recently by both line-transect and mark-recapture methods. Barlow and Forney (2007) estimated 603 (CV=0.29) blue whales off California, Oregon, and Washington based on ship line-transect surveys in 2001 and Forney (2007), estimated 721 (CV=0.27) from a 2005 line-transect survey of the same area. More recently, Barlow (2010) estimated 442 (CV=0.25) blue whales from a 2008 line-transect survey in the same region. The unweighted geometric mean of the 2005 and 2008 line-transect estimates is 565 (CV=0.18) whales. Calambokidis et al. (2010) used photographic mark-recapture and estimated population sizes of 2,799 (CV=0.27) based on 2005-2008 photographs of left sides and 2,195 (CV=0.24) based on right sides. The average of the mark-recapture estimates is 2,497 (CV=0.24) whales. Mark-recapture estimates are often negatively biased by individual heterogeneity in sighting probabilities (Hammond 1986); however, Calambokidis et al. (2010) minimize such effects by selecting one sample that was taken randomly with respect to distance from the coast. Similarly, the line-transect estimates may also be negatively biased because some blue whales in this stock are outside of the study area at the time of survey (Calambokidis and Barlow 2004). Because some fraction of the population is always outside the survey area, the line-transect and mark recapture estimation methods provide different measures of abundance for this stock. Line transect estimates reflect the average density and abundance of blue whales in the study area during summer and autumn surveys, while mark recapture estimates provide an estimate of total population size. Therefore, the best estimate of blue whale abundance is the average of mark-recapture estimates, or 2,497 (CV=0.24).

Minimum Population Estimate

The minimum population estimate for blue whales is taken as the lower 20th percentile of the log-normal distribution of abundance estimated from the mark-recapture estimate, or approximately 2,046.

Current Population Trend

There is some indication that blue whales 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. Estimates from line transect surveys declined between 1991-2005 (Figure 2), which is probably due to variability in the fraction of the population that utilizes California waters during the summer and autumn (Calambokidis et al. 2009).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No information exists on the overall rate of growth of blue whale populations in the Pacific (Best 1993). Based on mark-recapture estimates from the US West Coast and Baja California, Mexico, Calambokidis et al. (2010) estimate a rate of increase just under 3% per year, but it is not known if that corresponds to the maximum growth rate of this stock.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (2,046) <u>times</u> one half the default maximum net growth rate for cetaceans (½ of 4%) <u>times</u> a recovery factor of 0.3 (for an endangered species which has a minimum abundance greater than 1,500 and a $CV_{Nmin}<0.5$), resulting in a PBR of 12.2. Because whales in this stock spends approximately three quarters of their time outside the U.S. EEZ, the PBR allocation for U.S. waters is one-quarter of this total, or 3.1 whales per year.

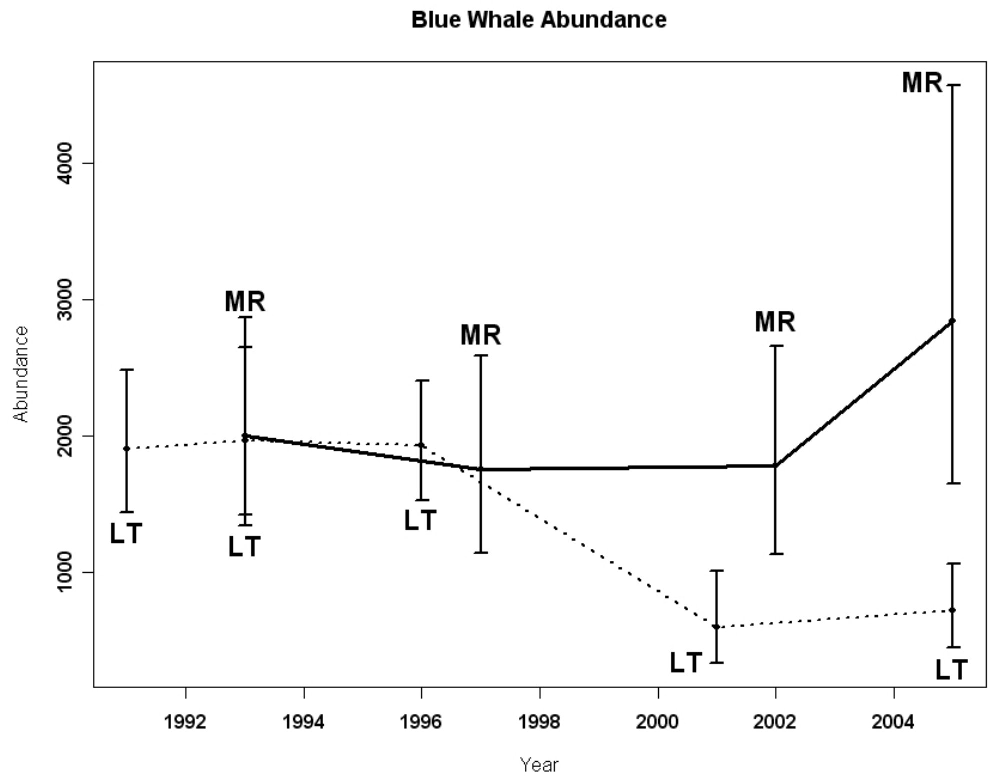

Figure 2. Estimates of abundance from vessel-based line transect (LT) and mark-recapture (MR) surveys conducted in California waters, 1991-2005 (Barlow and Forney 2007; Calambokidis et al. 2003; Calambokidis and Barlow 2004; Forney 2007; Calambokidis et al. 2007). The four line transect estimates are based on annual surveys conducted in 1991, 1993, 1996, 2001, and 2005, respectively. The three mark-recapture estimates are based on 1991-1993, 1995-1997, 2000-2002, and 2004-2006 pooled estimates, respectively. Approximate 95% lognormal confidence intervals of the individual LT and MR estimates are also shown.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

The offshore drift gillnet fishery is the only fishery that is likely to take blue whales from this stock, but no fishery mortality or serious injuries have been observed (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 2004-2008 data (Carretta et al. 2005 Carretta and Enriquez 2006, 2007, 2009a, 2009b). 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 (Carretta et al. 2005, Carretta and Enriquez 2006, 2007, 2009a, 2009b). Mean annual takes are based on 2004-2008 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	2004 2005 2006 2007 2008	observer	20.6% 20.9% 18.5% 16.4% 13.5%	0 0 0 0 0	0 0 0 0 0	0 (n/a)
Total Annual Takes						0 (n/a)

Ship Strikes

Ship strikes were implicated in the deaths of five blue whales, from 2004-2008 (NMFS SWR Stranding Database). Four of these deaths occurred in 2007, the highest number recorded for any year. During 2004-2008, there were an additional eight injuries of unidentified large whales attributed to ship strikes. Additional mortality from ship strikes probably goes unreported because the whales do not strand or, if they do, they do not always have obvious signs of trauma. 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.). Blue whale mortality and injuries attributed to ship strikes in California waters averaged 1.0 per year for 2004-2008. The high number of ship strikes observed in 2007 resulted in NOAA implementing a mitigation plan that includes NOAA weather radio and U.S. Coast Guard advisory broadcasts to mariners entering the Santa Barbara Channel to be observant for whales, along with recommendations that mariners transit the channel at 10 knots or less. The Channel Islands National Marine Sanctuary also developed a blue whale/ship strike response plan, which involved weekly overflights to record whale locations. Additional plan information can be found at http://channelislands.noaa.gov/focus/alert.html.

STATUS OF STOCK

The reported take of North Pacific blue whales by commercial whalers totaled 9,500 between 1910 and 1965 (Ohsumi and Wada 1972). Approximately 3,000 of these were taken from the west coast of North America from Baja California, Mexico to British Columbia, Canada (Tonnessen and Johnsen 1982; Rice 1992; Clapham et al. 1997; Rice 1974). Blue whales in the North Pacific were given protected status by the IWC in 1966, but Doroshenko (2000) reported that a small number of blue whales were taken illegally by Soviet whalers after that date. As a result of commercial whaling, blue whales were listed as "endangered" under the Endangered Species Conservation Act of 1969. This protection was transferred to the Endangered Species Act (ESA) in 1973. 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 (1.0/year) from ship strikes is less than the calculated PBR (3.1) 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.

Habitat Concerns

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

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FIN WHALE (*Balaenoptera physalus 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).

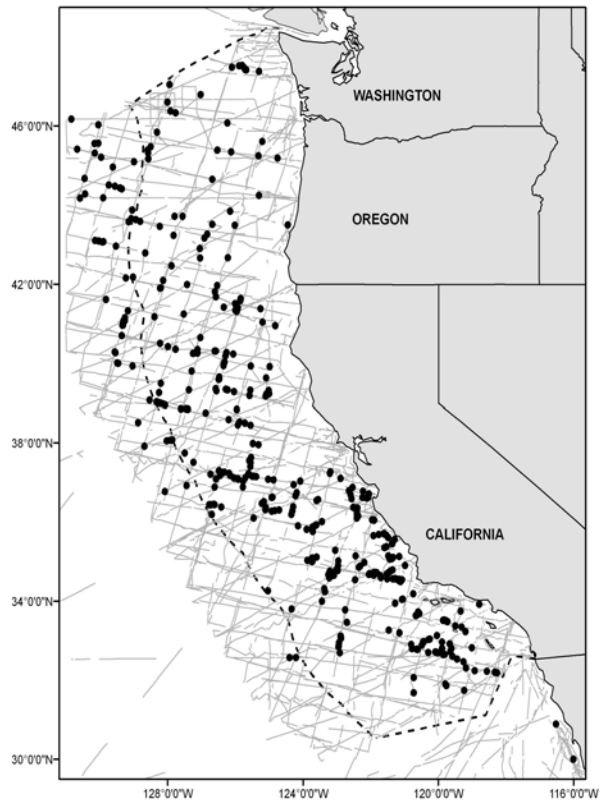

Figure 1. Fin whale sighting locations based on shipboard surveys off California, Oregon, and Washington, 1991- 2008 (see Appendix 2 for data sources and information on timing and location of surveys). Dashed line represents the U.S. EEZ; thin lines indicate completed transect effort of all surveys combined.

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). 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 2005 (3,281, CV=0.25) and 2008 (2,825, CV = 0.26) (Forney 2007, Barlow 2010), or 3,044 (CV=0.18) whales. This is probably 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 2005 and 2008 summer/fall ship surveys (Forney 2007; Barlow 2010) or approximately 2,624.

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 statistically 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, 2005, and 2008 in California, Oregon, and Washington waters out to 300 nmi. Estimates from these four surveys have been 2,042 (CV= 0.13); 2,118 (CV= 0.18); 3,281 (CV=0.25); and 2,825 (CV=0.26) whales, respectively (Barlow and Forney 2007; Forney 2007; Barlow 2010).

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 (2,624) <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 16.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Information on historic whaling has been moved to the Status of Stock section.

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 . 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 2004-2008 data (Carretta et al. 2005, Carretta and Enriquez 2006, 2007, 2009a, 2009b). This results in an average estimate of 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 .

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	2004 2005 2006 2007 2008	observer	20.6% 20.9% 18.5% 16.4% 13.5%	0 0 0 0 0	0 0 0 0 0	0 (n/a)
Total annual takes						0 (n/a)

Ship Strikes

Ship strikes were implicated in the deaths of four fin whales and the injury of another from 2004 to 2008, NMFS, unpublished stranding data). During 2004-2008, there were an additional eight injuries of unidentified large whales attributed to ship strikes. Additional mortality from ship strikes probably goes unreported because the whales do not strand or, if they do, they do not always have obvious signs of trauma. The average observed annual mortality and injury due to ship strikes is 1.0 fin whales per year for the period 2004-2008.

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. Approximately 46,000 fin whales were taken from the North Pacific by commercial whalers between 1947 and 1987 (C. Allison, IWC, pers. comm.). Approximately 5,000 fin whales were taken from the west coast of North America from 1919 to 1965 (Rice 1974; Tonnessen and Johnsen 1982; Clapham et al. 1997). Fin whales in the North Pacific were given protected status by the IWC in 1976. Fin whales are formally listed as "endangered" under the Endangered Species Act (ESA), and consequently the California to Washington stock is automatically considered as a "depleted" and "strategic" stock under the MMPA. The total incidental mortality due to fisheries (zero) and ship strikes (1.0/yr) is less than the calculated PBR (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. Increasing levels of anthropogenic sound in the world's oceans has been suggested to be a habitat concern for whales, particularly for baleen whales that may communicate using low-frequency sound (Croll *et al.* 2002).

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Revised 01/15/2011

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The International Whaling Commission (IWC) only considers one stock of sei whales in the North Pacific (Donovan 1991), but some evidence exists for multiple populations (Masaki 1977; Mizroch et al. 1984; Horwood 1987). Sei whales are distributed far out to sea in temperate regions of the world and do not appear to be associated with coastal features. Whaling effort for this species was distributed continuously across the North Pacific between 45-55^{o}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^{o}) will be considered as a separate stock.

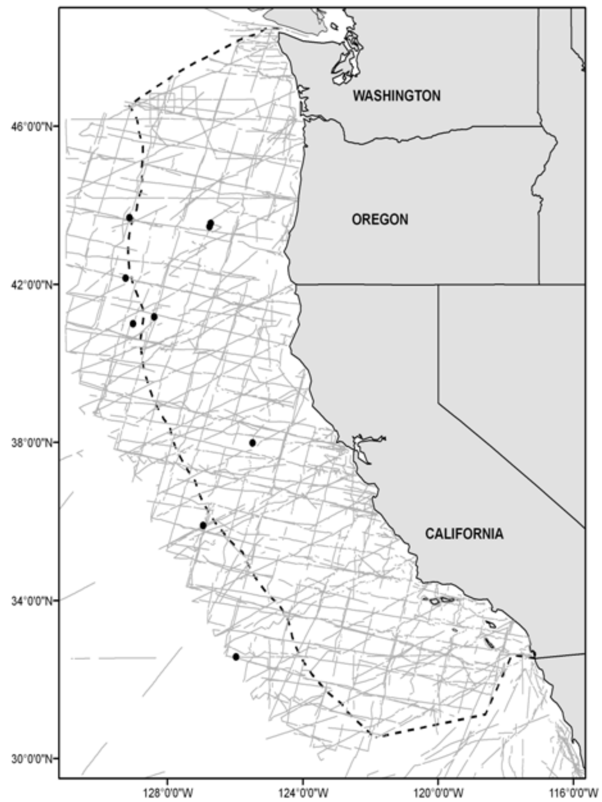

Figure 1. Sei whale sighting locations based on shipboard surveys off California, Oregon, and Washington, 1991-2008 (see Appendix 2 for data sources and information on timing and location of surveys). Dashed line represents the U.S. EEZ; thin lines indicate completed transect effort of all surveys combined.

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 nine confirmed sightings of sei whales were made in California, Oregon, and Washington waters during extensive ship and aerial surveys between 1991- 2008 (Hill and Barlow 1992; Carretta and Forney 1993; Mangels and Gerrodette 1994; VonSaunder and Barlow 1999; Barlow 2003; Forney 2007; Barlow 2010). 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 74 (CV=0.88) and 215 (CV=0.71) sei whales, respectively (Forney 2007, Barlow 2010). The best estimate of abundance for California, Oregon, and Washington waters out to 300 nmi is the unweighted geometric mean of the 2005 and 2008 estimates, or 126 (CV=0.53) sei whales (Barlow and Forney 2007 ; Forney 2007; Barlow 2010).

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 2005 and 2008 shipboard line-transect surveys, or approximately 83 whales.

Current Population Trend

There are no data on trends in sei whale abundance in the eastern North Pacific waters. Although the population in the North Pacific is expected to have grown since being given protected status in 1976, the possible effects of continued unauthorized take (Yablokov 1994) and incidental ship strikes and gillnet mortality make this uncertain.

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 (83) 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 0.17.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

[Information on historic whaling has been moved to the Status of Stock section]

Fishery Information

The offshore drift gillnet fishery is the only fishery that is likely to take sei whales from this stock, but no fishery mortality or serious injuries have been observed (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 2004-2008 data (Carretta et al. 2005, Carretta and Enriquez 2006, 2007, 2009a, 2009b.). This results in an average estimate of zero sei whales taken annually. However, some gillnet mortality of large whales may go unobserved because whales swim away with a portion of the net.

Table 1. Summary of available information on the incidental mortality and injury of sei whales (eastern North Pacific stock) for commercial fisheries that might take this species. n/a indicates that data are not available. Mean annual takes are based on 2004-2008 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	2004	observer	20.6%	0	0	0 (n/a)
	2005		20.9%	0	0	
	2006		18.5%	0	0	
	2007		16.4%	0	0	
	2008		13.5%	0	0	
Total annual takes						0 (n/a)

Ship Strikes

One ship strike death was reported in Washington in 2003 (NMFS Northwest Regional Office, unpublished data). During 2004-2008, there were an additional eight injuries of unidentified large whales attributed to ship strikes. Additional mortality from ship strikes probably goes unreported because the whales do not strand or, if they do, they do not always have obvious signs of trauma. The average observed annual mortality due to ship strikes is zero sei whales per year for the period 2004-2008.

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. 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, at least 410 were taken by-shore-based whaling stations in central California between 1919 and 1965 (Rice 1974; 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. 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. Although the current rate of ship strike deaths and serious injuries is zero, it is likely that some sei whale ship strikes are unreported. Increasing levels of anthropogenic sound in the world's oceans has been suggested to be a habitat concern for whales, particularly for baleen whales that may communicate using low-frequency sound (Croll *et al.* 2002).

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Revised 01/15/2011

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

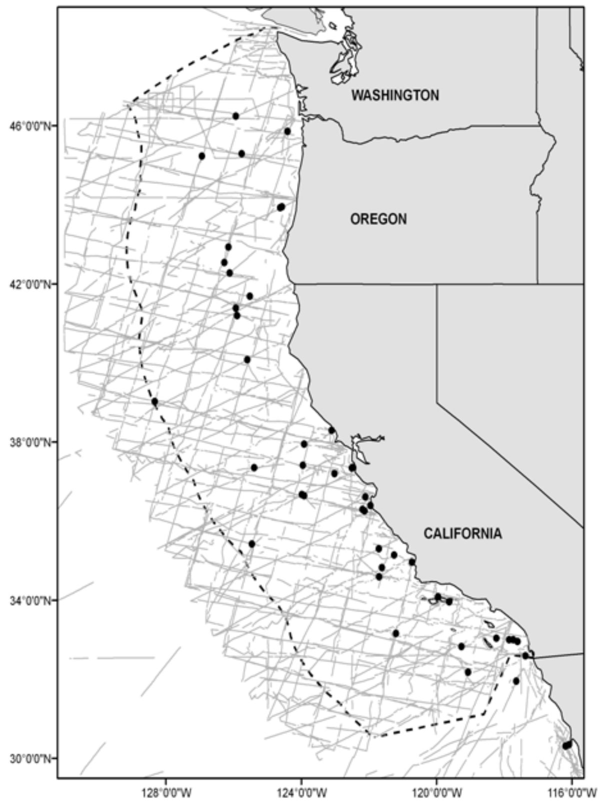

Figure 1. Minke whale sighting locations based on shipboard surveys off California, Oregon, and Washington, 1991-2008 (see Appendix 2 for data sources and information on timing and location of surveys). Dashed line represents the U.S. EEZ; thin lines indicate completed transect effort of all surveys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

POPULATION SIZE

No estimates have been made for the number of minke whales in the entire North Pacific. Forney (2007) estimated 957 (CV=1.36) during a 2005 ship survey off California, Oregon, and Washington, while the most recent survey in 2008 did not record any minke whales while on survey effort (Barlow 2010). The number of minke whales off California Oregon, and Washington is estimated to be the arithmetic mean of two recent ship line transect surveys conducted in summer and autumn 2005 and 2008 (Barlow and Forney 2007 ; Forney 2007; Barlow 2010); or 478 (CV=1.36) whales. 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 2005 and 2008 summer/fall ship surveys in California, Oregon, and Washington waters (Barlow and Forney 2007; Forney 2007; Barlow 2010) or approximately 202.

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 (202) 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 2.0 whales.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Information on historic whaling has been moved to the Status of Stock section.

Table 1. Summary of available information on the incidental mortality and injury of minke whales (CA/OR/WA stock) for commercial fisheries that might take this species (Carretta et al. 2005, Carretta and Enriquez 2006, 2007, 2009a, 2009b). Mean annual takes are based on 2004-2008 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	2004 2005 2006 2007 2008	observer	20.6% 20.9% 18.5% 16.4% 13.5%	0 0 0 0 0	0 0 0 0 0	0 (n/a)
CA halibut and other species large mesh (>3.5") set gillnet fishery	2004 2005 2006 2007 2008		0% 0% ~1% 17.8% 0%	0	0	n/a
Total annual takes						0

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 2004-2008. 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 California drift gillnet fishery dropped considerably (Barlow and Cameron 2003). Mean annual takes for this fishery (Table 1) are based on 2004-2008 data (Carretta et al. 2005, Carretta and Enriquez 2006, 2007, 2009a, 2009b). 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 coming from a minke whale using genetic sequencing methods.

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 2004-2008. 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

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 (Rice 1974; Clapham et al. 1997). Reported aboriginal takes of minke whales in Alaska totaled 7 between 1930 and 1987 (C. Allison, IWC, pers. comm.). 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 is 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 (2.0), 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. Increasing levels of anthropogenic sound in the world’s oceans has been suggested to be a habitat concern for whales, particularly for baleen whales that may communicate using low-frequency sound.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Rough-toothed dolphins are found throughout the world in tropical and warm-temperate waters (Perrin et al. 2009). They are present around all the main Hawaiian islands (Shallenberger 1981; Tomich 1986) and have been observed at least as far northwest as French Frigate Shoals (Nitta and Henderson 1993). Recent sighting locations of rough-toothed dolphins during a 2002 shipboard survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands (Barlow 2006) are shown in Figure 1. Eight strandings have been reported from Maui, Oahu, and the island of Hawaii (Nitta 1991; Maldini et al. 2005). Little is known about stock structure for this species in the North Pacific. Photographic identification studies around the main Hawaiian islands have indicated that dispersal rates between the islands of Kauai/Niihau and Hawaii do not exceed 2% per year (Baird *et al*. 2008). Resighting rates off the island of Hawaii are high, with 75% of well-marked individuals resighted on two or more occasions, suggesting high site fidelity and low population size. Resighting data coupled with relatively high sighting rates within the Main Islands stratum versus the outer EEZ stratum (Barlow 2006) may suggest that there are island-associated populations of rough-toothed dolphins in the Hawaii EEZ. Rough-toothed dolphins have also been documented in American Samoan waters (NMFS, PIR, unpublished data). For the Marine Mammal Protection Act (MMPA) stock assessment reports, there are two Pacific management stocks: 1) The Hawaiian Stock (this report), and 2) the American Samoa Stock. The Hawaiian stock includes animals found both within the Hawaiian Islands EEZ and in adjacent international waters; however, because data on abundance, distribution, and human-caused impacts are largely lacking for international waters, the status of this stock is evaluated based on data from the U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

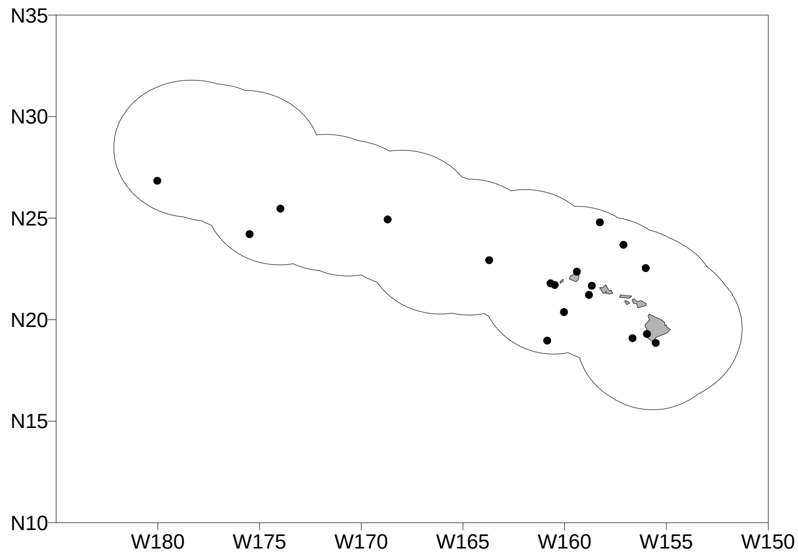

Figure 1. Rough-toothed dolphin sighting locations during the 2002 shipboard cetacean survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ.

POPULATION SIZE

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

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate for Hawaiian Islands EEZ waters (Barlow 2006) is 6,067 rough-toothed dolphins within the Hawaiian Islands EEZ.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size within the U.S. EEZ of the Hawaiian Islands (6,067) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a stock of unknown status with no known fishery mortality or serious injury; Wade and Angliss 1997), resulting in a PBR of 61 rough-toothed dolphins per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Information on fishery-related mortality and serious injury of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Gillnets appear to capture marine mammals wherever they are used and lobster traps and longlines can be expected to occasionally entangle cetaceans (Perrin et al. 1994).

Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries, and some of these interactions involved rough-toothed dolphins (Nitta and Henderson 1993). Rough-toothed dolphins are known to take bait and catch from Hawaiian sport and commercial fisheries operating near the main islands and in a portion of the northwestern islands (Shallenberger 1981; Schlais 1984; Nitta and Henderson 1993), and they have been specifically reported to interact with the day handline fishery for tuna (palu-ahi) and the troll fishery for billfish and tuna (Schlais 1984; Nitta and Henderson 1993). There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2004 and 2008, no rough-toothed dolphins were observed hooked or entangled in the SSLL fishery (100% observer coverage) or the DSLL fishery (20-28% observer coverage) (McCracken & Forney 2010). 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. Baird *et al.* (2008) reported increased vessel avoidance of boats by rough-toothed dolphins off the island of Hawaii relative to those off Kauai or Niihau and attributed this to possible shooting of dolphins that are stealing bait or catch from recreational fisherman off the island of Hawaii (Kuljis 1983).

STATUS OF STOCK

The status of rough-toothed dolphins in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this species. It is not listed as “threatened” or “endangered” under the Endangered Species Act (1973), nor as “depleted” under the MMPA. Given the absence of recent fishery-related mortality or serious injuries, the Hawaiian stock of rough-toothed dolphins is not considered strategic under the 1994 amendments to the MMPA, and the total fishery mortality and serious injury can be considered to be insignificant and approaching zero.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

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

POPULATION SIZE

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

Minimum Population Estimate

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

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

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

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

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

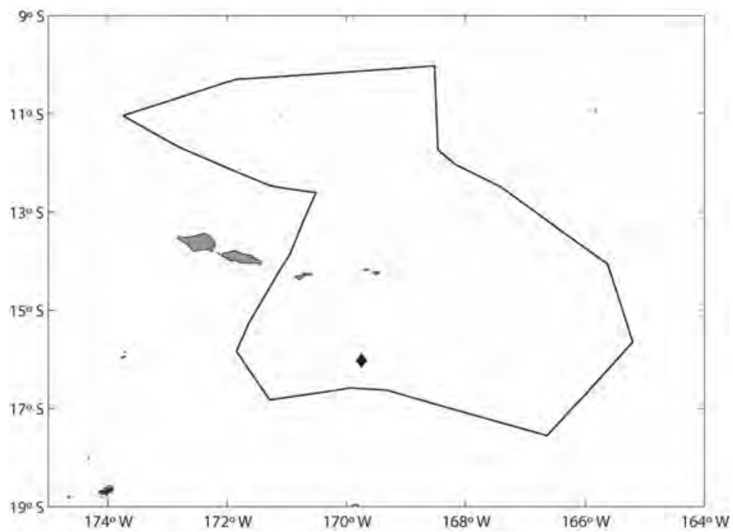

Figure 2. Locations of observed rough-toothed dolphin takes (filled diamonds) in the American Samoa longline fishery, 2006-2008. Solid lines represent the U.S. EEZ. Set locations in this fishery are summarized in Appendix 1.

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

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

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

STATUS OF STOCK

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

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Risso's dolphins are found in tropical to warm-temperate waters worldwide (Perrin et al. 2009). Although they have been considered rare in Hawaiian waters (Shallenberger 1981), six sightings were made during a 2002 survey of the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands (Figure 1). There are five stranding records from the main islands (Nitta 1991; Maldini et al. 2005). For the Marine Mammal Protection Act (MMPA) stock assessment reports, Risso's dolphins within the Pacific U.S. EEZ are divided into two discrete, non-contiguous areas: 1) Hawaiian waters (this report), and 2) waters off California, Oregon and Washington. The Hawaiian stock includes animals found both within the Hawaiian Islands EEZ and in adjacent international waters; however, because data on abundance, distribution, and human-caused impacts are largely lacking for international waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

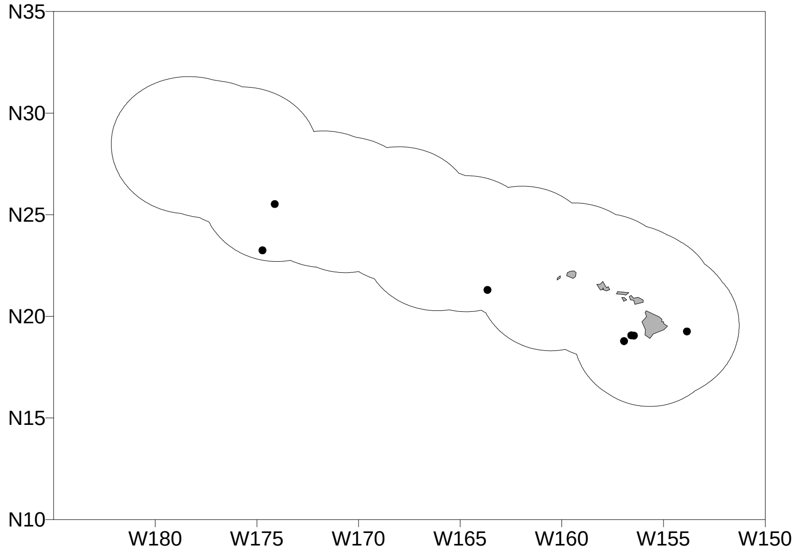

Figure 1. Risso's dolphin sighting locations during the 2002 shipboard cetacean survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ.

POPULATION SIZE

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

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate (Barlow 2006) is 1,195 Risso's dolphins within the Hawaiian Islands EEZ.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size within the U.S. EEZ of the Hawaiian Islands (1,195) <u>times</u> one half the default maximum net growth rate for cetaceans (½ of 4%) <u>times</u> a recovery factor of 0.50 (for a stock of unknown status with no known fishery mortality or serious injury within the U.S. EEZ of the Hawaiian Islands; Wade and Angliss 1997), resulting in a PBR of 12 Risso's dolphins per year.

HUMAN CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Information on fishery-related mortality and serious injury of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Gillnets appear to capture marine mammals wherever they are used, and float lines from lobster traps and longlines can be expected to occasionally entangle cetaceans (Perrin et al. 1994). Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nitta and Henderson 1993), and some of these interactions involved Risso's dolphins.

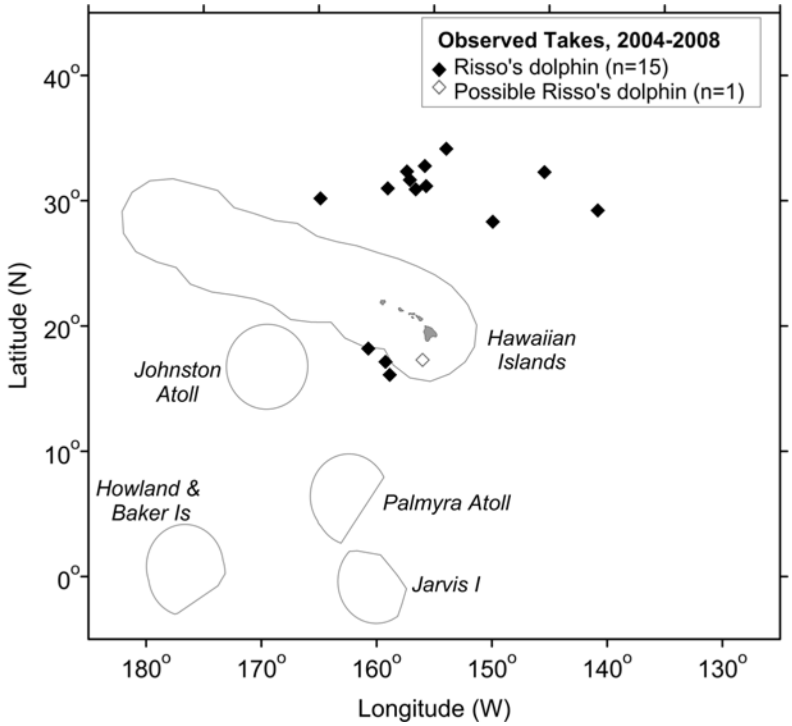

Figure 1. Locations of Risso's dolphin takes (filled diamonds) and possible takes of this species (open diamonds) in Hawaii-based longline fisheries, 2004-2008 . Solid lines represent the U.S. EEZs. Fishery descriptions are provided in Appendix 1.

There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2004 and 2008, 10 Risso's dolphins were observed killed or seriously injured in the SSLL fishery (100% observer coverage), and 15 Risso's dolphins were observed killed or seriously injured in the DSLL fishery (20-28% observer coverage) (Forney 2009, McCracken & Forney 2010). Three Risso's dolphin in the DSLL fishery and two in the SSLL fishery were killed; the remainder were determined to have been seriously injured (Forney 2009), based on an evaluation of the observer's description of the interaction and following the most recently developed criteria for assessing serious injury in marine mammals (Andersen et al. 2008). The total observed mortality and serious injury of cetaceans in the SSLL fishery (with 100% coverage), and the estimated annual and 5-yr average mortality and serious injury of cetaceans in the DSLL fishery are reported by McCracken and Forney (2010). Average 5-yr estimates of annual mortality and serious injury for 2004-2008 are 2.6 (CV = 0.40) Risso's dolphins outside of U.S. EEZs, and none within the Hawaiian Islands EEZ (Table 1, McCracken & Forney 2010). One additional unidentified cetacean, which may have been a Risso's dolphin, was also taken in the DSLL fishery within U.S. EEZ waters during 2006 (Figure 2, Forney and McCracken 2008).

Table 1. Summary of available information on incidental mortality and serious injury of Risso's dolphin (Hawaii stock) in commercial fisheries, within and outside of U.S. EEZs (McCracken & Forney 2010). Mean annual takes are based on 2004-2008 data unless indicated otherwise.

Fishery Name	Year	Data Type	Percent Observer Coverage	Mortality and Serious Injury outside of U.S. EEZ			Mortality and Serious Injury within Hawaiian Islands EEZ		
				Observed	Estimated (CV)	Mean Annual Takes (CV)	Observed	Estimated (CV)	Mean Annual Takes (CV)
Hawaii-based deep-set longline fishery	2004	observer data	25%	0	0 (n/a)	2.6 (0.4)	0	0 (-)	0 (-)
	2005		28%	2	3 (0.6)		0	0 (-)	
	2006		22%	4	5 (0.4)		0	0 (-)	
	2007		20%	4	3 (1.0)		0	0 (-)	
	2008		22%	5	2 (1.2)		0	0 (-)	

Fishery Name	Year	Data Type	Percent Observer Coverage	Mortality and Serious Injury outside of U.S. EEZ			Mortality and Serious Injury within Hawaiian Islands EEZ		
				Observed	Estimated (CV)	Mean Annual Takes (CV)	Observed	Estimated (CV)	Mean Annual Takes (CV)
Hawaii-based shallow-set longline fishery	2004 2005 2006 2007 2008	observer data	100% 100% 100% 100% 100%	0 1 2 3 4	Same as observed	2.0	0 0 0 0 0	0 (-) 0 (-) 0 (-) 0 (-) 0 (-)	0 (-)
Minimum total annual takes within U.S. EEZ waters									0 (-)

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 stealing bait and catch are increasing. It is not known whether these interactions result in serious injury or mortality of dolphins, nor whether Risso's dolphins are involved.

STATUS OF STOCK

The status of Risso's dolphins in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this species. It is not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. Given the absence of recent fishery-related mortality or serious injuries within the Hawaiian Islands EEZ, the Hawaiian stock of Risso's dolphins is not considered strategic under the 1994 amendments to the MMPA, and the total fishery mortality and serious injury can be considered to be insignificant and approaching zero. However, the potential effect of injuries sustained by Risso's dolphins in U.S. pelagic longline fisheries in international waters is not known, because no abundance or bycatch estimates are available for international waters.

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Revised 01/15/2011

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Common bottlenose dolphins are widely distributed throughout the world in tropical and warm-temperate waters (Perrin et al. 2009). The species is primarily coastal in much of its range, but there are populations in some offshore deepwater areas as well. Bottlenose dolphins are common throughout the Hawaiian Islands, from the island of Hawaii to Kure Atoll (Shallenberger 1981). Twelve strandings have been reported within the main Hawaiian Islands (Nitta 1991, Maldini et al. 2005). Recent sighting locations based on a 2002 shipboard survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands (Barlow 2006) are shown in Figure 1. In the Hawaiian Islands, they are found in shallow inshore waters and deep water (Baird et al. 2009).

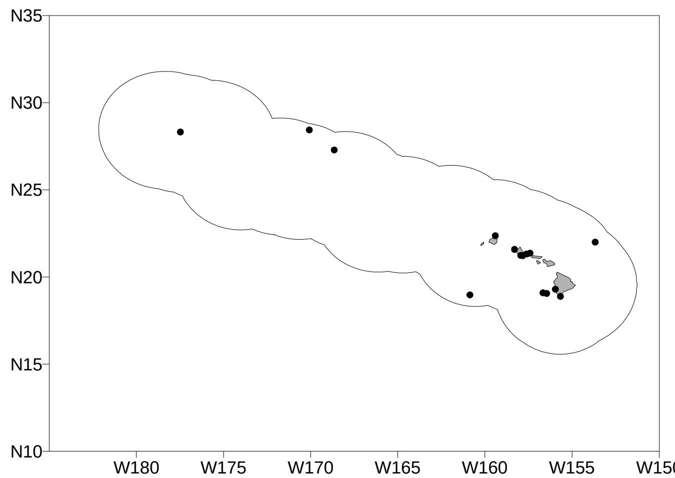

Figure 1. Bottlenose dolphin sighting locations during the 2002 shipboard cetacean survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ.

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

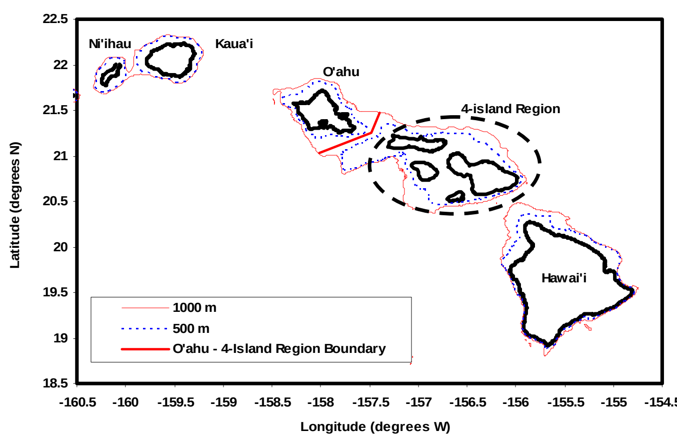

Figure 2. Insular bottlenose dolphin stock boundaries (red lines). Areas beyond the 1000 m isobath represent the pelagic stock range.

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

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

HUMAN CAUSED MORTALITY AND SERIOUS INJURY

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 (Perrin et al. 1994). In Hawaii, some mortality of bottlenose dolphins has been observed in inshore gillnets, but no estimate of annual human-caused mortality and serious injury is available, because these fisheries are not observed or monitored.

Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries, and some of these interactions involved bottlenose dolphins (Nitta and Henderson 1993). There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2004 and 2008, four bottlenose dolphins were observed hooked or entangled in the SSLL fishery (100% observer coverage), and one bottlenose dolphin was observed taken in the DSLL fishery (20-28% observer coverage) (Forney 2009, McCracken 2009). Based on the locations, these takes are all considered to have been from the Pelagic Stock of bottlenose dolphins. All five dolphins were determined to have been seriously injured (Forney 2009), based on an evaluation of the observer's description of the interaction and following the most recently developed criteria for assessing serious injury in marine mammals (Andersen et al. 2008). Average 5-yr estimates of annual mortality and serious injury for the Pelagic Stock during 2004-2008 are 0.6 (CV = 0) bottlenose dolphins outside of U.S. EEZs, and 0.4 (CV = 0.68) within the Hawaiian Islands EEZ (Table 1, McCracken 2009).

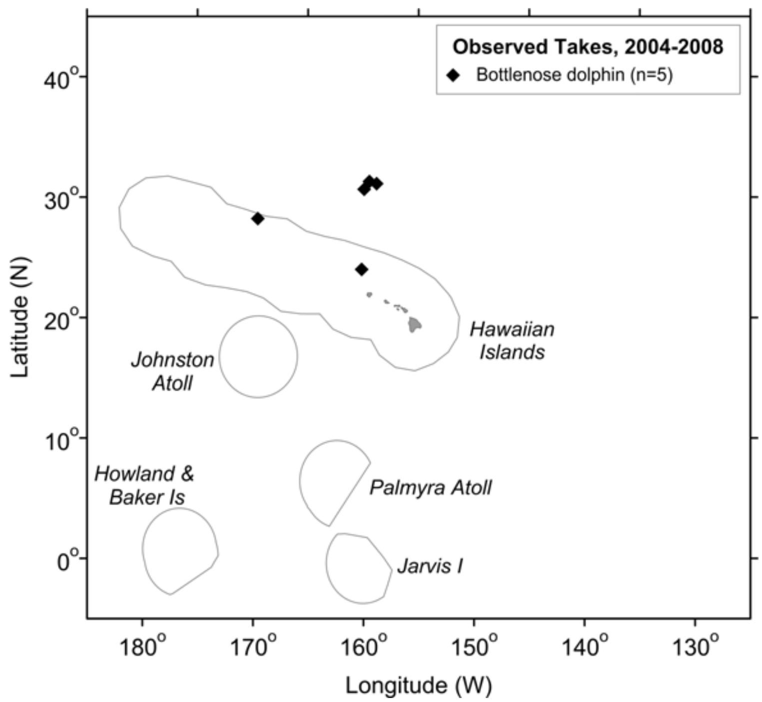

Figure 3. Locations of observed Pelagic Stock bottlenose dolphin takes (filled diamonds) in the Hawaii-based longline fishery, 2004-2008. Solid lines represent the U. S. EEZ. Fishery descriptions are provided in Appendix 1.

Bottlenose dolphins are one of the species commonly reported to steal bait and catch from several Hawaiian sport and commercial fisheries (Nitta and Henderson 1993; Schlais 1984). Observations of bottlenose dolphins stealing bait or catch have also been made in the day handline fishery (palu-ahi) for tuna, the handline fishery for mackerel scad, the troll fishery for billfish and tuna, and the inshore set gillnet fishery (Nitta and Henderson 1993). Nitta and Henderson (1993) indicated that bottlenose dolphins remove bait and catch from handlines used to catch bottomfish off the island of Hawaii and Kaula Island and on several banks of the Northwestern Hawaiian Islands. Fishermen claim interactions with dolphins that steal bait and catch are increasing, including anecdotal reports of bottlenose getting “snagged” (Rizzuto 2007). Interaction rates between dolphins and the NWHI bottomfish fishery have been estimated based on studies conducted in 1990-1993, indicating that an average of 2.67 dolphin interactions, most likely involving bottlenose and rough-toothed dolphins, occurred for every 1000 fish brought on board (Kobayashi and Kawamoto 1995). It is not known whether these interactions result in serious injury or mortality of dolphins. Beginning in the early 1970s the National Marine Fisheries Service received reports of fishermen shooting at bottlenose dolphins to deter them from stealing fish catches (Nitta and Henderson 1993). Nitta and Henderson (1993) also reported that one bottlenose dolphin calf was removed from a small-mesh set gillnet off Maui in 1991 and expressed surprise that bottlenose dolphins are "rarely reported entangled or raiding set gill nets in Hawaii," considering that they so often remove fish from fishing lines. One bottlenose dolphin entangled in a gillnet was reported stranded on Maui in 1998 (NMFS/PIR, unpublished data; Maldini 2003). During 2009, one bottlenose dolphin was photographed off the Kona Coast of the island of Hawaii with a hook and line trailing out of its mouth (pers. comm. Robin Baird), but the responsible fishery is not known. No estimates of human-caused serious injury and mortality are available for nearshore hook-and-line fisheries, because these fisheries and not observed or monitored.

Table 1. Summary of available information on incidental mortality and serious injury of bottlenose dolphins (Hawaii stock) in commercial and gillnet fisheries, within and outside of the U.S. EEZs (McCracken 2009, Forney 2009). Mean annual takes are based on 2004-2008 data unless otherwise indicated; n/a = not available.

Fishery Name	Year	Data Type	Percent Observer Coverage	Mortality and Serious Injury outside of U.S. EEZ			Mortality and Serious Injury within Hawaiian Islands EEZ		
				Observed	Estimated	Mean Annual Takes (CV)	Observed	Estimated (CV)	Mean Annual Takes (CV)
Hawaii-based deep-set longline fishery	2004	observer data	25%	0	0 (-)	0 (-)	0	0 (-)	0.2 (3.1)
	2005		28%	0	0 (-)		0	0 (-)	
	2006		22%	0	0 (-)		1	1 (1.6)	
	2007		20%	0	0 (-)		0	0 (-)	
	2008		22%	0	0 (-)		0	0 (-)	
Hawaii-based shallow-set longline fishery	2004	observer data	100%	0	Same as observed	0.6 (0.0)	0	Same as observed	0.2
	2005		100%	0			0		
	2006		100%	1			0		
	2007		100%	2			1		
	2008		100%	0			0		
Minimum total annual takes within U.S. EEZ waters									0.4 (0.68)[1]

[1] **Takes were all from the Pelagic Stock of bottlenose dolphins**

KAUAI AND NIIHAU STOCK

POPULATION SIZE

A photo-identification study conducted in 2003, 2004 and 2005 identified 102 individual bottlenose dolphins around Kauai and Niihau (Baird et al. 2009). A Lincoln-Peterson mark-recapture analysis of the photo-identification data resulted in an abundance estimate of 147 (CV=0.11) (Baird et al. 2009). This abundance underestimates the total number of bottlenose dolphins around Kauai and Niihau because it only represents individuals with distinguishable marks.

Minimum Population Estimate

The log-normal 20th percentile of the Baird et al. (2009) mark-recapture estimate is 134. This is greater than the number of distinct individuals (102) identified during the photo-identification study.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (134) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a stock of unknown status with no reported fishery mortality or serious injury during the last five years; Wade and Angliss 1997), resulting in a PBR of 1.3 bottlenose dolphins per year.

STATUS OF STOCK

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

OAHU STOCK

POPULATION SIZE

A photo-identification study conducted in 2002, 2003 and 2006 identified 67 individual bottlenose dolphins around Oahu (Baird et al. 2009). A Lincoln-Peterson mark-recapture analysis of the photo-identification data resulted in an abundance estimate of 594 (CV=0.54) (Baird et al. 2009). The estimate only represents individuals with distinguishable marks and does not include individuals from the Northeastern (windward) side of the island. The sample size of encounters (11) was small compared to encounters off other islands; therefore, this estimate is imprecise and should be considered provisional until additional abundance studies can be completed.

Minimum Population Estimate

The log-normal 20th percentile of the Baird et al. (2009) mark-recapture estimate is 388. This is substantially greater than the number of distinct individuals (67) identified during the photo-identification study.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (388) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a stock of unknown status with no reported fishery mortality during the last five years; Wade and Angliss 1997), resulting in a PBR of 3.9 bottlenose dolphins per year.

STATUS OF STOCK

The status of bottlenose dolphins in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this species. It is not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The Oahu stock of bottlenose dolphins is not considered strategic under the 1994 amendments to the MMPA, because there have been no reports of recent mortality or serious injuries of this stock. However, there is no systematic monitoring of near-shore fisheries that may take this species. Insufficient information is available to determine whether the total fishery mortality and serious injury for bottlenose dolphins is insignificant and approaching zero mortality and serious injury rate.

4-ISLANDS REGION STOCK

POPULATION SIZE

A photo-identification study conducted from 2000-2006 identified 98 individual bottlenose dolphins around Maui and Lanai (Baird et al. 2009). A Lincoln-Peterson mark-recapture analysis of the photo-identification data resulted in an abundance estimate of 153 (CV=0.24) (Baird et al. 2009). This abundance underestimates the total number of bottlenose dolphins in the 4-islands region because it only represents individuals with distinguishable marks and does not include individuals from the Northeastern (windward) sides of Maui and Molokai.

Minimum Population Estimate

The log-normal 20th percentile of the Baird et al. (2009) mark-recapture estimate is 125. This is greater than the number of distinct individuals (98) identified during the photo-identification study.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (125) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a stock of unknown status with no reported fishery mortality during the last five years; Wade and Angliss 1997), resulting in a PBR of 1.3 bottlenose dolphins per year.

STATUS OF STOCK

The status of bottlenose dolphins in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this species. It is not listed as “threatened” or “endangered” under the Endangered Species Act (1973), nor as “depleted” under the MMPA. The 4-Islands Region Stock of bottlenose dolphins is not considered strategic under the 1994 amendments to the MMPA, there have been no reports of recent mortality or serious injuries of this stock. However, there is no systematic monitoring of near-shore fisheries that may take this species. Insufficient information is available to determine whether the total fishery mortality and serious injury for bottlenose dolphins is insignificant and approaching zero mortality and serious injury rate.

HAWAII ISLAND STOCK

POPULATION SIZE

A photo-identification study conducted from 2000-2006 identified 69 individual bottlenose dolphins around the island of Hawaii (Baird et al. 2009). A Lincoln-Peterson mark-recapture analysis of the photo-identification data resulted in an abundance estimate of 102 (CV=0.13) (Baird et al. 2009). This abundance underestimates the total number of bottlenose dolphins around the island of Hawaii because it only represents individuals with distinguishable marks and does not include individuals from the Northeastern (windward) side of the island.

Minimum Population Estimate

The log-normal 20th percentile of the Baird et al. (2009) mark-recapture estimate is 91. This is greater than the number of distinct individuals (69) identified during the photo-identification study.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (91) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a stock of unknown status with no reported fishery mortality during the last five years; Wade and Angliss 1997), resulting in a PBR of 0.9 bottlenose dolphins per year.

STATUS OF STOCK

The status of bottlenose dolphins in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this species. It is not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The Hawaii Island Stock of bottlenose dolphins is not considered strategic under the 1994 amendments to the MMPA, because there have been no reports of recent mortality or serious injuries of this stock. However, there is no systematic monitoring of gillnet fisheries that may take this species. Insufficient information is available to determine whether the total fishery mortality and serious injury for bottlenose dolphins is insignificant and approaching zero mortality and serious injury rate.

HAWAIIAN PELAGIC STOCK

POPULATION SIZE

Population estimates have been made in Japanese waters (Miyashita 1993) and the eastern tropical Pacific (Wade and Gerrodette 1993), but it is not known whether these animals are part of the same population that occurs around the Hawaiian Islands. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 3,215 (CV= 0.59) bottlenose dolphins (Barlow 2006), equivalent to a density of 1.31 individuals per 1000 km^2. Applying this density to the 2,464,486 km^2 area of the Pelagic Stock between the 1000m isobath and the Hawaiian Islands EEZ boundary (see Figures 1-2), the stock-specific abundance is estimated as 3,178 (CV=0.59). This is currently the best available abundance estimate for the Hawaiian Pelagic stock.

Minimum Population Estimate

The log-normal 20^{th} percentile of the 2002 line-transect abundance estimate for the Hawaiian Pelagic Stock is 2,006 bottlenose dolphins.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size within the U.S EEZ of the Hawaiian Islands (2,006) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.45 (for a stock of unknown status with a Hawaiian Islands EEZ fishery mortality and serious injury rate between 0.60 and 0.80; Wade and Angliss 1997), resulting in a PBR of 18 bottlenose dolphin per year.

STATUS OF STOCK

The status of bottlenose dolphins in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this species. It is not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The Hawaiian Pelagic Stock of bottlenose dolphins is not considered strategic under the 1994 amendments to the MMPA, because the estimated rate of fisheries related mortality or serious injury within the Hawaiian Islands EEZ (0.4 animals per year) is less than the PBR (18). However, the potential effects of interactions with U.S. and international pelagic longline fisheries in international waters are not known. Insufficient information is available to determine whether the total fishery mortality and serious injury for bottlenose dolphins is insignificant and approaching zero mortality and serious injury rate.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Pantropical spotted dolphins are primarily found in tropical and subtropical waters worldwide (Perrin et al. 2009). Much of what is known about the species in the North Pacific has been learned from specimens obtained in the large directed fishery in Japan and in the eastern tropical Pacific (ETP) tuna purse-seine fishery (Perrin et al. 2009). These dolphins are common and abundant throughout the Hawaiian archipelago, particularly in channels between islands, over offshore banks (e.g. Penguin Banks), and off the lee shores of the islands (see Shallenberger 1981). Recent sighting locations from a 2002 shipboard survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands are shown in Figure 1 (Barlow 2006). Twelve strandings of this species have been documented in Hawaii (Nitta 1991, Maldini et al. 2005). Morphological differences and distribution patterns have been used to establish that the spotted dolphins around Hawaii belong to a stock that is distinct from those in the ETP (Perrin 1975; Dizon et al. 1994; Perrin et al. 1994b). Their possible affinities with other stocks elsewhere in the Pacific have not been investigated.

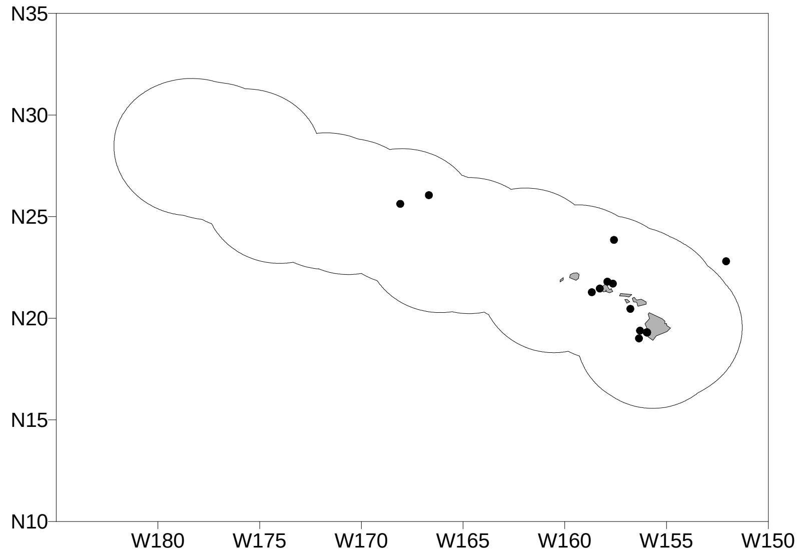

Figure 1. Pantropical spotted dolphin sighting locations during the 2002 shipboard survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ.

Fishery interactions with pantropical spotted dolphins demonstrate that this species also occurs in U.S. EEZ waters around Palmyra Island, but it is not known whether these animals are part of the Hawaiian stock or a separate stock of pantropical spotted dolphins. Based on patterns of movement and population structure observed in other island-associated cetaceans (Norris and Dohl 1980; Norris et al.1994; Baird et al. 2008a, 2008b, 2009, Chivers et al 2007, McSweeney et al. 2007, 2009), the animals around Palmyra Island may represent a separate stock. Efforts are currently underway to obtain additional tissue samples of pantropical spotted dolphins for further studies of population structure in the North Pacific Ocean. Analysis of 177 genetic samples collected throughout the main Hawaiian Islands suggests that spotted dolphins are not mating randomly across the main Hawaiian Islands, and there is clustering of genotypes, into Hawaii, Oahu, and 4-islands area regions, suggesting that individual island-associated stocks may exist (Courbis et al., in prep.). Hawaiian spotted dolphins may be split into separate island-associated stocks pending the outcome of on-going genetic analysis of these samples. For the Marine Mammal Protection Act (MMPA) stock assessment reports, there is a single Pacific management stock including animals found both within the Hawaiian Islands EEZ and in adjacent international waters. Because data on abundance, distribution, and human-caused impacts are largely lacking for international waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005). Spotted dolphins involved in eastern tropical Pacific tuna purse-seine fisheries are managed separately under the MMPA. Information on pantropical spotted dolphins around Palmyra Island will provisionally be included with this stock assessment report, recognizing that separate stock status may be warranted for these animals in the future. Estimates of abundance, potential biological removals, and status determinations will be presented separately for U.S. EEZ waters of the Hawaiian Islands and Palmyra Island.

POPULATION SIZE

Population estimates are available for Japanese waters (Miyashita 1993) and the eastern tropical Pacific

(Wade and Gerrodette 1993). A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 8,978 (CV=0.48) pantropical spotted dolphins (Barlow 2006). This is currently the best available abundance estimate for pantropical spotted dolphins within the Hawaiian Islands EEZ.

No abundance estimates are currently available for pantropical spotted dolphins in U.S. EEZ waters of Palmyra Island; however, density estimates for pantropical spotted dolphins in other Pacific regions can provide a range of likely abundance estimates in this unsurveyed region. Published estimates of pantropical spotted dolphins (animals per km^2) in the Pacific are: 0.0040 (CV=0.48) for the U.S. EEZ of the Hawaiian Islands (Barlow 2006); 0.0407 (CV=0.45) for nearshore waters surrounding the main Hawaiian Islands (Mobley et al. 2000), 0.0678 (CV=0.15) and 0.1064 (CV=0.09) for the eastern tropical Pacific Ocean (Wade and Gerrodette 1993; Ferguson and Barlow 2003), and 0.0731 (CV=0.33) for the eastern tropical Pacific Ocean west of 120°W and north of 5°N (Ferguson and Barlow 2003). Applying the lowest and highest of these density estimates to U.S. EEZ waters surrounding Palmyra Island (area size = 352,821 km^2) yields a range of plausible abundance estimates of 1,414 - 37,525 pantropical spotted dolphins.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate for the Hawaiian Islands EEZ (Barlow 2006) is 6,701 pantropical spotted dolphins. No minimum population estimate is currently available for waters surrounding Palmyra Island, but the pantropical spotted dolphin density estimates from other Pacific regions (Barlow 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 Island EEZ, based on the densities observed elsewhere, range from 964 - 34,792 pantropical spotted dolphins.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Hawaiian pantropical spotted dolphin stock is calculated as the minimum population size within the U.S. EEZ of the Hawaiian Islands (6,701) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no known fishery mortality within the U.S. EEZ of the Hawaiian Islands; Wade and Angliss 1997), resulting in a PBR of 61 pantropical spotted dolphins per year. No separate PBR can presently be calculated for pantropical spotted dolphins within the Palmyra Island EEZ, but based on the range of plausible minimum abundance estimates (964 - 34,792), a recovery factor of 0.50 (for a species of unknown status with no documented mortality and serious injury within the Palmyra Islands EEZ during the past five years; Wade and Angliss 1997), and the default growth rate (½ of 4%), the PBR would likely fall between 9.6 and 347 pantropical spotted dolphins per year.

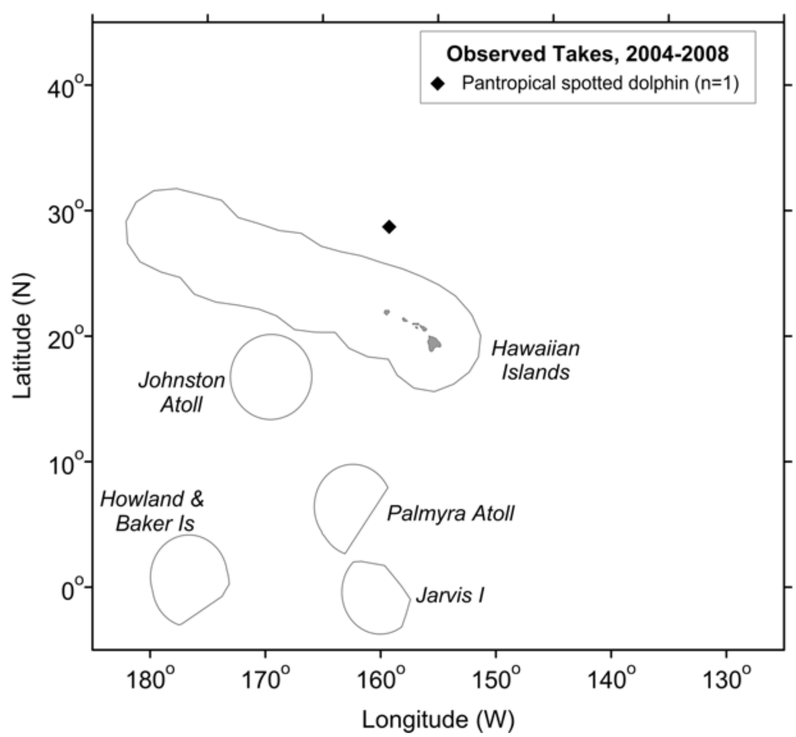

Figure 2. Locations of observed spotted dolphin takes (filled diamonds) in the Hawaii deep-set longline fishery, 2004-2008. Solid lines represent the U.S. EEZ. Set locations in this fishery are summarized in Appendix 1.

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 cetaceans (Perrin et al. 1994a). Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nitta and Henderson 1993). There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2004 and 2008, no pantropical spotted dolphins were observed hooked or entangled in the SSLL fishery (100% observer coverage), and one pantropical spotted dolphin was observed incidentally killed in international waters in the DSLL fishery (20-28% observer coverage) (Forney 2009, McCracken 2009) (Figure 2). Average 5-yr estimates of annual mortality and serious injury for 2004-2008 are 0.5 (CV=0.7) spotted dolphins outside of U.S. EEZs, and none within the Hawaiian Islands EEZ (Table 1, McCracken & Forney 2010).

Commercial and recreational troll fisherman have been observed “fishing” dolphins off the island of Hawaii, including spotted dolphins, in order to catch tuna associated with the animals (Courbis et al. 2009, Rizzuto, 2007, Shallenberger 1981). Anecdotal reports from fisherman indicate that spotted dolphins are occasionally hooked (Rizzuto 1997) and photographs of dolphins suggest animals may be injured by both lines and propeller strikes (Barid unpublished data). 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 pantropical spotted dolphins are involved.

STATUS OF STOCK

The status of pantropical spotted dolphins in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this species. It is not listed as “threatened” or “endangered” under the Endangered Species Act (1973), nor as “depleted” under the MMPA. Given the absence of recent fishery-related mortality or serious injuries within U.S. EEZs, the Hawaiian stock of spotted dolphins is not considered strategic under the 1994 amendments to the MMPA, and the total fishery mortality and serious injury can be considered to be insignificant and approaching zero. However, the potential effect of injuries sustained by pantropical spotted dolphins in U.S. pelagic longline fisheries in international waters is not known, because no abundance estimates or international bycatch estimates are available.

Table 1. Summary of available information on incidental mortality and serious injury of pantropical spotted dolphins (Hawaiian stock) in commercial fisheries, within and outside of the U.S. EEZs (McCracken & Forney 2010). Mean annual takes are based on 2004-2008 data unless otherwise indicated.

				Observed and estimated mortality and serious injury of pantropical spotted dolphins, by EEZ region					
				Outside of U.S. EEZs			Hawaiian Islands EEZ		
Fishery Name	Year	Data Type	Percent Observer Coverage	Obs	Estimated (CV)	Mean Annual Takes (CV)	Obs	Estimated (CV)	Mean Annual Takes (CV)
Hawaii-based deep-set longline fishery	2004 2005 2006 2007 2008	observer data	25% 28% 22% 20% 22%	0 0 0 0 1	0 (-) 0 (-) 0 (-) 0 (-) 2 (0.3)	0.5 (0.7)	0 0 0 0 0	0 (-) 0 (-) 0 (-) 0 (-) 0 (-)	0 (-)
Hawaii-based shallow-set longline fishery	2004 2005 2006 2007 2008	observer data	100% 100% 100% 100% 100%	0 0 0 0 0	Same as observed	0 0 0 0 0	0 0 0 0 0	Same as observed	0
Minimum total annual takes within U.S. EEZ waters					0 (-)				

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Revised 12/03/2012

SPINNER DOLPHIN (*Stenella longirostris longirostris*): Hawaiian Islands Stock Complex- Hawaii Island, Oahu/4-islands, Kauai/Niihau, Pearl & Hermes Reef, Midway Atoll/Kure, Hawaii Pelagic

STOCK DEFINITION AND GEOGRAPHIC RANGE

Six morphotypes within four subspecies of spinner dolphins have been described worldwide in tropical and warm-temperate waters (Perrin et al. 2009). The Gray's (or pantropical) spinner dolphin (*Stenella longirostris longirostris*) is the most widely distributed subspecies and is found in the Atlantic, Indian, central and western Pacific Oceans (Perrin *et al.* 1991). Within the central and western Pacific, spinner dolphins are island-associated and use shallow protected bays to rest and socialize during the day then move offshore at night to feed (Norris and Dohl 1980; Norris *et al.* 1994). They are common and abundant throughout the entire Hawaiian archipelago (Shallenberger 1981; Norris and Dohl 1980; Norris et al. 1994), and 26 strandings have been reported (Maldini et al. 2005). Sighting locations from a 2002 shipboard survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the main Hawaiian Islands (Barlow 2006) are shown in Figure 1. There were no on-effort sightings of spinner dolphins during the 2010 survey of the Hawaiian Islands (NMFS unpublished data).

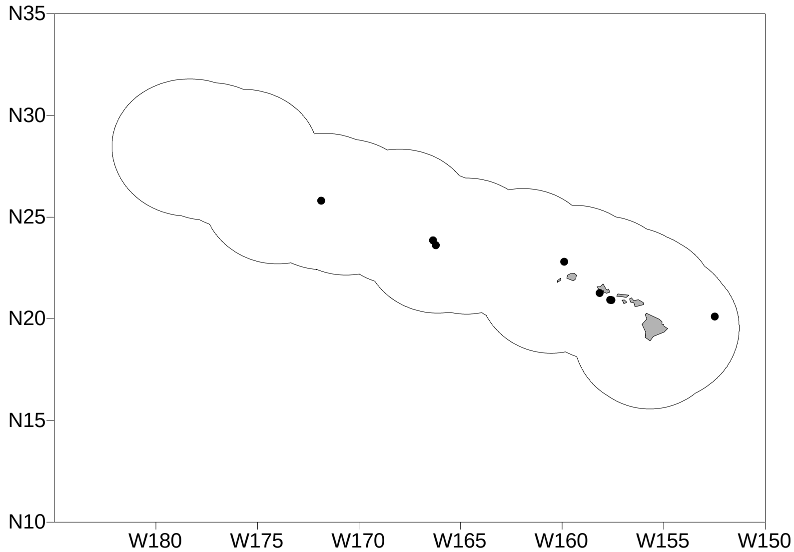

Figure 1. Spinner dolphin sighting locations during the 2002 shipboard cetacean survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006; see Appendix 2 for details on timing and location of survey effort). Outer line indicates approximate boundary of survey area and U.S. EEZ.

Hawaiian spinner dolphins belong to a stock that is separate from animals in the eastern tropical Pacific (Perrin 1975; Dizon et al. 1994). The Hawaiian form is referable to the subspecies *S. longirostris longirostris*, which occurs pantropically (Perrin 1990). Genetic structure of spinner dolphins in the Hawaiian archipelago is evident between spinner dolphins sampled at five different islands/atolls: Hawaii, Oahu/4-islands, Kauai/Niihau, Pearl and Hermes Reef, Midway Atoll/Kure (Andrews 2009, Andrews et al. 2010). These distinctions are supported by available photo-ID and animal movement data (Karczmarski et al. 2005). In particular, mitochondrial and microsatellite DNA data from individuals sampled along the Kona Coast of Hawaii Island show marked distinctions from individuals sampled at all other Hawaiian Islands including Maui (Andrews

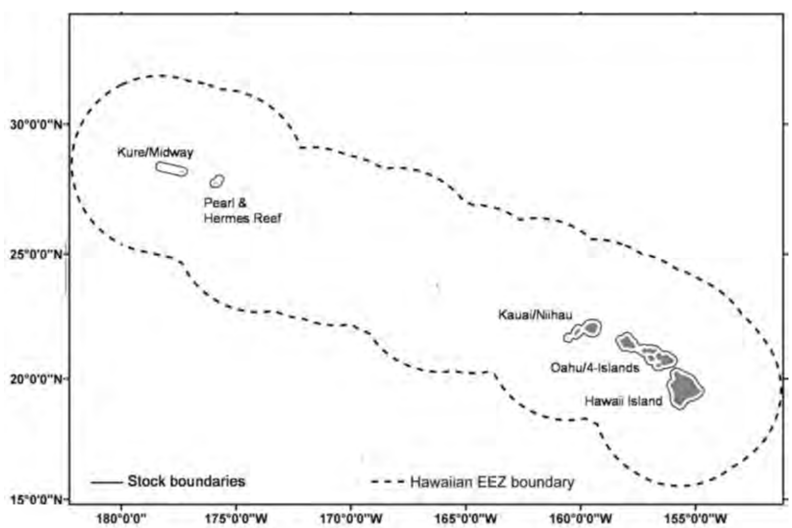

Figure 2. Spinner dolphin stock boundaries. Animals outside of the defined island areas represent the pelagic stock range

2009, Andrews et al. 2010). Hill et al. (2010) suggest an offshore boundary for each island-associated stock at 10 nmi from shore based on anecdotal accounts of spinner dolphin distribution. Analysis of individual spinner dolphin movements suggest that few individuals move long distances (from one main Hawaiian Island to another) and no dolphins have been seen farther than 10 nmi from shore (Hill et al. 2011). Norris et al. (1994) suggested that spinner dolphins may move between leeward and windward shores of the main Hawaiian Islands seasonally, and this does appear to be supported by recent analyses of abundance at Hawaii Island (Hill et al. 2011). For the Marine Mammal Protection Act (MMPA) stock assessment reports, there are six stocks found within the U.S. EEZ of the Hawaiian Islands: 1) Hawaii Island, 2) Oahu/4-Islands, 3) Kauai/Niihau, 4) Pearl & Hermes Reef, 5) Kure/Midway, and 6) Hawaii Pelagic, including animals found both within the Hawaiian Islands EEZ (outside of island-associated boundaries) and in adjacent international waters. Spinner dolphins in the eastern tropical Pacific that may interact with tuna purse-seine fisheries are managed separately under the MMPA.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Information on fishery-related mortality of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaii-based fisheries cause marine mammal mortality and serious injury in other U.S. fisheries. Gillnets appear to entangle marine mammals wherever they are used, and float lines from lobster or fish traps and longlines occasionally entangle cetaceans (Perrin et al. 1994). In Hawaii, some entanglements of spinner dolphins have been observed (Nitta and Henderson 1993; NMFS/PIR, unpublished data), but no estimate of annual human-caused mortality and serious injury is available because the nearshore fisheries are not observed or monitored.

Interactions with cetaceans have been reported for all Hawaii pelagic fisheries (Nitta and Henderson 1993). There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. However, there are fishery closures within 25-75 miles from shore in the MHI and 50 miles from shore in the NWHI where insular or island-associated species occur. Between 2006 and 2010, no spinner dolphins were observed hooked or entangled in the SSLL fishery (100% observer coverage) or the DSLL fishery (20-28% observer coverage) (McCracken 2011).

Interaction rates between dolphins and the former NWHI bottomfish fishery were estimated based on studies conducted in 1990-1993, indicating an average of 2.67 dolphin interactions occurred for every 1000 fish brought on board, most likely involving bottlenose and rough-toothed dolphins (Kobayashi and Kawamoto 1995). This fishery was observed from 2003 through 2005 at 18-25% coverage, during which time no incidental takes of cetaceans were reported.

<u>HAWAII ISLAND STOCK</u>

POPULATION SIZE

Over the past few decades abundance estimates have been produced from studies along the Kona coast of Hawaii Island. Norris et al. (1994) photo-identified 192 individuals along the west coast of Hawaii and estimated 960 animals for this area in 1979-1980. Östman (1994) photo-identified 677 individual spinner dolphins in the same area from 1989 to 1992. Using the same estimation procedures as Norris et al. (1994), Östman (1994) estimated a population size of 2,334 for his study area along the Kona coast of Hawaii. As part of the Marine Mammal Research Program of the Acoustic Thermometry of Ocean Climate (ATOC) study, a total of twelve aerial surveys were conducted within 25 nmi of the main Hawaiian Islands in 1993, 1995 and 1998. An abundance estimate of 3,184 (CV=0.37) spinner dolphins was calculated from the combined survey data (Mobley et al. 2000), now representing the Kauai/Niihau, Oahu/4-Islands, and Hawaii Island stocks. Those data are well over 8 years old and abundance estimates are out of date. New mark-recapture estimates based on photo-identification studies have resulted in new seasonal abundance estimates for the Hawaii Island stock. Closed capture models provide three seasonal estimates for the leeward coast of Hawaii Island for different time periods: 790 (CV = 0.17) for May to July, 2003; 280 (CV = 0.21) for January to March, 2005; and 205 (CV = 0.16) for January to March, 2006 (Hill et al. 2011). Considerable seasonal variation in spinner dolphin occurrence on the leeward versus south and east sides of the island is thought to occur, with lower abundance off the leeward Kona coast in the winter, potentially due to increased wind and swell in that region (Norris et al. 1994). Because estimates are confined to a small geographic region along the leeward coast, the summer estimate (May to July 2003) is likely to provide the best representation of the number of animals resident to Hawaii Island, though it is likely still an underestimate.

Minimum Population Estimate

The log-normal 20th percentile of the 2003 abundance summer estimate for the leeward coast of Hawaii Island is 685 spinner dolphins. This minimum estimate is several years old and may not represent the current population. Moreover, it is likely negatively-biased, as it represents a minimum estimate of the number of dolphins, accounting only for those along the leeward coast in 2003; no data were included from the rest of Hawaii Island.

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. A default level of 4% is assumed for maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Hawaii Island stock is calculated as the minimum estimate of population size (685) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no estimated fishery mortality or serious injury within the U.S. EEZ of the Hawaiian Islands; Wade and Angliss 1997) resulting in a PBR of 6.9 spinner dolphins per year.

STATUS OF STOCK

The status of Hawaii Island spinner dolphins relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance for this stock. A habitat issue of increasing concern is the potential effect of swim-with-dolphin programs and other tourism activities on spinner dolphins around the main Hawaiian Islands (Danil et al. 2005, Courbis & Timmel 2009). All Hawaiian spinner dolphin stocks are potentially exposed to high levels of Naval sonar and frequent detonations during training exercises. The sensitivity of spinner dolphins to these sound levels is unknown and therefore the impact of these exercises on spinner dolphin stocks is unknown. Spinner dolphins are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The Hawaii Island stock of spinner dolphins is not considered a strategic stock under the MMPA, because the estimated rate of mortality and serious injury within the Hawaiian Islands EEZ is zero, although coastal fisheries that are most likely to interact with this stock are unmonitored. Insufficient information is available to determine whether the total fishery mortality and serious injury for this Hawaii Island spinner dolphin stock is insignificant and approaching zero mortality and serious injury rate.

OAHU/4-ISLANDS STOCK

POPULATION SIZE

As part of the Marine Mammal Research Program of the Acoustic Thermometry of Ocean Climate (ATOC) study, a total of twelve aerial surveys were conducted within 25 nmi of the main Hawaiian Islands in 1993, 1995 and 1998. An abundance estimate of 3,184 (CV=0.37) spinner dolphins was calculated from the combined survey data (Mobley et al. 2000), now representing the Kauai/Niihau, Oahu/4-Islands, and Hawaii Island stocks. Those data are well over 8 years old and abundance estimates from these data are out of date. New mark-recapture estimates based on photo-identification studies have resulted in new seasonal abundance estimates for the Oahu/4-Islands stock. Closed-capture models provide two separate estimates for the leeward coast of Oahu representing different time periods: 160 (CV = 0.14) for June to July, 2002; and 355 (CV = 0.09) for July to September 2007 (Hill et al. 2011). The 2002 estimate is now more than 8 years old and therefore will no longer be used based on NMFS Guidelines for Assessing Marine Mammal Stocks (NMFS 2005). The 2007 estimate is the best-available estimate of the population size of the Oahu/4-Islands stock; however, it is likely an underestimate as it includes only dolphins found off the leeward coast of Oahu, and does not account for individuals that may spend most of their time along other parts of Oahu or somewhere else in the 4-Islands area.

Minimum Population Estimate

The log-normal 20th percentile of the 2007 abundance estimate for the summertime leeward coast of Oahu and the 4-Islands area is 329 spinner dolphins. This minimum estimate is several years old and may not represent the current population. Moreover, it is likely negatively-biased, as it represents a minimum estimate of the number of dolphins, accounting only for those along the leeward Oahu coast in 2007; no data were included from the rest of the stock range.

Current Population Trend

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. A default level of 4% is assumed for maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Oahu/4-Islands stock is calculated as the minimum estimate of population size (329) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no estimated fishery mortality or serious injury within the U.S. EEZ of the Hawaiian Islands; Wade and Angliss 1997) resulting in a PBR of 3.3 spinner dolphins per year.

STATUS OF STOCK

The status of Oahu/4-Islands spinner dolphins relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance for this stock. A habitat issue of increasing concern is the potential effect of swim-with-dolphin programs and other tourism activities on spinner dolphins around the main Hawaiian Islands (Danil et al. 2005, Courbis & Timmel 2009). All Hawaiian spinner dolphin stocks are potentially exposed to high levels of Naval sonar and frequent detonations during training exercises. The sensitivity of spinner dolphins to these sound levels is unknown and therefore the impact of these exercises on spinner dolphin stocks is unknown. Spinner dolphins are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The Oahu/4-Islands stock of spinner dolphins is not considered a strategic stock under the MMPA, because the estimated rate of mortality and serious injury within the Hawaiian Islands EEZ is zero, although coastal fisheries that are most likely to interact with this stock are unmonitored. Insufficient data exist to determine whether the total fishery mortality and serious injury for this Oahu/4-Islands spinner dolphin stock is insignificant and approaching zero mortality and serious injury rate.

KAUAI/NIIHAU STOCK

POPULATION SIZE

As part of the Marine Mammal Research Program of the Acoustic Thermometry of Ocean Climate (ATOC) study, a total of twelve aerial surveys were conducted within 25 nmi of the main Hawaiian Islands in 1993, 1995 and 1998. An abundance estimate of 3,184 (CV=0.37) spinner dolphins was calculated from the combined survey data (Mobley et al. 2000), now representing the Kauai/Niihau, Oahu/4-Islands, and Hawaii Island stocks. Those data are well over 8 years old and abundance estimates from these data are out of date. New mark-recapture estimates based on photo-identification studies have resulted in a new seasonal abundance estimate for the Kauai/Niihau stock. Closed capture models provide an estimate of 601 (CV = 0.20) spinner dolphins for the leeward coast of Kauai for the period October to November 2005. This estimate is considered the best-available estimate of the population size of the Kauai/Niihau stock; however, it is likely an underestimate as it includes only dolphins found off the leeward coast of Kauai, and does not account for individuals that may spend most of their time along other parts of Kauai, Niihau, or Kaula Rock.

Minimum Population Estimate

The log-normal 20th percentile of the leeward Kauai abundance estimate is 509 spinner dolphins. This minimum estimate is several years old and may not represent the current population. Moreover, it is likely negatively-biased, as it represents a minimum estimate of the number of dolphins, accounting only for those along the leeward Kauai coast in 2005; no data were included from the rest of the stock range near Niihau or Kaula Rock.

Current Population Trend

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. A default level of 4% is assumed for maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Kauai/Niihau stock is calculated as the minimum population size (509) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no estimated fishery mortality or serious injury within the U.S. EEZ of the Hawaiian Islands; Wade and Angliss 1997 resulting in a PBR of 5.1 spinner dolphins per year.

STATUS OF STOCK

The status of Kauai/Niihau spinner dolphins relative to OSP is unknown, and there are insufficient data to evaluate abundance trends. A habitat issue of increasing concern is the potential effect of swim-with-dolphin programs and other tourism activities on spinner dolphins around the main Hawaiian Islands (Danil et al. 2005, Courbis & Timmel 2009). All Hawaiian spinner dolphin stocks are potentially exposed to high levels of Naval sonar and frequent detonations during training exercises. The sensitivity of spinner dolphins to these sound levels is unknown and therefore the impact of these exercises on spinner dolphin stocks is unknown. Spinner dolphins are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The Kauai/Niihau stock of spinner dolphins is not considered a strategic stock under the MMPA, because the estimated rate of mortality and serious injury within the Hawaiian Islands EEZ is zero, although coastal fisheries that are most likely to interact with this stock are unmonitored. Insufficient data are available to determine whether the total fishery mortality and serious injury for this Kauai/Niihau spinner dolphin stock is insignificant and approaching zero mortality and serious injury rate.

PEARL & HERMES REEF STOCK

POPULATION SIZE

There is no information on the abundance of the Pearl & Hermes Reef stock of spinner dolphins. A photo-identification catalog of individual spinner dolphins from this stock is available, though inadequate survey effort and low re-sighting rates prevent robust estimation of abundance.

Minimum Population Estimate

There is no information on the minimum abundance of the Pearl & Hermes Reef stock of spinner dolphins.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate for this species in Hawaiian waters. A default level of 4% is assumed for maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Pearl & Hermes Reef stock is calculated as the minimum population size times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no estimated fishery mortality or serious injury within the U.S. EEZ of the Hawaiian Islands; Wade and Angliss 1997). Because there is no minimum population estimate available for this stock the PBR for Pearl & Hermes Reef stock of spinner dolphins is undetermined.

STATUS OF STOCK

The status of Pearl & Hermes Reef spinner dolphins relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance for this stock. Spinner dolphins are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The Pearl & Hermes Reef stock of spinner dolphins is not considered a strategic stock under the MMPA, because the estimated rate of mortality and serious injury within the Hawaiian Islands EEZ is zero. Insufficient data are available to determine whether the total fishery mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate.

MIDWAY ATOLL/KURE STOCK

POPULATION SIZE

In the Northwestern Hawaiian Islands, a multi-year photo-identification study at Midway Atoll resulted in a population estimate of 260 spinner dolphins based on 139 identified individuals (Karczmarski et al. 1998). This abundance estimate for the Midway Atoll/Kure stock of spinner dolphins is now more than 8 years old and therefore will no longer be used based on NMFS Guidelines for Assessing Marine Mammal Stocks (NMFS 2005). A 2010 shipboard line-transect survey within the Hawaiian EEZ resulted in a single off-effort sighting of spinner dolphins at Kure Atoll. This sighting cannot be used within a line-transect framework; however, photographs of individuals may be used in the future to estimate the abundance of spinner dolphin at Midway Atoll/Kure using mark-recapture methods.

Minimum Population Estimate

The minimum abundance estimate for the Midway Atoll/Kure stock is now more than 8 years old and therefore will no longer be used (NMFS 2005). There is no current minimum population size available for this stock.

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. A default level of 4% is assumed for maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Midway Atoll/Kure stock is calculated as the minimum population size <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 estimated fishery mortality or serious injury within the U.S. EEZ of the Hawaiian Islands; Wade and Angliss 1997). The PBR for the Midway Atoll/Kure stock of spinner dolphins is undetermined because no minimum population estimate is available for this stock.

STATUS OF STOCK

The status of Midway Atoll/Kure spinner dolphins relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Spinner dolphins are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The Midway Atoll/Kure stock of spinner dolphins is not considered strategic under the MMPA, because the estimated rate of mortality and serious injury within the Hawaiian Islands EEZ is zero. Insufficient data are available to determine whether the total fishery mortality and serious injury for this Midway Atoll/Kure spinner dolphin stock is insignificant and approaching zero mortality and serious injury rate.

<u>HAWAII PELAGIC STOCK</u>

POPULATION SIZE

A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 3,351 (CV=0.74) spinner dolphins (Barlow 2006); however, this estimate assumed a single Hawaiian Islands stock. This estimate for the Hawaiian EEZ is ≥ 8 years old and therefore will no longer be used based on NMFS Guidelines for Assessing Marine Mammal Stocks (NMFS 2005). A 2010 shipboard line-transect survey within the Hawaiian EEZ did not result in any sightings of pelagic spinner dolphins.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate for all stocks combined (Barlow 2006) is 1,920 spinner dolphins, however the minimum abundance estimate for the entire Hawaiian EEZ is ≥ 8 years old and will no longer be used (NMFS 2005). No minimum estimate of abundance is available for this stock, as there were no sightings of pelagic spinner dolphins during a 2010 shipboard line-transect survey of the Hawaiian EEZ.

Current Population Trend

No data on current population trend are available.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate for this species in Hawaiian waters. A default level of 4% is assumed for maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

Because there is no minimum population size estimate for Hawaii pelagic spinner dolphins, the potential biological removal (PBR) is undetermined.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Interactions with cetaceans have been reported for all Hawaii pelagic fisheries (Nitta and Henderson 1993). There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2006 and 2010, no spinner dolphins were observed hooked or entangled in the SSLL fishery (100% observer coverage) or the DSLL fishery (20-28% observer coverage) (McCracken 2011).

STATUS OF STOCK

The status of Hawaii pelagic spinner dolphins relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance for this stock. Spinner dolphins are not listed as “threatened” or “endangered” under the Endangered Species Act (1973), nor as “depleted” under the MMPA. The Hawaii pelagic stocks of spinner dolphins is not considered a strategic stock under the MMPA, because the estimated rate of mortality and serious injury within the Hawaiian Islands EEZ is zero. However, there is no systematic monitoring of nearshore fisheries that may take animals from the pelagic stock. Insufficient information is available to determine whether the total fishery mortality and serious injury for this Hawaii pelagic spinner dolphin stock is insignificant and approaching zero mortality and serious injury rate.

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Revised 01/15/2011

SPINNER DOLPHIN (*Stenella longirostris longirostris*): American Samoa Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Gray's spinner dolphins (*Stenella longirostris longirostris*) are the most widely distributed subspecies of spinner dolphins and are found in tropical and subtropical waters of the Atlantic, Indian, central and western Pacific Oceans (Perrin et al. 1991, Norris et al. 1994, Oremus *et al.* 2007, Johnston et al. 2008). Spinner dolphins are considered common in American Samoa (Reeves et al. 1999). During small-boat surveys from 2003 to 2006 in the waters surrounding the island of Tutuila, the spinner dolphin was the most frequently encountered species (i.e., 34 of 52 sightings) and was found in waters with a mean depth of 44m (Johnston et al. 2008). Photo-identification data collected during the surveys indicate the presence of a resident population of spinner dolphins in the waters surrounding Tutuila (Johnston et al. 2008). Approximately 1/3 of the individuals within the photo-id catalog were sighted in multiple years (Johnston et al. 2008). In addition, some of these individuals demonstrated strong site fidelity and were encountered within only a few kilometers from one year to the next (Johnston et al. 2008). During a shipboard survey in 2006 spinner dolphins were also encountered just south of the island of Ta‘u, American Samoa (Johnston et al. 2008).

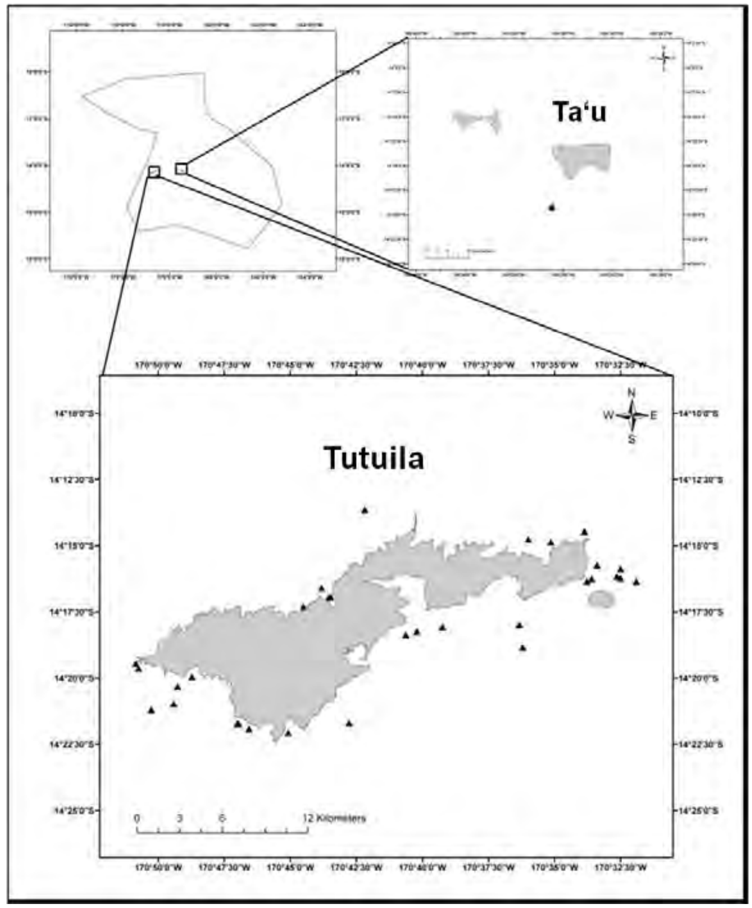

Figure 1. Spinner dolphin sightings from visual sighting surveys, 2003-2006 (Johnston et al 2008).

Genetic analyses of biopsy samples collected during the 2003-2006 small boat surveys around Tutuila indicate that spinner dolphins in American Samoa are distinct from those of the Hawaiian Archipelago. Pairwise F-statistical analyses revealed significant ($p<0.001$) genetic distinction, at both mtDNA and microsatellite loci, between spinner dolphins sampled in American Samoa and those sampled in the Hawaiian Islands (Johnston et al. 2008, Andrews 2009). For the Marine Mammal Protection Act (MMPA) stock assessment reports, there are eight Pacific management stocks, six of these extend from the Hawaiian archipelago to 10 nmi offshore: 1) Kure/Midway, 2) Pearl and Hermes Reef, 3) French Frigate Shoals, 4) Kauai/Niihau, 5) Oahu/4-Islands, and 6) Hawaii Island, The Hawaii Pelagic Stock, which includes animals within the U.S. EEZ of the Hawaiian Islands, but more than 10 nmi from the shore where insular populations exist, and 8) the American Samoa Stock, which include animals inhabiting the EEZ waters around American Samoa (this report). Spinner dolphins involved in eastern tropical Pacific tuna purse-seine fisheries are managed separately under the MMPA.

POPULATION SIZE

No abundance estimates are currently available for spinner dolphins in U.S. EEZ waters of American Samoa; however, density estimates for spinner dolphins in other tropical Pacific regions can provide a range of likely abundance estimates in this unsurveyed region. Published estimates of spinner dolphins (animals per km^2) in the Pacific are: 0.0014 (CV=0.74) for the U.S. EEZ of the Hawaiian Islands (Barlow 2006); 0.0443 (CV=0.37) for nearshore waters surrounding the main Hawaiian Islands (Mobley et al. 2000), 0.0532 (CV=0.19) and 0.0473

(CV=0.15) for the eastern tropical Pacific Ocean (Wade and Gerrodette 1993; Ferguson and Barlow 2003), and 0.1280 (CV=0.27) for eastern tropical Pacific waters west of 120^{o}W and north or south of 10^o, a region with similar oceanographic conditions to those around American Samoa. Applying the lowest and highest of these density estimates to U.S. EEZ waters surrounding American Samoa (area size = 404,578 km^2) yields a range of plausible abundance estimates of 553 – 51,773 spinner dolphins.

Minimum Population Estimate
No minimum population estimate is currently available for waters surrounding American Samoa, but the spinner dolphin density estimates from other tropical Pacific regions (Barlow 2003, Mobley et al. 2000, Wade and Gerrodette 1993, Ferguson and Barlow 2003, see above) can provide a range of likely values. The lognormal 20th percentiles of plausible abundance estimates for the American Samoa EEZ, based on the densities observed elsewhere, range from 317 – 41,483 spinner dolphins.

Current Population Trend
No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES
No data are available on current and maximum net productivity rate in American Samoan waters.

POTENTIAL BIOLOGICAL REMOVAL
No PBR can presently be calculated for spinner dolphins within the American Samoa EEZ, but based on the range of plausible minimum abundance estimates (317 – 41,483), a recovery factor of 0.50 (for a species of unknown status with no fishery mortality and serious injury within the American Samoa EEZ; Wade and Angliss 1997), and the default growth rate (½ of 4%), the PBR would likely fall between 3.2 and 415 spinner dolphins per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY
Fishery Information
Information on fishery-related mortality of cetaceans in American Samoan waters is limited, but the gear types used in American Samoa's fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Gillnets appear to capture marine mammals wherever they are used, and float lines from lobster traps and longlines can be expected to occasionally entangle whales (Perrin et al. 1994). The primary fishery in American Samoa is the commercial pelagic longline fishery that targets tunas, which was introduced in 1995 (Levine and Allen 2009). In 2008, there were 28 federally permitted vessels within the longline fishery in American Samoa (Levine and Allen 2009). The fishery has been monitored since March 2006 under a mandatory observer program, which records all interactions with protected species (Pacific Islands Regional Office 2009). No interactions with spinner dolphins have been recorded. Prior to 1995, bottomfishing and trolling were the primary fisheries in American Samoa but became less prominent after longlining was introduced (Levine and Allen 2009). Nearshore subsistence fisheries include spear fishing, rod and reel, collecting, gill netting, and throw netting (Craig 1993, Levine and Allen 2009). Information on fishery-related mortality of cetaceans in the nearshore fisheries is unknown, but the gear types used in American Samoan fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Gillnets appear to capture marine mammals wherever they are used. Although boat-based nearshore fisheries have been randomly monitored since 1991, by the American Samoa Department of Marine and Wildlife Sources (DMWR), no estimates of annual human-caused mortality and serious injury of cetaceans are available.

STATUS OF STOCK
The status of spinner dolphins in American Samoan waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. No habitat issues are known for spinner dolphins in American Samoa. Spinner dolphins are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The American Samoan stock of spinner dolphins is not considered a strategic stock under the 1994 amendments to the MMPA because the estimated rate of mortality and serious injury within the American Samoa EEZ is zero. Insufficient information is available to determine whether the total fishery mortality and serious injury for spinner dolphins is insignificant and approaching zero mortality and serious injury rate.

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STRIPED DOLPHIN (*Stenella coeruleoalba*): Hawaiian Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Striped dolphins are found in tropical to warm-temperate waters throughout the world (Perrin et al. 2009). They have been documented in the Hawaiian Islands from 20 strandings (Nitta 1991, Maldini et al. 2005), although sightings have historically been infrequent (Shallenberger 1981, Mobley et al. 2000). A comprehensive shipboard survey of the Hawaiian Exclusive Economic Zone (EEZ), resulted in 15 sightings of striped dolphins (Figure 1; Barlow 2006).

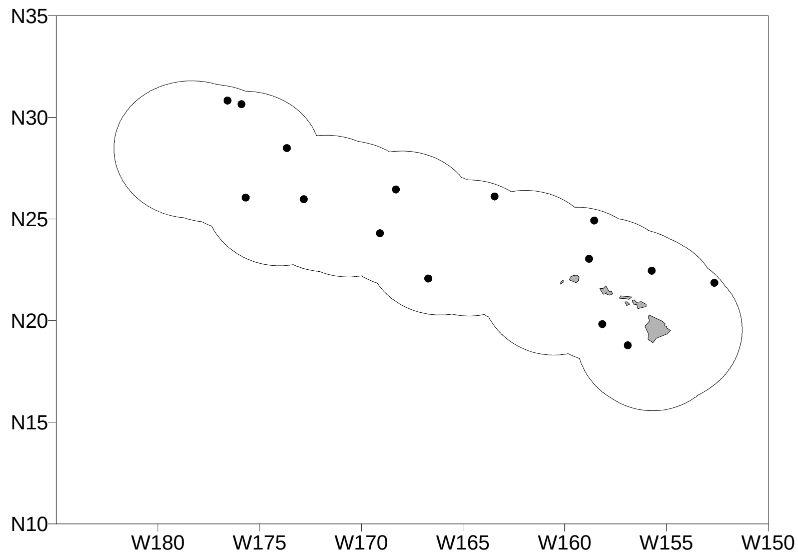

Figure 1. Striped dolphin sighting locations during the 2002 shipboard survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ.

Striped dolphins have been intensively exploited in the western North Pacific, where three migratory stocks are provisionally recognized (Kishiro and Kasuya 1993). In the eastern tropical Pacific all striped dolphins are provisionally considered to belong to a single stock (Dizon et al. 1994). For the Marine Mammal Protection Act (MMPA) stock assessment reports, striped dolphins within the Pacific U.S. EEZ are divided into two discrete, non-contiguous areas: 1) waters off California, Oregon and Washington, and 2) waters around Hawaii (this report), including animals found both within the Hawaiian Islands EEZ and in adjacent international waters. Because data on abundance, distribution, and human-caused impacts are largely lacking for international waters, the status of all stocks combined is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005). Striped dolphins involved in eastern tropical Pacific tuna purse-seine fisheries are managed separately under the MMPA.

POPULATION SIZE

Population estimates are available for Japanese waters (Miyashita 1993) and the eastern tropical Pacific (Wade and Gerrodette 1993), but it is not known whether any of these animals are part of the same population that occurs around the Hawaiian Islands. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 13,143 (CV=0.46) striped dolphins (Barlow 2006). This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate (Barlow 2006) is 9,088 striped dolphins.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size within the U.S. EEZ of the Hawaiian Islands (9,088) <u>times</u> one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.45 (for a stock of unknown status with a Hawaiian Islands EEZ fishery mortality and serious injury rate CV between 0.60 and 0.80; Wade and Angliss 1997), resulting in a PBR of 82 striped dolphins per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Information on fishery-related mortality and serious injury of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Gillnets appear to capture marine mammals wherever they are used, and float lines from lobster traps and longlines can be expected to occasionally entangle cetaceans (Perrin et al. 1994).

Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nitta and Henderson 1993). There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2004 and 2008, one striped dolphin was seriously injured on the high seas in the SSLL fishery (100% observer coverage), and one striped dolphin was killed within the Hawaiian Islands EEZ in the DSLL fishery (20-28% observer coverage) (Figure 2, Forney 2009, McCracken & Forney 2010). Average 5-yr estimates of annual mortality and serious injury for 2004-2008 are zero dolphins outside of U.S. EEZs, and 0.9 (CV=0.6) within the Hawaiian Islands EEZ (Table 1).

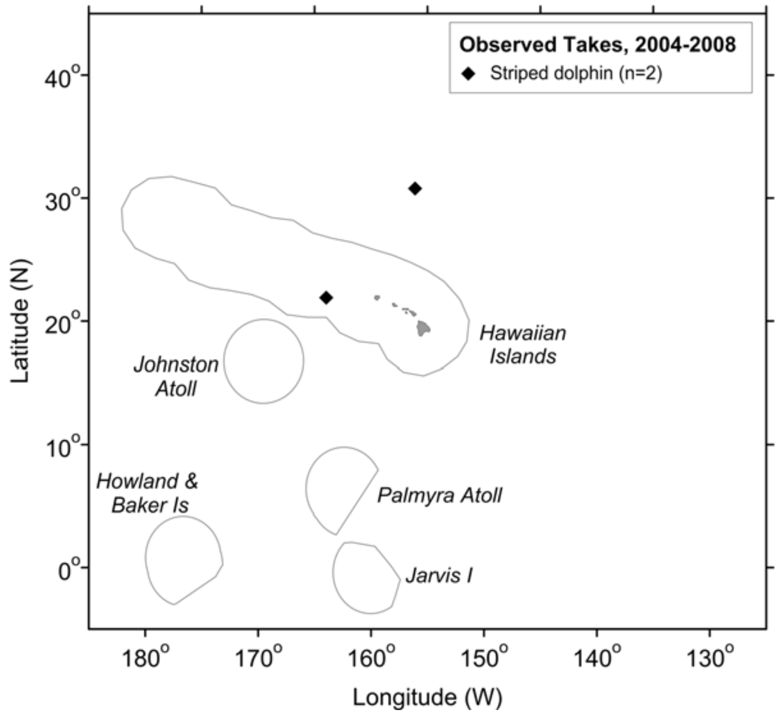

Figure 2. Locations of striped dolphin takes (filled diamonds) in Hawaii-based longline fisheries, 2004-2008 Solid lines represent the U.S. EEZs. Fishery descriptions are provided in Appendix 1.

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

STATUS OF STOCK

The status of striped dolphins in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this species. It is not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The Hawaiian stock of striped dolphins is not considered strategic under the 1994 amendments to the MMPA, because the estimated rate of fisheries related mortality and serious injury within the Hawaiian Islands EEZ (0.9 animals per year) is less than the PBR (82). Total fishery mortality and serious injury for striped dolphins can be considered insignificant and approaching zero, because the average annual takes are less than 10% of the PBR.

Table 1. Summary of available information on incidental mortality and serious injury of striped dolphin (Hawaii stock) in commercial fisheries, within and outside of U.S. EEZs (McCracken & Forney 2010). Mean annual takes are based on 2004-2008 data unless otherwise indicated.

Fishery Name	Year	Data Type	Percent Observer Coverage	Mortality and Serious Injury outside of U.S. EEZ			Mortality and Serious Injury within Hawaiian Islands EEZ		
				Observed	Estimated	Mean Annual Takes (CV)	Observed	Estimated (CV)	Mean Annual Takes (CV)
Hawaii-based deep-set longline fishery	2004 2005 2006 2007 2008	observer data	25% 28% 22% 20% 22%	0 0 0 0 0	0 (-) 0 (-) 0 (-) 0 (-) 0 (-)	0 (-)	0 0 1 0 0	0 (-) 0 (-) 5 (0.3) 0 (-) 0 (-)	0.9 (0.6)
Hawaii-based shallow-set longline fishery	2004 2005 2006 2007 2008	observer data	100% 100% 100% 100% 100%	0 0 0 0 1	Same as observed	0.2	0 0 0 0 0	0 0 0 0 0	0
Minimum total annual takes within U.S. EEZ waters									0.9 (0.6)

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Fraser's dolphins are distributed worldwide in tropical waters (Dolar 2009 in Perrin et al. 2009). They have only recently been documented within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands, during a 2002 cetacean survey (Barlow 2006, Figure 1). No strandings of Fraser's dolphins have been documented in the Hawaiian Islands (Nitta 1991; Maldini et al. 2005), though there is one sighting off the island of Hawaii from April 2008 (Baird unpublished). For the Marine Mammal Protection Act (MMPA) stock assessment reports, there is a single Pacific management stock including animals found both within the Hawaiian Islands EEZ and in adjacent international waters. Because data on abundance, distribution, and human-caused impacts are largely lacking for international waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

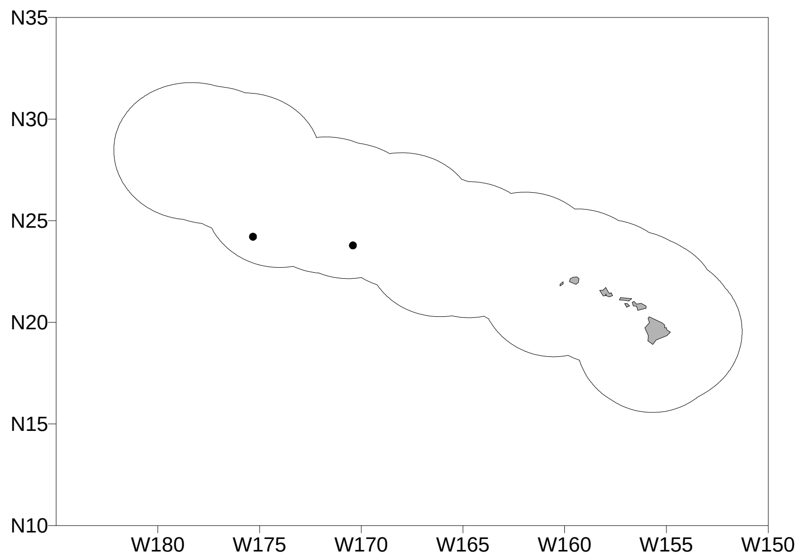

Figure 1. Fraser's dolphin sighting locations during the 2002 shipboard cetacean survey of U.S. waters surrounding the Hawaiian Islands (Barlow 2006; see Appendix 2 for details on timing and location of survey effort). Outer line indicates approximate boundary of survey area and U.S. EEZ.

POPULATION SIZE

Population estimates for Fraser's dolphins have been made in the eastern tropical Pacific (Wade and Gerrodette 1993), but it is not known whether these animals are part of the same population that occurs around the Hawaiian Islands and in the central North Pacific. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 10,226 (CV=1.16) Fraser's dolphins (Barlow 2006). This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate (Barlow 2006) is 4,700 Fraser's dolphins.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate for the Hawaiian stock of Fraser's dolphin.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock of Fraser's dolphin is calculated as the minimum population size within the U.S. EEZ of the Hawaiian Islands (4,700) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a stock of unknown status with no known fishery mortality or serious injury within the Hawaiian Islands EEZ; Wade and Angliss 1997), resulting in a PBR of 47 Fraser's dolphins per year.

HUMAN CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Information on fishery-related mortality and serious injury of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Gillnets appear to capture marine mammals wherever they are used, and float lines from lobster traps and longlines can be expected to occasionally entangle cetaceans (Perrin et al. 1994). Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nitta and Henderson 1993), but none of these interactions are known to have involved Fraser's dolphins. There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2004 and 2008, no Fraser's dolphins were observed hooked or entangled in the SSLL fishery (100% observer coverage) or the DSLL fishery (20-28% observer coverage) (McCracken & Forney 2010).

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 Fraser's dolphins are involved.

STATUS OF STOCK

The status of Fraser's dolphins in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this species. It is not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. Given the absence of recent fishery-related mortality or serious injuries, the Hawaiian stock of Fraser's dolphins is not considered strategic under the 1994 amendments to the MMPA, and the total fishery mortality and serious injury can be considered to be insignificant and approaching zero.

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Revised 01/15/2011

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Melon-headed whales are found in tropical and warm-temperate waters throughout the world. The distribution of reported sightings suggests that the oceanic habitat of this species is primarily equatorial waters (Perryman et al. 1994). Small numbers have been taken in the eastern tropical Pacific, and they are occasionally killed in direct fisheries in Japan and elsewhere in the western Pacific. Large herds are seen regularly in Hawaiian waters, especially off the Waianae coast of Oahu, the north Kohala coast of Hawaii, and the leeward coast of Lanai (Shallenberger 1981). A comprehensive shipboard survey of the Hawaiian Exclusive Economic Zone (EEZ), resulted in only one sighting of melon-headed whales (Figure 1; Barlow 2006). Inter-island movements from Kauai to Hawaii have been documented and genetic samples from at least 82 animals are available for future stock structure analyses (R.W. Baird, pers. comm.). Little is known about this species elsewhere in its range, and most knowledge about its biology comes from mass strandings (Perryman et al. 1994). Fourteen strandings are known from Hawaii (Nishiwaki and Norris 1966; Shallenberger 1981; Nitta 1991; Maldini et al. 2005). For the Marine Mammal Protection Act (MMPA) stock assessment reports, there is a single Pacific management stock including animals found both within the Hawaiian Islands EEZ and in adjacent international waters. Because data on abundance, distribution, and human-caused impacts are largely lacking for international waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

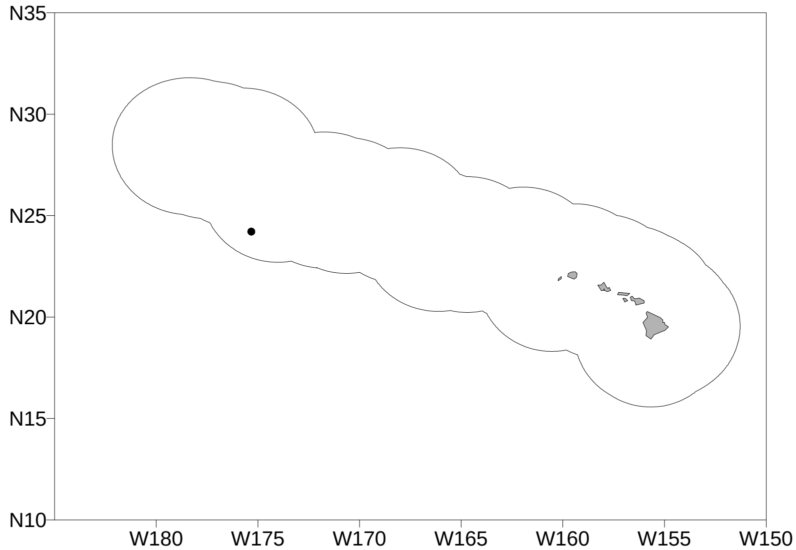

Figure 1. Melon-headed whale sighting location during the 2002 shipboard survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ.

POPULATION SIZE

An abundance estimate of melon-headed whales is available for the eastern tropical Pacific (Wade and Gerrodette 1993), but it is not known whether any of these animals are part of the same population that occurs around the Hawaiian Islands. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 2,950 (CV=1.17) melon-headed whales (Barlow 2006). This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate (Barlow 2006) is 1,350 melon-headed whales in the Hawaiian Islands EEZ.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size within the U.S. EEZ of the Hawaiian Islands (1,350) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no known fishery mortality; Wade and Angliss 1997), resulting in a PBR of 14 melon-headed whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Information on fishery-related mortality and serious injury of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Gillnets appear to capture marine mammals wherever they are used, and float lines from lobster traps and longlines can be expected to occasionally entangle cetaceans (Perrin et al. 1994).

Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nitta and Henderson 1993), but no interactions with melon-headed whales have been documented. There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2004 and 2008, no melon-headed whales were observed hooked or entangled in the SSLL fishery (100% observer coverage) or the DSLL fishery (20-28% observer coverage) (McCracken & Forney 2010). 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 melon-headed whales are involved.

Other Mortality

In recent years, there has been increasing concern that loud underwater sounds, such as active sonar and seismic operations, may be harmful to beaked whales (Cox et al. 2006) and other cetaceans, including melon-headed whales (Southall et al. 2006) and pygmy killer whales (*Feresa attenuata*) (Wang and Yang 2006). The use of active sonar from military vessels has been implicated in mass strandings of beaked whales and recent mass-stranding reports suggest some delphinids may be impacted as well. A 2004 mass-stranding of melon-headed whales in Hanalei Bay, Kauai occurred during a multi-national sonar training event around Hawaii (Southall et al. 2006). Although data limitations preclude a conclusive finding regarding the role of Navy sonar in triggering this event, sonar transmissions were considered a plausible, if not likely cause of the mass stranding based on the spatiotemporal link between the sonar exercises and the stranding, the direction of movement of the transmitting vessels near Hanalei Bay, and propagation modeling suggesting the sonar transmissions would have been audible at the mouth of Hanalei Bay (Southall et al 2006; Brownell et al. 2009). Additional research on the behavioral response of delphinids in the presence of sonar transmissions is needed in order to understand the level of impact. No estimates of potential mortality or serious injury are available for U.S. waters.

STATUS OF STOCK

The status of melon-headed whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this species. It is not listed as “threatened” or “endangered” under the Endangered Species Act (1973), nor as “depleted” under the MMPA. Given the absence of recent fishery-related mortality or serious injuries, the Hawaiian stock of melon-headed whales is not considered strategic under the 1994 amendments to the MMPA, and the total fishery mortality and serious injury can be considered to be insignificant and approaching zero.

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Revised 01/15/2011

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Pygmy killer whales are found in tropical and subtropical waters throughout the world (Ross and Leatherwood 1994). They are poorly known in most parts of their range. Small numbers have been taken directly and incidentally in both the western and eastern Pacific. Most knowledge of this species is from stranded or live-captured specimens. Pryor et al. (1965) stated that pygmy killer whales have been observed several times off the lee shore of Oahu, and that "they seem to be regular residents of the Hawaiian area." Although all sightings up to that time had been off Oahu and the Big Island, Shallenberger (1981) stated that this species might be found elsewhere in Hawaii, as well. More recently, pygmy killer whales have also been seen off the islands of Niihau and Lanai (McSweeney et al. 2009). Three sightings of pygmy killer whales were made during a 2002 shipboard survey of U.S. Exclusive Economic Zone (EEZ) waters surrounding the Hawaiian Islands (Figure 1; Barlow 2006). Six strandings have been documented from Maui and the island of Hawaii (Nitta 1991, Maldini et al. 2005). A 22-year study off the island of Hawaii suggested this species is relatively rare (1.2% of all sightings) yet occurs year-round and in stable groups. High resighting rates suggest a small-island associated population off the island of Hawaii (McSweeney *et al*. 2009), which may warrant division of this population into a separate island-associated stock in the future. For the Marine Mammal Protection Act (MMPA) stock assessment reports, there is a single Pacific management stock including animals found both within the Hawaiian Islands EEZ and in adjacent international waters. Because data on abundance, distribution, and human-caused impacts are largely lacking for international waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

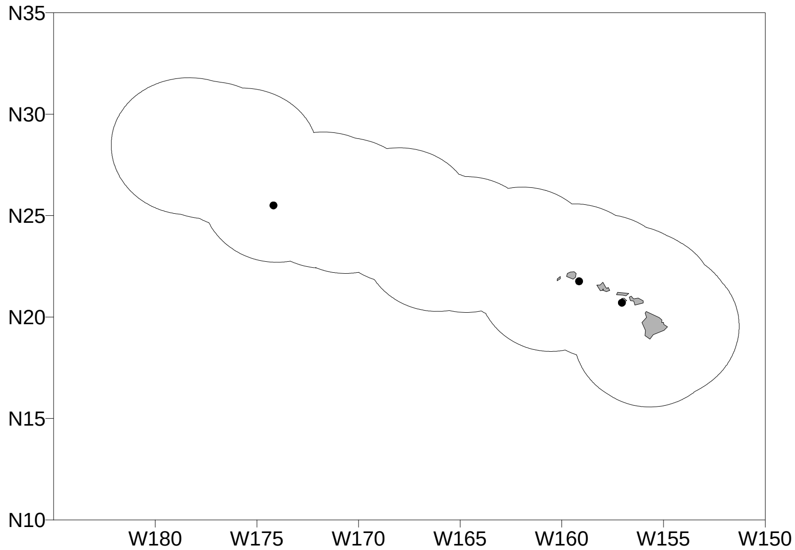

Figure 1. Pygmy killer whale sighting locations during the 2002 shipboard survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ.

POPULATION SIZE

A population estimate has been made for this species in the eastern tropical Pacific (Wade and Gerrodette 1993), but it is not known whether any of these animals are part of the same population that occurs around the Hawaiian Islands. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 956 (CV=0.83) pygmy killer whales (Barlow 2006). This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate (Barlow 2006) is 520 pygmy killer whales within the Hawaiian EEZ.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size within the U.S. EEZ of the Hawaiian Islands (520) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a stock of unknown status with no known fishery mortality or serious injury within the Hawaiian Islands EEZ; Wade and Angliss 1997), resulting in a PBR of 5.2 pygmy killer whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Information on fishery-related mortality and serious injury of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Gillnets appear to capture marine mammals wherever they are used, and float lines from lobster traps and longlines can be expected to occasionally entangle cetaceans (Perrin et al. 1994).

Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nitta and Henderson 1993), but no interactions with pygmy killer whales have been documented. There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2004 and 2008, no pygmy killer whales were observed hooked or entangled in the SSLL fishery (100% observer coverage) or the DSLL fishery (20-28% observer coverage) (McCracken & Forney 2010). 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 pygmy killer whales are involved. A stranded pygmy killer whale from Oahu showed signs of hooking injury (Schofield 2007) and mouthline injuries have also been noted in some individuals (Baird unpublished data), though it is not known if these interactions result in serious injury or mortality.

Other Mortality

In recent years, there has been increasing concern that loud underwater sounds, such as active sonar and seismic operations, may be harmful to beaked whales (Cox et al. 2006) and other cetaceans, including melon-headed whales (Southall et al. 2006, Brownell et al. 2009) and pygmy killer whales (Wang and Yang 2006). The use of active sonar from military vessels has been implicated in mass strandings of beaked whales, and recent mass-stranding reports suggest some delphinids may be impacted as well. Two mass-strandings of pygmy killer whales occurred in the coastal areas of southwest Taiwan in February 2005, possibly associated with offshore naval training exercises (Wang and Yang 2006). A necropsy of one of the pygmy killer whales revealed hemorrhaging in the cranial tissues of the animal. Additional research on the behavioral response of delphinids in the presence of sonar transmissions is needed in order to understand the level of impact. No estimates of potential mortality or serious injury are available for U.S. waters.

STATUS OF STOCK

The status of pygmy killer whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this species. This species is not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. Given the absence of recent fishery-related mortality or serious injuries, the Hawaiian stock of pygmy killer whales is not considered strategic under the 1994 amendments to the MMPA, and the total fishery mortality and serious injury can be considered to be insignificant and approaching zero.

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FALSE KILLER WHALE (*Pseudorca crassidens*): Hawaiian Islands Stock Complex – Main Hawaiian Islands Insular, Northwestern Hawaiian Islands, and Hawaii Pelagic Stocks

STOCK DEFINITION AND GEOGRAPHIC RANGE

False killer whales are found worldwide 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 et al. 2005). One on-effort sighting of false killer whales was made during a 2002 shipboard survey, and six during a 2010 shipboard survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands (Figure 1; Barlow 2006, Bradford et al. 2012). Smaller-scale surveys conducted around the main Hawaiian Islands (Figure 2) show that false killer whales are also encountered in nearshore waters (Baird et al. 2005, Mobley et al. 2000), and a single on-effort and three off-effort sightings during a 2010 shipboard survey reveal that the species also occurs near shore in the Northwestern Hawaiian Islands (Baird et al. 2012). This species also occurs in U.S. EEZ waters around Palmyra and Johnston Atolls (NMFS/PIR/PSD unpublished data), and American Samoa (Johnston et al. 2008, Oleson 2009).

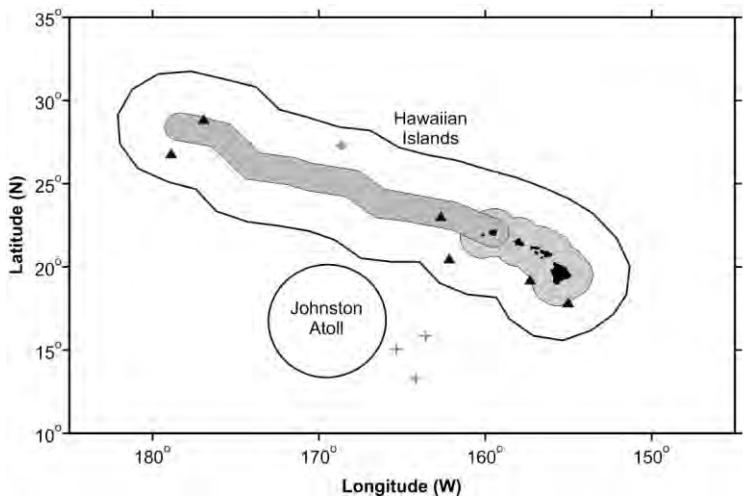

Figure 1. False killer whale on-effort sighting locations during standardized shipboard surveys of the Hawaiian U.S. EEZ (2002, gray diamond, Barlow 2006; 2010, black triangles, Bradford et al. 2012, the Johnston Atoll EEZ and pelagic waters of the central Pacific south of the Hawaiian Islands (2005), gray crosses, Barlow and Rankin 2007). Outer lines represent approximate boundary of U.S. EEZs; light shaded gray area is the main Hawaiian Islands insular false killer whale stock area, including overlap zone between MHI insular and pelagic false killer whale stocks; dark shaded gray area is the Northwestern Hawaiian Islands stock area, which overlaps the pelagic false killer whale stock area and part of the MHI insular false killer whale stock area.

Genetic, photo-identification, and telemetry studies indicate there are three demographically-independent populations of false killer whales in Hawaiian waters. Genetic analyses indicate restricted gene flow between false killer whales sampled near the main Hawaiian Islands (MHI), the Northwestern Hawaiian Islands (NWHI), and in pelagic waters of the Eastern (ENP) and Central North Pacific (CNP) (Chivers et al. 2007, 2010; Martien et al. 2011). Chivers et al. (2010) expanded previous analyses with additional samples and analysis of 8 nuclear DNA (nDNA) microsatellites, revealing strong phylogeographic patterns consistent with local evolution of haplotypes nearly unique to false killer whales occurring nearshore within the Hawaiian Archipelago. Analysis of 21 additional samples collected during a 2010 shipboard survey in Hawaiian waters reveals significant differentiation in both mitochondrial DNA (mtDNA) and nDNA between false killer whales found near the MHI and the NWHI (Martien et al. 2011). Photographic–identification of individuals seen near the NWHI confirms that they do not associate with individuals near the MHI (Baird et al. in press). Two false killer whales previously photographed near Kauai were seen in groups observed near Nihoa in the NWHI, and are not known to associate with animals from the MHI, suggesting geographic overlap of MHI and NWHI false killer whale populations near Kauai. Further evaluation of photographic and genetic data from individuals seen near the MHI suggest the occurrence of three separate social clusters (Baird et al. in press, Martien et al. 2011), where mating primarily occurs within clusters, though some mating is known to occur between males and females of different social clusters (Martien et al. 2011).

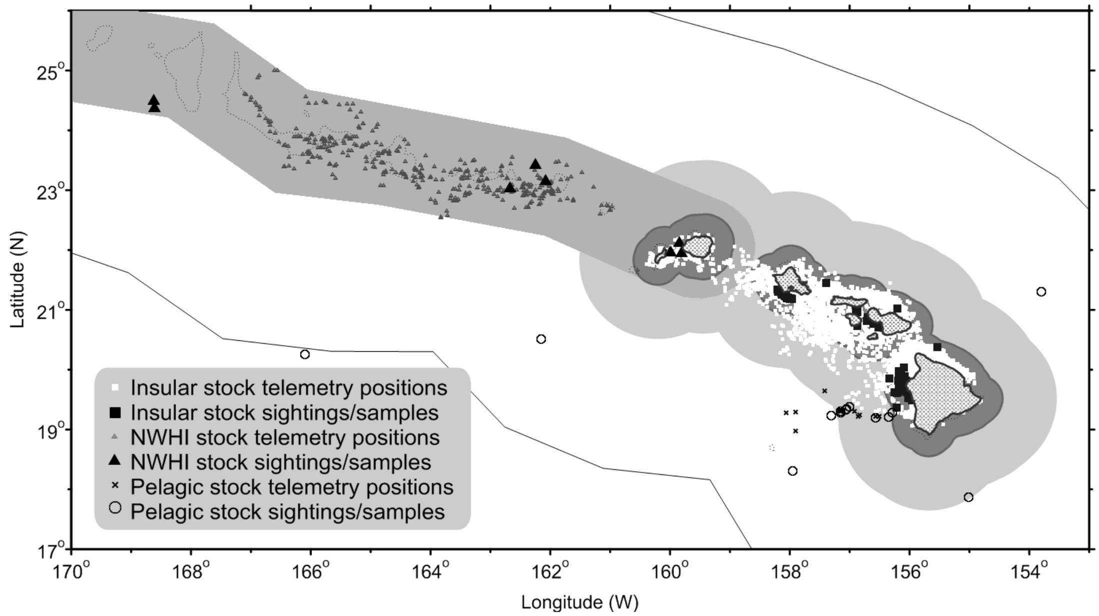

Figure 2. Sighting, biopsy, and telemetry records of false killer whale identified as being part of the MHI insular (square symbols), NWHI (triangle symbols), or pelagic (open and cross symbols) stocks. The dark gray area is the 40-km MHI insular core area; light gray area is the 40-km to 140-km MHI insular-pelagic overlap zone (Baird et al. 2010, Baird unpublished data; reproduced from Forney et al. 2010); medium gray area is the 50-nmi (93-km) Monument boundary extended to the east to encompass Kauai, representing the NWHI stock boundary. The MHI insular, pelagic, and NWHI stocks overlap in the vicinity of Kauai.

Observers have collected tissue samples for genetic analysis from cetaceans incidentally caught in the Hawaii-based longline fishery since 2003. Between 2003 and 2010, eight false killer whale samples, four collected outside the Hawaiian EEZ and four collected within the EEZ but more than 100 nautical miles (185km) from the main Hawaiian Islands (see Figure 3), were determined to have Pacific pelagic haplotypes (Chivers et al. 2010). At the broadest scale, significant differences in both mtDNA and nDNA are evident between pelagic false killer whales in the ENP and CNP strata (Chivers et al. 2010), although the sample distribution to the east and west of Hawaii is insufficient to determine whether the sampled strata represent one or more stocks, and where pelagic stock boundaries would be drawn.

Genetic, photographic, and telemetry data collected from Hawaiian false killer whales demonstrates the existence of a previously unknown stock of island-associated false killer whales in the NHWI, and supports the current recognized boundaries of the MHI insular and pelagic stocks. The three stocks have overlapping ranges. MHI insular false killer whales have been seen as far as 112 km from the main Hawaiian Islands, while pelagic stock animals have been seen within 42 km of the main Hawaiian Islands (Baird et al. 2008, Baird 2009, Baird et al. 2010, Forney et al. 2010). NWHI false killer whales have been seen as far as 93 km from the NWHI and near Kauai (Baird et al. 2012, Bradford et al. 2012, Martien et al. 2011). Animals seen within 40 km of the main Hawaiian Islands between Hawaii Island and Oahu are considered to belong to the MHI insular stock. Waters within 40 km of Kauai and Niihau are an overlap zone between the MHI insular and NWHI stock, as individuals from both populations have been seen here. Animals seen within 93 km of the NWHI, inside the Papahānaumokuākea Marine National Monument may belong to either the NWHI or pelagic stock, as animals from both stocks have been seen inside the Monument. Animals beyond 140 km of the MHI and beyond 93 km of the NWHI are considered to belong to the pelagic stock. The MHI insular and pelagic stocks overlap between 40 km and 140 km from shore between Oahu and Hawaii Island. All three stocks overlap within 40 km and 93 km around Kauai and Niihau, and the MHI insular and pelagic stocks overlap from 93 km to 140 km around these islands (Figure 2).

The pelagic stock includes animals found within the Hawaiian Islands EEZ and in adjacent international waters; however, because data on false killer whale abundance, distribution, and human-caused impacts are largely lacking for international waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005). The Palmyra Atoll stock of false killer whales remains a separate stock, because comparisons amongst false killer whales sampled at Palmyra Atoll and those sampled from the MHI insular stock and the pelagic ENP reveal restricted gene flow, although the sample size remains low for robust comparisons (Chivers et al. 2007, 2010). NMFS will obtain and analyze additional samples for genetic studies of stock structure, and will evaluate new information on stock ranges as it becomes available.

For the Marine Mammal Protection Act (MMPA) stock assessment reports, there are currently five Pacific Islands Region management stocks (Forney et al. 2011, Martien et al. 2011): 1) the Main Hawaiian Islands insular stock, which includes animals inhabiting waters within 140 km (approx. 75 nmi) of the main Hawaiian Islands, 2) the Northwestern Hawaiian Islands stock, which includes animals inhabiting waters within 93 km (50 nmi) of the NWHI and Kauai, 3) the Hawaii pelagic stock, which includes false killer whales inhabiting waters greater than 40 km (22 nmi) from the main Hawaiian Islands, 4) the Palmyra Atoll stock, which includes animals found within the U.S. EEZ of Palmyra Atoll, and 5) the American Samoa stock, which includes animals found within the U.S. EEZ of American Samoa. Estimates of abundance, potential biological removal, and status determinations for the first three stocks are presented below; the Palmyra Atoll and American Samoa Stocks are covered in separate reports.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Interactions with false killer whales, including depredation of catch, have been identified in logbooks and NMFS observer records from Hawaii pelagic longlines (Nitta and Henderson 1993, NMFS/PIR unpublished data). False killer whales have been observed feeding on mahi mahi, *Coryphaena hippurus*, and yellowfin tuna, *Thunnus albacares* (Baird 2009), and they have been reported to take large fish from the trolling lines of commercial and recreational fishermen (Shallenberger 1981). There are anecdotal reports of marine mammal interactions in the commercial Hawaii shortline fishery which sets gear at Cross Seamount and possibly around the main Hawaiian Islands. The shortline fishery is permitted through the State of Hawaii Commercial Marine License program, and until recently, no reporting systems existed to document marine mammal interactions. This fishery was added to the 2010 List of Fisheries as a Category II fishery (Federal Register Vol. 74, No. 219, p. 58859-58901, November 16, 2009), and efforts are underway to obtain data on interactions between shortlines and marine mammals. Baird and Gorgone (2005) documented high rates of dorsal fin disfigurements consistent with injuries from unidentified fishing line for false killer whales belonging to the MHI insular stock. It is unknown whether these injuries might have been caused by longline gear, shortline gear, or other hook-and-line gear used around the main Hawaiian Islands.

There are two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas, within the ranges of both MHI insular and pelagic stocks. Between 2006 and 2010, two false killer whales were observed hooked or entangled in the SSLL fishery (100% observer coverage) within the U.S. EEZ of the Hawaiian Islands, and 24 false killer whales were observed taken in the DSLL fishery (≥20% observer coverage) within Hawaiian waters or adjacent high-seas waters (excluding Palmyra Atoll) (Forney 2011). One false killer whale take in the DSLL fishery resulted in the death of the animal in international waters. Based on an evaluation of the observer"s description of each interaction and following the most recently developed criteria for assessing serious injury in marine mammals (Andersen et al. 2008), one animal taken in the SSLL fishery was considered not seriously injured and one was considered seriously injured, both within the Hawaii EEZ. In the DSLL fishery, one false killer whale taken within the overlap zone of the MHI insular and pelagic stocks, two taken in Hawaiian waters within the range of the pelagic stock, and one taken in international waters were considered not seriously injured. The level of injury could not be determined

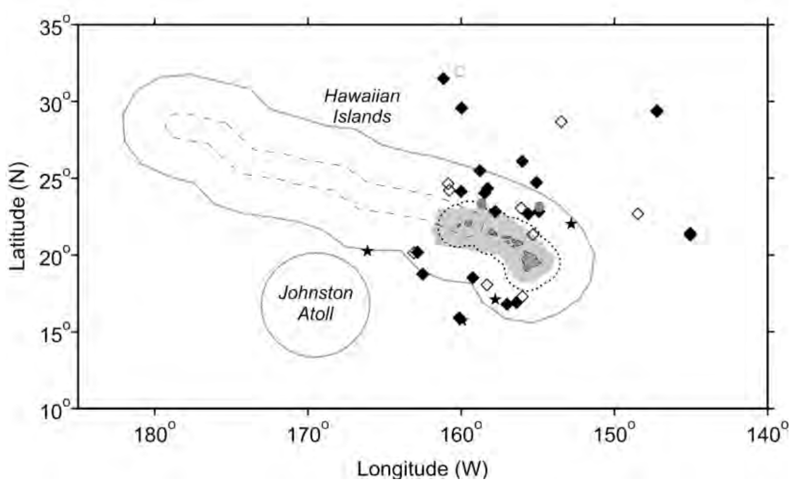

Figure 3. Locations of observed false killer whale takes (filled symbols) and possible takes ("blackfish") of this species (open symbols) in the Hawaii-based longline fisheries, 2006-2010. Deep-set fishery takes are shown in black; shallow-set fishery takes are shown in gray. Stars are locations of genetic samples from fishery-caught false killer whales. Solid gray lines represent the U.S. EEZ; the dotted line is the outer (140-km) boundary of the overlap zone between MHI insular and pelagic false killer whale stocks; the dashed line is the 93-km boundary of the NWHI stock; the gray shaded area is the February-September longline exclusion zone. Fishery descriptions are provided in Appendix 1.

based on the observer descriptions for one false killer whale taken in the DSLL, within the range of the pelagic stock. The remaining 18 false killer whales taken in the DSLL fishery (nine in international waters, nine in the Hawaiian Islands EEZ pelagic stock range were considered seriously injured (Forney 2011). Seven additional unidentified "blackfish" (unidentified cetaceans known to be either false killer whales or short-finned pilot whales) that may have been false killer whales were also seriously injured during 2006-2010 (Forney 2011; see McCracken 2011 for description of short-finned pilot whale takes within the deep and shallow set fisheries). Six of these were taken in the DSLL fishery within U.S. EEZ waters, including one animal within the MHI insular stock range, and one was taken in the SSLL fishery in international waters (Figure 3).

Table 1. Summary of available information on incidental mortality and serious injury of false killer whales (Hawaiian Islands Stock Complex) and unidentified blackfish in commercial fisheries, by stock and EEZ area, as applicable (McCracken 2010). Mean annual takes are based on 2006-2010 estimates unless otherwise indicated. Information on all observed takes (T) and combined mortality events & serious injuries (MSI) is included. Total takes were prorated to deaths, serious injuries, and non-serious injuries based on the observed proportions of each outcome. Unidentified blackfish are pro-rated as either false killer whales or short-finned pilot whales according to their distance from shore (McCracken 2010). CVs are estimated based on the methods of McCracken and Forney (2010) and do not yet incorporate additional uncertainty introduced by prorating false killer whales in the overlap zone and prorating the unidentified blackfish.

Fishery Name	Year	Data Type	Percent Observer Coverage	Observed total interactions (T) and mortality events, and serious injuries (MSI), and total estimated mortality and serious injury (M&SI) of false killer whales by stock / EEZ region							
				Hawaii Pelagic Stock				**Main Hawaiian Islands Insular Stock**		**Northwestern Hawaiian Islands Stock**	
				Outside of U.S. EEZs		Hawaiian Islands EEZ					
				Obs. FKW T/MSI Obs. UB T/MSI	Estimated M&SI (CV)	Obs. FKW T/MSI Obs. UB T/MSI	Estimated M&SI (CV)	Obs. FKW T/MSI Obs. UB T/MSI	Estimated M&SI (CV)	Obs. FKW T/MSI Obs. UB T/MSI	Estimated M&SI (CV)
Hawaii-based deep-set longline fishery	2006	Observer data	22%	2/2 0/0	8 (0.7)	2/1* 2/2*	13 (1.7)	1/0* 1/1*	2.2 (0.7)	0/0	0 (-)
	2007		20%	1/0 0/0	2 (3.7)	2/1 0/0	8 (0.8)	0/0 0/0	0 (-)	0/0	0 (-)
	2008		22%	0/0 0/0	0 (-)	4/3 3/3	17 (0.4)	0/0 0/0	0 (-)	0/0	0 (-)
	2009		20%	7/7 0/0	39 (0.2)	2/2 0/0	12 (0.5)	0/0 0/0	0 (-)	0/0	0 (-)
	2010		21%	1/1 0/0	6 (1.3)	2/3 1/1	14 (0.5)	0/0 0/0	0 (-)	0/0	0 (-)
Mean Estimated Annual Takes (CV)					**11.2 (0.3)**		**13.6 (0.3)**		**0.5 (1.7)**		**0 (-)**
Hawaii-based shallow-set longline fishery	2006	Observer data	100%	0/0 0/0	0	0/0 0/0	0	0/0 0/0	0	0/0	0
	2007		100%	0/0 0/0	0	0/0 0/0	0	0/0 0/0	0	0/0	0
	2008		100%	0/0 1/1	0.5	1/0 0/0	0	0/0 0/0	0	0/0	0
	2009		100%	0/0 0/0	0	1/1 0/0	1	0/0 0/0	0	0/0	0
	2010		100%	0/0 0/0	0	0/0 0/0	0	0/0 0/0	0	0/0	0
Mean Annual Takes (100% coverage)					**0.1**		**0.2**		**0**		**0**
Minimum total annual takes within U.S. EEZ							**13.8 (0.3)**		**0.5 (1.7)**		**0 (-)**

* False killer whale and unidentified blackfish takes within the MHI insular/pelagic stock overlap zone are shown once for each stock, but total estimates derived from these takes are prorated among potentially affected stocks based on the distance from shore of the take location (see text above, and McCracken 2010).

The total observed mortality and serious injury of cetaceans in the SSLL fishery (with 100% coverage), and the estimated annual and 5-yr average mortality and serious injury of cetaceans in the DSLL fishery (with approximately 20% coverage) are reported by McCracken (2011). A number of recent changes are reflected in the methodology. Estimated takes of false killer whales and observed takes for which injury severity is undetermined, are prorated based on the proportions of observed interactions that resulted in death or serious injury (93%) or non-serious injury (7%), between the years 2000 and 2010. Further, takes of false killer whales of unknown stock in the MHI insular/pelagic stock overlap zone are prorated assuming that densities of MHI insular stock animals decline and pelagic stock increase with distance from shore (McCracken 2010). No genetic samples are available to establish stock identity for these takes, but both stocks are considered at risk of interacting with longline gear. The pelagic stock is known to interact with longline fisheries in waters offshore of the overlap zone, based on two genetic samples obtained by fishery observers (Chivers et al. 2008). MHI insular false killer whales have been documented via telemetry to move far enough offshore (112km) to reach longline fishing areas, and animals from this stock have a high rate of dorsal fin disfigurements consistent with injuries from unidentified fishing line (Baird and Gorgone 2005).

Finally, unidentified blackfish are prorated to each stock based on distance from shore (McCracken 2010). The distance-from-shore model was chosen following consultation with the Pacific Scientific Review Group, based on the model"s performance and simplicity relative to a number of other more complicated models with similar output (McCracken 2010). Proration of false killer whales takes within the MHI insular-pelagic overlap zone and of unidentified blackfish takes introduces unquantified uncertainty into the bycatch estimates, but until methods of determining stock identity for animals observed taken within the overlap zone are available, and all animals taken can be identified to species (e.g., photos, tissue samples), this approach ensures that potential impacts to all stocks are assessed.

Based on these bycatch analyses, estimates of annual and 5-yr average annual mortality and serious injury of false killer whales, by stock and EEZ area, are shown in Table 1. Estimates of mortality and serious injury (M&SI) include a pro-rated portion of the animals categorized as unidentified blackfish (UB). Although M&SI estimates are shown as whole numbers of animals, the 5-yr average M&SI is calculated based on the unrounded annual estimates.

Because of high rates of false killer whale mortality and serious injury in Hawaii-based longline fisheries, a Take Reduction Team (Team) was established in January 2010 (75 FR 2853, 19 January 2010). The Team was charged with developing recommendations to reduce incidental mortality and serious injury of the Hawaii pelagic, MHI insular, and Palmyra stocks of false killer whales in the DSLL and SSLL fisheries. The Team submitted a draft Take Reduction Plan (Plan) to NMFS (http://www.nmfs.noaa.gov/pr/pdfs/interactions/fkwtrp_draft.pdf), and NMFS published a final Plan based on the Team"s recommendations (77 FR 71260, 29 November, 2012). The Plan became effective December 31, 2012, but certain gear requirements go into effect on February 27, 2013. Take reduction measures include gear requirements, time-area closures, and measures to improve captain and crew response to hooked and entangled false killer whales. Additionally, the Plan includes non-regulatory measures that NMFS will implement to improve data quality and dissemination to the Team and the public.

MAIN HAWAIIAN ISLANDS INSULAR STOCK

POPULATION SIZE

A photographic mark-recapture study during 2000-2004 around the main Hawaiian Islands produced an estimate of 123 (CV=0.72) MHI insular false killer whales (Baird et al. 2005). This abundance estimate is based in part on data collected more than 8 years ago, and is considered outdated as a measure of current abundance (NMFS 2005). A Status Review for the MHI insular stock (Oleson et al. 2010) used recent, unpublished estimates for two time periods, 2000-2004 and 2006-2009 in a Population Viability Analysis (PVA). The new estimates were based on more recent sighting histories and open population models, yielding more precise estimates for the two time periods. The new estimate for the 2000-2004 period is 162 (CV=0.23) animals. Two separate estimates for 2006-2009 were presented in the Status Review; 151 (CV=0.20) and 170 (CV=0.21), depending on whether animals photographed near Kauai are included in the estimate (Baird unpublished data). The animals seen near Kauai included in the higher estimate have now been associated with the NWHI stock (Baird et al in press), such that the best estimate of population size is the smaller estimate of 151 animals. However, it should be noted that even this smaller estimate may be positively-biased, because missed photo-ID matches were discovered after the analyses were complete (discussed in Oleson *et al.* 2010). The best estimate will be updated when a new mark-recapture estimate accounting for the missed matches is available.

Minimum Population Estimate

The minimum population estimate for the MHI insular stock of false killer whales is the number of distinct individuals identified during 2008-2011 photo-identification studies, or 129 false killer whales (Baird, unpublished data). Recent mark-recapture estimates (Oleson et al. 2010) of abundance are known to have a positive bias of unknown magnitude, and therefore are not suitable for deriving a minimum abundance estimate.

Current Population Trend

Reeves et al. (2009) suggested that the MHI insular stock of false killer whales may have declined during the last two decades, based on sightings data collected near Hawaii using various methods between 1989 and 2007. Baird (2009) reviewed trends in sighting rates of false killer whales from aerial surveys conducted using consistent methodology around the main Hawaiian Islands between 1994 and 2003 (Mobley et al. 2000). Sighting rates during these surveys showed a statistically significant decline that could not be attributed to any weather or methodological changes. The Status Review of Hawaiian MHI insular false killer whales (Oleson *et al.* 2010) presented a quantitative analysis of extinction risk using a Population Viability Analysis (PVA). The modeling exercise was conducted to evaluate the probability of actual or near extinction, defined as fewer than 20 animals, given measured, estimated, or inferred information on population size and trends, and varying impacts of catastrophes, environmental stochasticity and Allee effects. All plausible models indicated the probability of decline to fewer than 20 animals within 75 years is greater than 20%. Though causation was not evaluated, all plausible models indicated current declines at an average annual rate of -9% since 1989 (95% probability intervals -5% to -12.5%; Oleson *et al.* 2010).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the MHI insular false killer whale stock is calculated as the minimum population size (129) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.1 resulting in a PBR of 0.3 false killer whales per year. The recovery factor was chosen to be 0.1 because the stock has been proposed for listing as endangered under the U.S Endangered Species Act (see below) and because of the significant recent decline experienced by this stock (Oleson et al. 2010).

STATUS OF STOCK

The status of MHI insular stock false killer whales relative to OSP is unknown, although this stock appears to have declined during the past two decades (Oleson et al. 2010, Reeves et al. 2009; Baird 2009). Ylitalo et al. (2009) documented elevated levels of polychlorinated biphenyls (PCBs) in three of nine MHI insular false killer whales sampled, and biomass of some false killer whale prey species may have declined around the main Hawaiian Islands (Oleson et al. 2010, Boggs & Ito 1993, Reeves et al. 2009). MHI insular false killer whales have been listed as "endangered" under the Endangered Species Act (1973) (77 FR 70915, 28 November, 2012). The listing follows receipt of a petition from the Natural Resources Defense Council on October 1, 2009, requesting that Hawaiian insular false killer whales be listed as endangered under the ESA. NMFS determined that the petition presented substantial scientific information indicating that a listing may be warranted and thus was required to conduct an ESA status review of the stock (75 FR 316; January 5, 2010) and established a Biological Review Team (BRT) for this purpose. The Status Review report produced by the BRT (Oleson et al. 2010) found that Hawaiian insular false killer whales are a Distinct Population Segment (DPS) of the global false killer whale taxon. The BRT evaluated risk to the population, including identification and ranking of threats to the population, quantitative assessment of extinction probability using a PVA, and an assessment of the overall risk of extinction to the population. The PVA analysis indicated the probability of near-extinction (less than 20 animals) within 75 years (3 generations) was greater than 20% for all biologically plausible models and given a wide range of input variables. Of the 29 indentified threats to the population, the BRT considered the effects of small population size, including inbreeding depression and Allee effects, exposure to environmental contaminants, competition for food with commercial fisheries, hooking, entanglement, or intentional harm by fishers to be the most substantial threats to the population. The BRT concluded that Hawaiian insular false killer whales were at high risk of extinction. Following additional information on the occurrence of another island-associated stock in the NWHI, the BRT reevaluated the DPS decision and concluded that the population still met the standard to be listed as a DPS (Oleson et al. 2012). False killer whales are not listed as "depleted" under the MMPA.

Based on the best available scientific information (Oleson et al. 2010), Main Hawaiian Islands insular false killer whales are declining, therefore the stock is considered "strategic" under the MMPA. The estimated average annual human-caused mortality and serious injury for this stock (0.5 animals per year) is greater than the PBR (0.3), providing further support for the "strategic" designation.

HAWAII PELAGIC STOCK

POPULATION SIZE

Analyses of a 2002 shipboard line-transect survey of the Hawaiian Islands EEZ resulted in an abundance estimate of 484 (CV = 0.93) false killer whales within the Hawaiian Islands EEZ outside of about 75 nmi of the main Hawaiian Islands (Barlow & Rankin 2007). This abundance estimate is now more than 8 years old and therefore will no longer be used based on NMFS Guidelines for Assessing Marine Mammal Stocks (NMFS 2005). A new abundance survey was completed in 2010 within the Hawaiian Islands EEZ and resulted in five on-effort detections of false killer whales attributed to the Hawaii pelagic stock. Analysis of 2010 shipboard line-transect data resulted in an abundance estimate of 1,503 (CV=0.66) false killer whales outside of 40 km of the main Hawaiian Islands (Bradford et al. 2012). Bradford et al. (2012) reported that most (64%) false killer whale groups seen during the 2010 HICEAS survey were seen moving toward the vessel when detected by the visual observers. Together with a significant increase in sightings close to the trackline, this behavioral data suggests vessel attraction is likely occurring and may be significant. Although Bradford et al. (2012) employed a half-normal model to minimize the effect of vessel attraction, any potential positive bias could not be entirely eliminated. The abundance estimate is presumably positively biased as a result of vessel attraction, but the extent of any bias is unknown. The acoustic data collected during the 2010 survey are still being analyzed and additional refinements to this estimate are expected. A 2005 survey (Barlow and Rankin 2007) resulted in a separate abundance estimate of 906 (CV=0.68) false killer whales in international waters south of the Hawaiian Islands EEZ and within the EEZ of Johnston Atoll, but it is unknown how many of these animals might belong to the Hawaii pelagic stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2010 abundance estimate for the Hawaiian Islands EEZ outside of 40 km from the main Hawaiian Islands (Bradford et al. 2012) is 906 false killer whales. The minimum abundance estimate has not been corrected for vessel attraction and may be an over-estimate of minimum population size. The acoustic data collected during the 2010 survey are still being analyzed and additional refinements to this estimate are expected.

Current Population Trend

No data are available on current population trend. It is incorrect to interpret the increase in the abundance estimate from 2002 to 2010 as an increase in population size, given changes to the survey design in 2010 and the analytical framework specifically intended to better enumerate and account for overall group size, the low precision of each estimate, and a lack of understanding of the oceanographic processes that may drive the distribution of this stock over time. Further, only a portion of the overall range of this population has been surveyed, precluding evaluation of abundance of the entire stock.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Following the NMFS Guidelines for Assessing Marine Mammal Stocks (NMFS 2005), the PBR is calculated only within the U.S. EEZ of the Hawaiian Islands, because estimates of human-caused mortality and serious injury are not available from all U.S. and non-U.S. sources in international waters where this stock may occur. The potential biological removal (PBR) level for the Hawaii pelagic stock of false killer whale is thus calculated as the minimum population size within the U.S. EEZ of the Hawaiian Islands (906) <u>times</u> one half the default maximum net growth rate for cetaceans (½ of 4%) <u>times</u> a recovery factor of 0.50 (for a stock of unknown status with a Hawaiian Islands EEZ mortality and serious injury rate CV = 0.30; Wade and Angliss 1997), resulting in a PBR of 9.1 false killer whales per year.

STATUS OF STOCK

The status of the Hawaii pelagic stock of false killer whales relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this stock. They are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. Following the NMFS Guidelines for Assessing Marine Mammal Stocks (NMFS 2005), the status of this transboundary stock of false killer whales is assessed based on the estimated abundance and estimates of mortality and serious injury within the U.S. EEZ of the Hawaiian Islands because estimates of human-caused mortality and serious injury from all U.S. and non-U.S. sources in international waters are not available, and because the geographic range of this stock beyond the Hawaiian Islands EEZ is poorly known. Because the rate of mortality and serious injury to false killer whales within the Hawaiian Islands EEZ (13.8 animals per year) exceeds the PBR (9.1 animals per year), this stock is considered a "strategic stock" under the MMPA. The total fishery mortality and serious injury for the Hawaii pelagic stock of false killer whales cannot be considered to be insignificant and approaching zero, because it has exceeded the PBR for more than 10 years.

NMFS has considered whether the status assessment of this transboundary stock would change if animals outside the Hawaiian Islands EEZ are considered. Using all available peer-reviewed information on the abundance of false killer whales on the high-seas and within the EEZ of Johnston Atoll, a PBR can be calculated as the lower 20th percentile of the Barlow and Rankin (2007) abundance estimate (539), <u>times</u> one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a stock of unknown status with a mortality and serious injury rate CV = 0.30; Wade and Angliss 1997), resulting in 5.4 false killer whales per year. This minimum abundance estimate may be based on a smaller geographic area than the (unknown) full range of the pelagic stock because areas to the north of the Hawaiian Islands EEZ are not included; however, the estimate meets the definition of a „minimum population estimate" under the MMPA. Bycatch information for the high seas is incomplete because the levels of false killer whale takes in non-U.S. fisheries are not known. The average annual estimated mortality and serious injury by U.S. longline vessels operating on the high seas and within the EEZ of Johnston Atoll is 11.3 (McCracken 2011). This value is greater than the PBR of 5.4, and the combined U.S. and international mortality and serious injury is likely substantially higher, because fishing effort by foreign vessels may be up to six times greater than that of the U.S. fleet (NMFS, unpublished data). Better information on the full geographic range of this stock and quantitative estimates of bycatch in international fisheries are needed to reduce the uncertainties regarding impacts of false killer whale takes on the high seas, but these uncertainties do not change the current assessment that the pelagic false killer whale stock is strategic.

NORTHWESTERN HAWAIIAN ISLANDS STOCK

POPULATION SIZE

A 2010 line transect survey that included the waters surrounding the Northwestern Hawaiian Islands produced an estimate of 552 (CV = 1.09) false killer whales attributed to the Northwestern Hawaiian Islands stock (Bradford et al. 2012). This is the best available abundance estimate for false killer whales within the Northwestern Hawaiian Islands. Bradford et al. (2012) reported that most (64%) false killer whale groups seen during the 2010 HICEAS survey were seen moving toward the vessel when detected by the visual observers. Together with a significant increase in sightings close to the trackline, this behavioral data suggests vessel attraction is likely occurring and may be significant. Although Bradford et al. (2012) employed a half-normal model to minimize the effect of vessel attraction, any potential positive bias could not be entirely eliminated. The abundance estimate is presumably positively biased as a result of vessel attraction, but the extent of any bias is unknown. The acoustic data collected during the 2010 survey are still being analyzed and additional refinements to this estimate are expected.

Minimum Population Estimate

The log-normal 20th percentile of the 2010 abundance estimate for the Northwestern Hawaiian Islands stock (Bradford et al. 2012) is 262 false killer whales. This estimate has not been corrected for vessel attraction and may be an over-estimate of minimum population size.

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 the waters surrounding the Northwestern Hawaiian Islands.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Northwestern Hawaiian Islands false killer whale stock is calculated as the minimum population size (262) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a stock of unknown status, Wade and Angliss 1997), resulting in a PBR of 2.6 false killer whales per year.

STATUS OF STOCK

The status of false killer whales in Northwestern Hawaiian Islands waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Ylitalo et al. 2009 documented elevated levels of polychlorinated biphenyls (PCBs) in three of nine Hawaii insular false killer whales sampled, and biomass of some false killer whale prey species may have declined around the Northwestern Hawaiian Islands (Oleson et al. 2010, Boggs & Ito 1993, Reeves et al. 2009), though waters within the Papahānaumokuākea Marine National Monument have been closed to commercial longlining since 1991. This stock is not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The rate of mortality and serious injury to false killer whales within the Northwestern Hawaiian Islands is unknown, but may be approaching zero if the stock remains entirely within Monument waters and the longline exclusion zone near Kauai. Mortality and serious injury does not exceed the PBR (2.6) for this stock and thus, this stock is not considered "strategic" under the MMPA.

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FALSE KILLER WHALE (*Pseudorca crassidens*): Palmyra Atoll 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 known from southern Japan, Hawaii, and the eastern tropical Pacific. Four on-effort sightings of false killer whales were recorded during a 2005 shipboard survey of the U.S. Exclusive Economic Zone (EEZ) of Palmyra Atoll (Figure 1; Barlow & Rankin 2007). This species also occurs in U.S. EEZ waters around Hawaii (Barlow 2006, Bradford et al. 2012), Johnston Atoll (NMFS/PIR/PSD unpublished data), and American Samoa (Johnston et al. 2008, Oleson 2009).

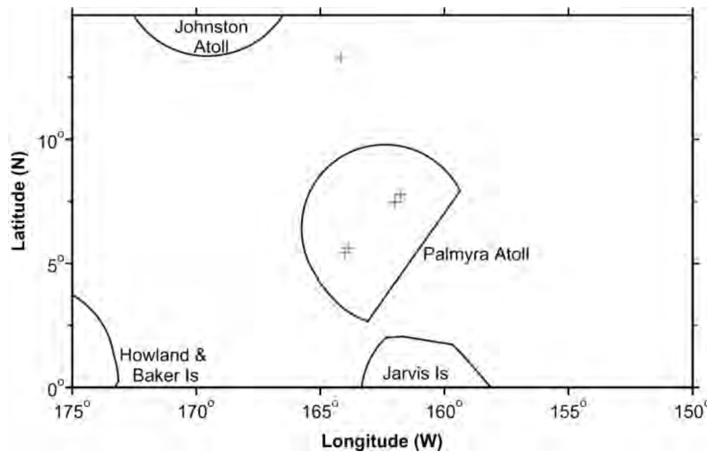

Figure 1. False killer whale on-effort sighting locations during a 2005 standardized shipboard survey of the Palmyra U.S. EEZ and pelagic waters of the central Pacific south of the Hawaiian Islands (gray crosses, Barlow and Rankin 2007). Solid lines represent approximate boundary of U.S. EEZs.

Genetic analyses indicate restricted gene flow between false killer whales sampled near the main Hawaiian Islands (MHI), the Northwestern Hawaiian Islands (NWHI), and in pelagic waters of the Eastern (ENP) and Central North Pacific (CNP) (Chivers et al. 2007, 2010, Martien et al. 2011). The Palmyra Atoll stock of false killer whales remains a separate stock, because comparisons amongst false killer whales sampled at Palmyra Atoll and those sampled from the insular stock of Hawaii and the pelagic ENP revealed restricted gene flow, although the sample size remains low for robust comparisons (Chivers et al. 2007, 2010). NMFS will obtain and analyze additional tissue samples from Palmyra and the broader tropical Pacific for genetic studies of stock structure, and will evaluate new information on stock ranges as it becomes available.

For the Marine Mammal Protection Act (MMPA) stock assessment reports, there are currently five Pacific Islands Region management stocks (Chivers et al. 2008, Martien et al. 2011): 1) the Hawaii insular stock, which includes animals inhabiting waters within 140 km (approx. 75 nmi) of the main Hawaiian Islands, 2) the Northwestern Hawaiian Islands stock, which includes false killer whales inhabiting waters within 93 km (50 nmi) of the NWHI and Kauai, 3) the Hawaii pelagic stock, which includes false killer whales inhabiting waters greater than 40 km (22 nmi) from the main Hawaiian Islands, 4) the Palmyra Atoll stock, which includes false killer whales found within the U.S. EEZ of Palmyra Atoll, and 5) the American Samoa stock, which includes false killer whales found within the U.S. EEZ of American Samoa. Estimates of abundance, potential biological removal, and status determinations for the Palmyra Atoll stock are presented below; the Hawaii Stock Complex and American Samoa Stocks are presented in separate reports.

POPULATION SIZE

A 2005 line transect survey in the U.S. EEZ waters of Palmyra Atoll produced an estimate of 1,329 (CV = 0.65) false killer whales (Barlow & Rankin 2007). This is the best available abundance estimate for false killer whales within the Palmyra Atoll EEZ.

Minimum Population Estimate

The log-normal 20th percentile of the 2005 abundance estimate for the Palmyra Atoll EEZ (Barlow & Rankin 2007) is 806 false killer whales.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Palmyra Atoll false killer whale stock is calculated as the minimum population size (806) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.40 (for a stock of unknown status with a mortality and serious injury rate CV >0.80; Wade and Angliss 1997), resulting in a PBR of 6.4 false killer whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Interactions with false killer whales, including depredation of catch, have been identified in logbooks and NMFS observer records from Hawaii pelagic longlines (Nitta and Henderson 1993, NMFS/PIR unpublished data). False killer whales have also been observed feeding on mahi mahi, *Coryphaena hippurus*, and yellowfin tuna, *Thunnus albacares*, and they have been reported to take large fish from the trolling lines of both commercial and recreational fishermen (Shallenberger 1981).

The Hawaii-based deep-set longline (DSLL) fishery targets primarily tunas and operate within U.S. waters and on the high seas near Palmyra Atoll. Between 2006 and 2010, one false killer whale was observed taken in the DSLL fishery within the Palmyra EEZ (≥20% observer coverage) (Forney 2011). Based on an evaluation of the observer's description of each interaction and following the most recently developed criteria for assessing serious injury in marine mammals (Andersen et al. 2008), the single false killer whale taken in the Palmyra EEZ was considered seriously injured (Forney 2011). The total estimated annual and 5-yr average mortality and serious injury of cetaceans in the DSLL fishery operating around Palmyra (with approximately 20% coverage) are reported by McCracken (2011) (Table 1). Although M&SI estimates are shown as whole numbers of animals, the 5-yr average M&SI is calculated based on the unrounded annual estimates.

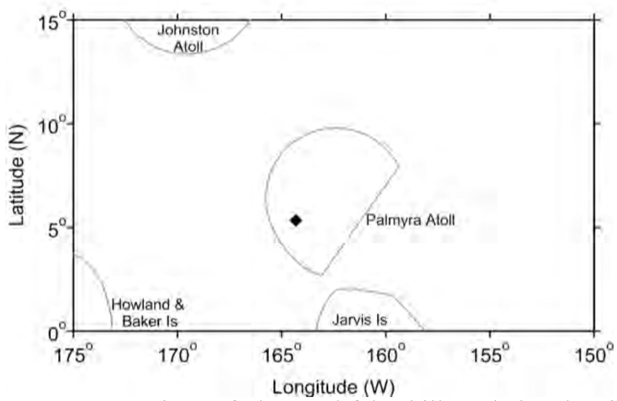

Figure 2. Locations of observed false killer whale takes in the Hawaii-based deep-set longline fishery, 2006-2010. Solid gray lines represent the U.S. EEZ. Fishery descriptions are provided in Appendix 1.

Because of high rates of false killer whale mortality and serious injury in Hawaii-based longline fisheries, a Take-Reduction Team (TRT) was established in January 2010 (75 FR 2853, 19 January 2010). The scope of the TRT was to reduce mortality and serious injury in the Hawaii pelagic, main Hawaiian Islands insular, and Palmyra stocks of false killer whales and across the DSLL and SSLL fisheries. The Team submitted a Draft Take-Reduction Plan to NMFS for consideration (Available at: http://www.nmfs.noaa.gov/pr/pdfs/interactions/fkwtrp_draft.pdf), and NMFS has recently published regulations based on this TRP (77 FR 71260, 29 November, 2012). The Team chose to exclude the Palmyra Atoll stock in the final implementation of the Plan due to low levels of M&SI of this stock for the past 5 years.

Table 1. Summary of available information on incidental mortality and serious injury of false killer whales (Palmyra Atoll stock) in the Hawaii-based longline fishery (McCracken 2011). Mean annual takes are based on 2006-2010 estimates unless otherwise indicated. Information on all observed takes (T) and combined mortality events & serious injuries (MSI) is included. Total takes were prorated to deaths, serious injuries, and non-serious injuries based on the observed proportions of each outcome.

Fishery Name	Year	Data Type	Percent Observer Coverage	Observed total interactions (T) and mortality events and serious injuries (MSI), and total estimated mortality and serious injury (M&SI) of false killer whales in the Palmyra Atoll EEZ	
				Observed T/MSI	Estimated Mean Annual Takes (CV)
Hawaii-based deep-set longline fishery	2006	observer data	22%	0/0	0 (-)
	2007		20%	1/1	2 (0.7)
	2008		22%	0/0	0 (-)
	2009		20%	0/0	0 (-)
	2010		21%	0/0	0 (-)
Minimum total annual takes within U.S. EEZ					**0.3 (1.7)**

STATUS OF STOCK

The status of false killer whales in Palmyra Atoll EEZ waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this stock. They are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The rate of mortality and serious injury to false killer whales within the Palmyra Atoll EEZ in the Hawaii-based longline fishery (0.3 animals per year) does not exceed the PBR (6.4) for this stock and thus, this stock is not considered "strategic" under the MMPA. The total fishery mortality and serious injury for Palmyra Atoll false killer whales is less than 10% of the PBR and, therefore, can be considered to be insignificant and approaching zero. Additional injury and mortality of false killer whales is known to occur in U.S and international longline fishing operations in international waters, and the potential effect on the Palmyra stock is unknown.

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FALSE KILLER WHALE *(Pseudorca crassidens)*: American Samoa Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

False killer whales are found worldwide mainly in tropical and warm-temperate waters (Stacey et al. 1994). The species is well-documented throughout the tropical and sub-tropical south Pacific, from Papua New Guinea and Australia to the line islands (Reeves et al. 1999). The species has been taken in the drive hunt in the Solomon Islands (Reeves et al 1999).). During small-boat surveys from 2003 to 2006 in the waters surrounding the island of Tutuila, American Samoa, false killer whales were observed during summer surveys on five occasions (Johnston et al 2008). During a shipboard survey in 2006 false killer whales were also encountered just north of the island of Ta'u, in the Manu'a Group within American Samoa (Johnston et al. 2008). Two false killer whales were entangled near 40-Fathom Bank south of the islands by the American Samoa-based longline fishery in 2008 (Oleson 2009), indicating some false killer whales maintain a more pelagic distribution. Five genetic samples collected near Tutuila are available for comparison to other false killer whale populations throughout the Pacific (Johnston et al 2008). For the Marine Mammal Protection Act (MMPA) stock assessment reports, there are four Pacific management stocks: 1) The Hawaii Insular Stock, which includes animals found within the 25-75 nmi longline exclusion boundary surrounding the main Hawaiian Islands, 2) The Hawaii Pelagic Stock, which includes animals found within the U.S. EEZ of the Hawaiian Islands but outside the 25-75 nmi longline exclusion zone, 3) The Palmyra Stock, which includes animals found within the U.S. EEZ of the Palmyra Atoll, and 4) The American Samoa Stock, which includes animals found within the U.S. EEZ American Samoa (this report).

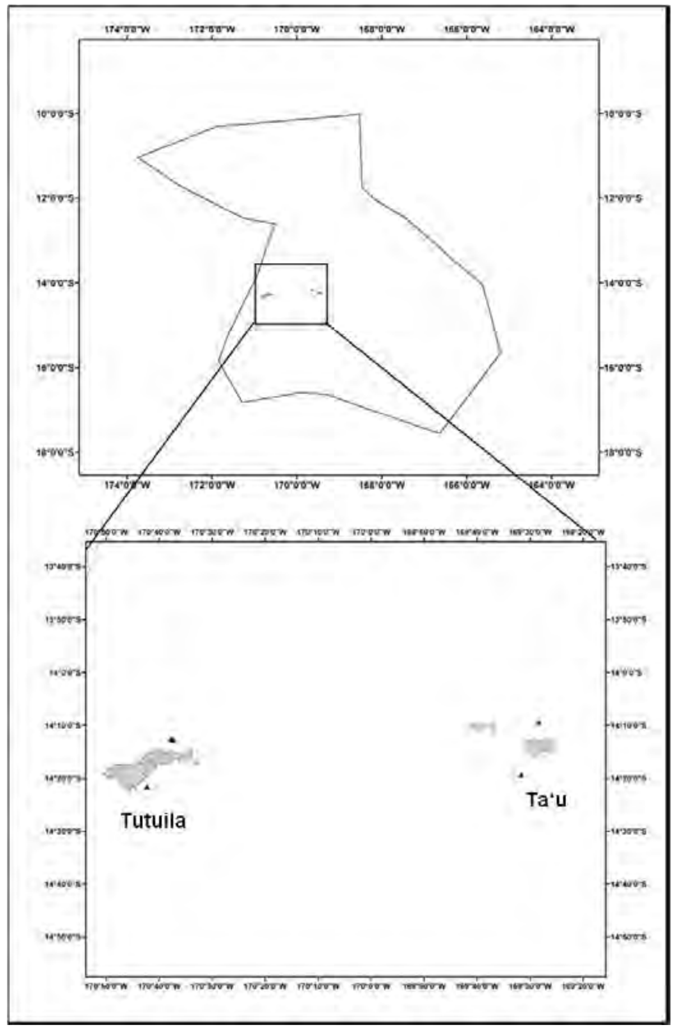

Figure 1. False killer whale sightings during visual surveys from 2003-2006 (Johnston et al 2008).

POPULATION SIZE

No abundance estimates are currently available for false killer whales in U.S. EEZ waters of American Samoa; however, density estimates for false killer whales in other tropical Pacific regions can provide a range of likely abundance estimates in this unsurveyed region. Published estimates of false killer whales (animals per km^2) in the Pacific are: 0.0002 (CV= 0.93) for the U.S. EEZ of the Hawaiian Islands (Barlow and Rankin 2007); 0.0038 (CV=0.65) for the U.S. EEZ around Palmyra, (Barlow and Rankin 2007), 0.0021 (CV=0.64) and 0.0016 (CV=0.31) for the eastern tropical Pacific Ocean (Wade and Gerrodette 1993; Ferguson and Barlow 2003). Applying the lowest and highest of these density estimates to U.S. EEZ waters surrounding American Samoa (area size = 404,578 km^2) yields a range of plausible abundance estimates of 87 – 1,538 false killer whales.

Minimum Population Estimate

No minimum population estimate is currently available for waters surrounding American Samoa, but the false killer whale density estimates from other tropical Pacific regions (Barlow and Rankin 2007, Wade and Gerrodette 1993, Ferguson and Barlow 2003, see above) can provide a range of likely values. The lognormal 20th percentiles of plausible abundance estimates for the American Samoa EEZ, based on the densities observed elsewhere, range from 45 – 936 false killer whales.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

No PBR can presently be calculated for false killer whales within the American Samoa EEZ, but based on the range of plausible minimum abundance estimates (45 - 936), a recovery factor of 0.40 (for a species of unknown status with a fishery mortality and serious injury rate CV > 0.80 within the American Samoa EEZ; Wade and Angliss 1997), and the default growth rate (½ of 4%), the PBR would likely fall between 0.4 and 7.5 false killer whales per year.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Information on fishery-related mortality of cetaceans in American Samoan waters is limited, but the gear types used in American Samoas fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Gillnets appear to capture marine mammals wherever they are used, and float lines from lobster traps and longlines can be expected to occasionally entangle cetaceans (Perrin et al. 1994). The primary fishery in American Samoa is the commercial pelagic longline fishery that targets tunas, which was introduced in 1995 (Levine and Allen 2009). In 2008, there were 28 federally permitted vessels within the longline fishery in American Samoa. The fishery has been monitored since March 2006 under a mandatory observer program, which records all interactions with protected species (Pacific Islands Regional Office 2009). Two false killer whales were killed or seriously injured by the fishery in 2008 (Oleson 2009). The average annual serious injury and mortality in commercial fisheries for false killer whales in American Samoa waters is 7.8 (CV=1.7) animals per year (Table 1).

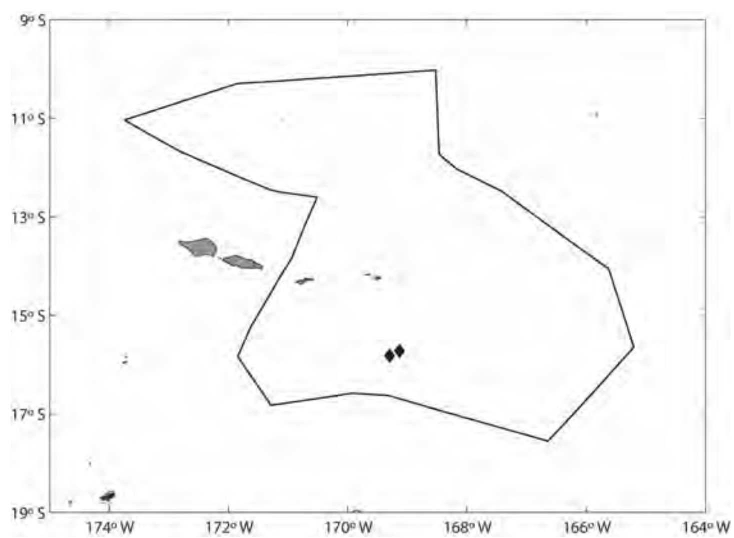

Figure 2. Locations of observed false killer whale takes (filled diamonds) in the American Samoa longline fishery, 2006-2008. Solid line represents the U.S. EEZ. Set locations in this fishery are summarized in Appendix 1.

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

STATUS OF STOCK

The status of false killer whales in American Samoan waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this stock. False killer whales are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The status of the American Samoa stock of false killer whales under the 1994 amendments to the MMPA cannot be determined at this time because no abundance estimates are available and PBR cannot be calculated. However, the estimated rate of fisheries related mortality and serious injury within the American Samoa EEZ (7.8 animals per year) exceeds the range of likely PBRs (0.4 – 7.5) for this region, suggesting that this stock would probably be strategic if abundance estimates were available. Additional research on the abundance of false killer whales in American Samoa is required to resolve this stock's status. Insufficient information is available to determine whether the total fishery mortality and serious injury for false killer whales is insignificant and approaching zero, but this appears unlikely given the estimated takes and likely PBR range.

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

Fishery Name	Year	Data Type	Percent Observer Coverage	Observed and estimated mortality and serious injury of false killer whales in the American Samoa EEZ		
				American Samoa EEZ		
				Obs.	Estimated (CV)	Mean Annual Takes (CV)
American Samoa-based longline fishery	2006 2007 2008	observer data	9.0% 7.7% 8.5%	0 0 2	0 (-) 0 (-) 23.5 (1.9)	7.8 (1.7)
Minimum total annual takes within U.S. EEZ waters						7.8 (1.7)

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KILLER WHALE (*Orcinus orca*): Hawaiian Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

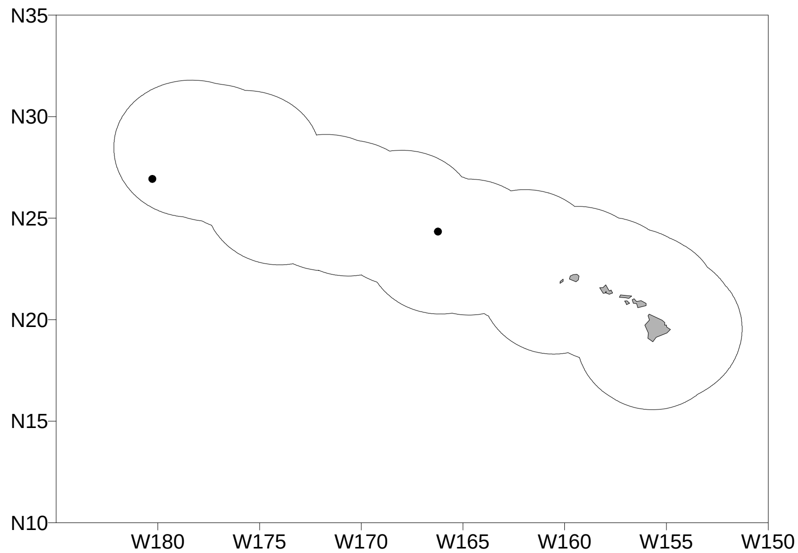

Figure 1. Killer whale sighting locations during the 2002 shipboard survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ.

Killer whales have been observed in all oceans and seas of the world (Leatherwood and Dahlheim 1978). Although reported from tropical and offshore waters (Heyning and Dahlheim 1988), killer whales prefer the colder waters of both hemispheres, with greatest abundances found within 800 km of major continents (Mitchell 1975). They are considered rare in Hawaiian waters. No killer whales were seen during 1993-98 aerial surveys within about 25 nmi of the main Hawaiian Islands, but one sighting was reported during subsequent surveys (Mobley et al. 2000, 2001). Two sightings of killer whales were made during a 2002 shipboard survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands (Figure 1; Barlow 2006). One stranding from the island of Hawaii was reported in 1950 (Richards 1952) and 21 additional sightings or strandings were reported around the main Hawaiian Islands, French Frigate Shoals, and offshore of the Hawaiian islands (Baird *et al.* 2006). Except in the northeastern Pacific where "resident", "transient", and "offshore" stocks have been described for coastal waters of Alaska, British Columbia, and Washington to California (Bigg 1982; Leatherwood et al. 1990, Bigg et al. 1990, Ford et al. 1994), little is known about stock structure of killer whales in the North Pacific. Baird et al. (2006) report a sighting of this species off the island of Hawaii in 2003 and also note analyses of genetic results from two samples collected, indicating a haplotype similar to the Gulf of Alaska "transient" killer whales and one similar to that of mammal eating killer whales in coastal Alaska. For the Marine Mammal Protection Act (MMPA) stock assessment reports, eight killer whale stocks are recognized within the Pacific U.S. EEZ: 1) the Eastern North Pacific Alaska Resident stock - occurring from southeastern Alaska to the Aleutian Islands and Bering Sea, 2) the Eastern North Pacific Northern Resident stock - occurring from British Columbia through part of southeastern Alaska, 3) the Eastern North Pacific Southern Resident stock – occurring mainly within the inland waters of Washington State and southern British Columbia, but also in coastal waters from British Columbia through California, 4) the Eastern North Pacific Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock - occurring mainly from Prince William Sound through the Aleutian Islands and Bering Sea, 5) the AT1 Transient stock - occurring in Alaska from Prince William Sound through the Kenai Fjords, 6) the West Coast Transient stock - occurring from California through southeastern Alaska, 7) the Eastern North Pacific Offshore stock - occurring from California through Alaska, and 8) the Hawaiian stock (this report). The Hawaii stock includes animals found both within the Hawaiian Islands EEZ and in adjacent international waters; however, because data on abundance, distribution, and human-caused impacts are largely lacking for international waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).Stock assessment reports for the Southern Resident, Eastern North Pacific Offshore, and Hawaiian stocks can be found in the Pacific Region stock assessment reports; all other killer whale stock assessments are included in the Alaska Region stock assessments.

POPULATION SIZE

Population sizes for killer whales in the coastal waters of British Columbia and Washington are known from photo-identification studies (Bigg et al. 1990). The population of killer whales in the eastern tropical Pacific has been estimated from shipboard sightings surveys (Wade and Gerrodette 1993). A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 349 (CV=0.98) killer whales (Barlow 2006). This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate (Barlow 2006) is 175 killer whales within the Hawaiian Islands EEZ.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current and maximum net productivity rate in Hawaiian waters.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size within the U.S. EEZ of the Hawaiian Islands (175) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a stock of unknown status with no known fishery mortality or serious injury within the Hawaiian Islands EEZ; Wade and Angliss 1997), resulting in a PBR of 1.8 killer whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Information on fishery-related mortality and serious injury of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Gillnets appear to capture marine mammals wherever they are used, and float lines from lobster traps and longlines can be expected to occasionally entangle cetaceans (Perrin et al. 1994).

Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nitta and Henderson 1993), but killer whale interactions appear to be rare. In 1990, a solitary killer whale was reported to have removed the catch from a longline in Hawaii (Dollar 1991). There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2004 and 2008, no killer whales were observed hooked or entangled in the SSLL fishery (100% observer coverage) or the DSLL fishery (20-28% observer coverage) (McCracken & Forney 2010). Interaction rates between dolphins and the NWHI bottomfish fishery have been estimated based on studies conducted in 1990-1993, indicating that an average of 2.67 dolphin interactions, most likely involving bottlenose and rough-toothed dolphins, occurred for every 1000 fish brought on board (Kobayashi and Kawamoto 1995). Fishermen claim interactions with dolphins that steal bait and catch are increasing. It is not known whether these interactions result in serious injury or mortality of dolphins, nor whether killer whales are involved.

STATUS OF STOCK

The status of killer whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this stock. This species is not listed as “threatened” or “endangered” under the Endangered Species Act (1973), nor as “depleted” under the MMPA. Given the absence of recent fishery-related mortality or serious injuries, the Hawaiian stock of killer whales is not considered strategic under the 1994 amendments to the MMPA, and the total fishery mortality and serious injury can be considered to be insignificant and approaching zero.

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Revised 01/15/2011

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Short-finned pilot whales are found in all oceans, primarily in tropical and warm-temperate waters. They are commonly observed around the main Hawaiian Islands and are also present around the Northwestern Hawaiian Islands (Shallenberger 1981; Barlow 2006). During a 2002 shipboard survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands, 25 sightings of short-finned pilot whales were made (Figure 1; Barlow 2006). Fourteen strandings of short-finned pilot whales have been documented from the main Hawaiian Islands, including five mass strandings (Tomich 1986; Nitta 1991; Maldini et al. 2005). Stock structure of short-finned pilot whales has not been adequately studied in the North Pacific, except in Japanese waters, where two forms have been identified based on pigmentation patterns and differences in the shape of the heads of adult males (Kasuya et al. 1988). The pilot whales in Hawaiian waters are similar morphologically to the Japanese "southern form." Preliminary photo-identification work with pilot whales in Hawaii indicated a high degree of site fidelity around the main island of Hawaii (Shane and McSweeney 1990) and around Kauai and Niihau (Baird et al. 2006).

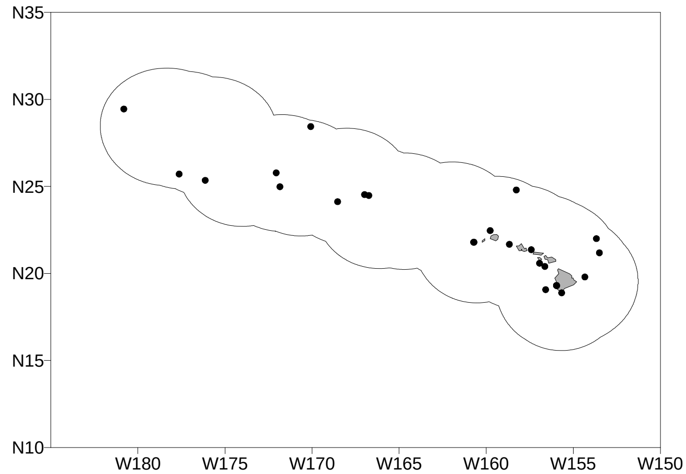

Figure 1. Short-finned pilot whale sighting locations during the 2002 shipboard survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006); see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ.

Genetic analyses of tissue samples collected near the main Hawaiian Islands indicate that Hawaiian short-finned pilot whales are reproductively isolated from short-finned pilot whales found in the eastern Pacific Ocean (S. Chivers, NMFS/SWFSC, unpublished data); however, the offshore range of this Hawaiian population is unknown. Fishery interactions with short-finned pilot whales demonstrate that this species also occurs in U.S. EEZ waters of Palmyra Atoll and Johnston Atoll (Figure 2), but it is not known whether these animals are part of the Hawaiian stock or whether they represent separate stocks of short-finned pilot whales. Based on patterns of movement and population structure observed in other island-associated cetaceans (Norris and Dohl 1980; Norris et al.1994; Baird et al. 2008a, 2008b, 2009, Chivers et al 2007, McSweeney et al. 2007, 2009), it is possible that the animals around Palmyra Atoll and Johnston Atoll are one or more separate stocks. Efforts are currently underway to obtain additional samples of short-finned pilot whales for further studies of population structure in the North Pacific Ocean. For the Marine Mammal Protection Act (MMPA) stock assessment reports, short-finned pilot whales within the Pacific U.S. EEZ are divided into two discrete, non-contiguous areas: 1) Hawaiian waters (this report), and 2) waters off California, Oregon and Washington. Information on short-finned pilot whales around Palmyra Atoll and Johnston 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. waters of the Hawaiian Islands, Palmyra Atoll, and Johnston Atoll. The Hawaii, Johnston, and Palmyra stocks each include animals found both within the Hawaiian Islands EEZ and in adjacent international waters; however, because data on abundance, distribution, and human-caused impacts are largely lacking for international waters, the status of each stock is evaluated based on data from U.S. EEZ waters (NMFS 2005).

POPULATION SIZE

Estimates of short-finned pilot whale populations have been made off Japan (Miyashita 1993) and in the eastern tropical Pacific (Wade and Gerrodette 1993), but it is not known whether any of these animals are part of the same population that occurs around the Hawaiian Islands. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 8,846 (CV=0.49) short-finned pilot whales (Barlow

2006). This is currently the best available abundance estimate for short-finned pilot whales within the Hawaiian Islands EEZ.

No abundance estimates are currently available for short-finned pilot whales in U.S. EEZ waters of Palmyra Atoll; however, density estimates for short-finned pilot whales in other Pacific regions can provide a range of likely abundance estimates in this unsurveyed region. Published estimates of short-finned pilot whale density (animals per km^2) in the Pacific are: 0.0040 (CV=0.38) for the U.S. EEZ of the Hawaiian Islands (Barlow 2006); 0.0237 (CV=0.32) for nearshore waters surrounding the main Hawaiian Islands (Mobley et al. 2000), 0.0084 (CV=0.14) and 0.0040 (CV=0.23) for the eastern tropical Pacific Ocean (Wade and Gerrodette 1993; Ferguson and Barlow 2003), and 0.0025 (CV=0.29) for the eastern tropical Pacific Ocean west of 120°W and north of 5°N (Ferguson and Barlow 2003). Applying the lowest and highest of these density estimates to U.S. EEZ waters surrounding Palmyra Atoll (area size = 352,821 km^2) yields a range of plausible abundance estimates of 891-8,362 short-finned pilot whales. Similarly, there are no abundance estimates for short-finned pilot whales in U.S. EEZ waters of Johnston Atoll. Applying the lowest and highest of the above density estimates to U.S. EEZ waters surrounding Johnston Atoll (area size = 443,586 km^2) yields a range of plausible abundance estimates of 1,121-10,513 short-finned pilot whales.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate for the Hawaiian Islands EEZ (Barlow 2006) is 5,986 short-finned pilot whales. No minimum population estimate is currently available for waters surrounding Palmyra Atoll or Johnston Atoll, but the short-finned pilot 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 20^{th} percentiles of plausible abundance estimates for the Palmyra Atoll EEZ, based on the densities observed elsewhere, range from 701 to 6,429 short-finned pilot whales. The lognormal 20th percentiles of plausible abundance estimates for the Johnston Atoll EEZ, based on the densities observed elsewhere, range from 882 to 8,083 short-finned pilot whales.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Hawaiian short-finned pilot whale stock is calculated as the minimum population size (5,986) <u>times</u> one half the default maximum net growth rate for cetaceans (½ of 4%) <u>times</u> a recovery factor of 0.40 (for a species of unknown status with a Hawaiian Islands EEZ fishery mortality and serious injury rate CV> 0.80; Wade and Angliss 1997), resulting in a PBR of 48 short-finned pilot whales per year. No separate PBR can presently be calculated for Palmyra Atoll waters, but based on the range of plausible minimum abundance estimates (701-6,429), a recovery factor of 0.50 (for a species of unknown status with no known fishery mortality and serious injury within the Palmyra Atoll EEZ; Wade and Angliss 1997), and the default growth rate (½ of 4%), the PBR would likely fall between 7.0 and 64 short-finned pilot whales per year. Similarly, based on the range of plausible minimum abundance estimates for Johnston Atoll (882-8,083), a recovery factor of 0.40 (for a species of unknown status with a fishery mortality and serious injury rate CV>0.80 within the Johnston Atoll EEZ; Wade and Angliss 1997), and the default growth rate (½ of 4%), the PBR would likely fall between 7.1 and 65 short-finned pilot whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Information on fishery-related mortality of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Gillnets appear to capture marine mammals wherever they are used, and float lines from lobster traps and longlines can be expected to occasionally entangle cetaceans (Perrin et al. 1994).

Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nitta and Henderson 1993). There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2004 and 2008, no short-finned pilot whales were observed hooked or entangled in the SSLL fishery (100% observer coverage), and eight short-finned pilot whales were observed taken in the DSLL fishery (20-28% observer coverage) (Forney 2009, McCracken 2009). Based on an evaluation of the observer's description of the interaction and following the most recently developed criteria for assessing serious injury in marine mammals (Andersen et al. 2008), two short-finned pilot whales taken in international waters were considered not seriously injured, and the remaining six (four in international waters, one in the Hawaiian Islands EEZ, and one in the EEZ of Johnston Atoll) were considered seriously injured (Forney 2009). Average 5-yr estimates of annual mortality and serious injury for 2004-2008 are 2.0 (CV = 0.5) short-finned pilot whales outside of U.S. EEZs, 0.7 (CV=1.4) within the Hawaiian Islands EEZ, and 0.5 (CV=0.8) within the Johnston Atoll EEZ (McCracken & Forney 2010). Eight additional unidentified cetaceans, which may have been short-finned-pilot whales, were also taken during 2004-2008. Six of these were taken in the DSLL fishery in Hawaiian Islands EEZ waters, one was taken in the DSLL fishery in international waters, and one was taken in the SSLL fishery in international waters (Figure 2). 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 short-finned pilot whales are involved.

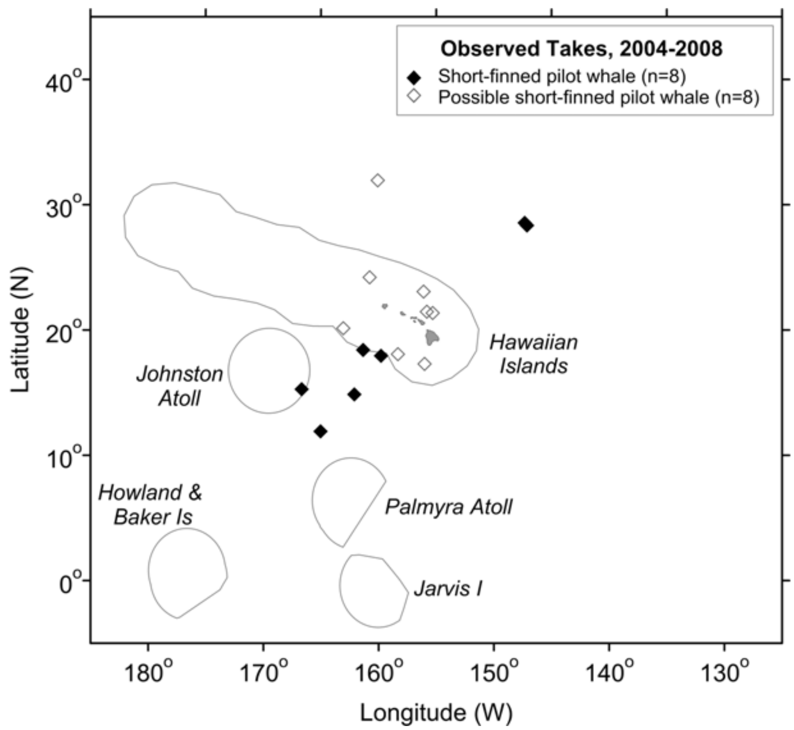

Figure 2. Locations of short-finned pilot whale takes (filled diamonds) and possible takes of this species (open diamonds) in Hawaii-based longline fisheries, 2004-2008 . Solid lines represent the U. S. EEZ. Fishery descriptions are provided in Appendix 1.

STATUS OF STOCK

The status of short-finned pilot whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this species. It is not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The Hawaiian stock of short-finned pilot whales is not considered strategic under the 1994 amendments to the MMPA, because the estimated rate of mortality and serious injury within the Hawaiian Islands EEZ (0.7 animals per year) is less than the PBR (52). Although no estimates of abundance or PBR are currently available for short-finned pilot whales around Johnston Atoll, the estimated average rate of mortality and serious injury of short-finned pilot whales within the EEZ of Johnston Atoll (0.5 animals per year) is below the range of likely PBRs (7.1 to 65) for this region. There have been no serious injuries or mortality of short-finned pilot whales within the Palmyra Atoll EEZ. The potential effects of mortality and serious injuries of short-finned pilot whales in the Hawaii-based fishery in international waters is not known, because no abundance estimates or international bycatch estimates are available. Based on the available data, which indicate total fishery-related takes are less than 10% of PBR, the total fishery mortality and serious injury for short-finned pilot whales can be considered to be insignificant and approaching zero.

Table 1. Summary of available information on incidental mortality and serious injury of short-finned pilot whales (Hawaiian stock) in commercial fisheries, within and outside of the U.S. EEZs (McCracken & Forney 2010). Mean annual takes are based on 2004-2008 data unless otherwise indicated.

Fishery Name	Year	Data Type	Percent Observer Coverage	Observed and estimated mortality and serious injury of short-finned pilot whales, by EEZ region								
				Outside of U.S. EEZs			Hawaiian Islands EEZ			Johnston 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 deep-set longline fishery	2004	observer data	25%	0	0 (-)	2.0 (0.5)	0	0 (-)	0.7 (1.4)	1	3 (0.2)	0.5 (0.8)
	2005		28%	1	4 (0.4)		0	0 (-)		0	0 (-)	
	2006		22%	1	1 (2.1)		1	4 (0.7)		0	0 (-)	
	2007		20%	1	2 (1.5)		0	0 (-)		0	0 (-)	
	2008		22%	1	3 (0.8)		0	0 (-)		0	0 (-)	
Hawaii-based shallow-set longline fishery	2004	observer data	100%	0	Same as observed	0 (n/a)	0	Same as observed	0	0	Same as observed	0
	2005		100%	0			0			0		
	2006		100%	0			0			0		
	2007		100%	0			0			0		
	2008		100%	0			0			0		
Minimum total annual takes within U.S. EEZ waters							1.2 (1.02)					

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BLAINVILLE'S BEAKED WHALE (*Mesoplodon densirostris*): Hawaiian Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Blainville's beaked whale has a cosmopolitan distribution in tropical and temperate waters, apparently the most extensive known distribution of any *Mesoplodon* species (Mead 1989). Two strandings were reported in 1961 from Midway Island (Galbreath 1963) and another in 1983 from Laysan Island (Nitta 1991). Sixteen sightings were reported from the main islands by Shallenberger (1981), who suggested that Blainville's beaked whales were present off the Waianae Coast of Oahu for prolonged periods annually. Resightings of individual Blainville's beaked whales during a 21-yr study suggests long-term site fidelity and year round occurrence off the island of Hawaii (McSweeney et al. 2007). Three sightings were made during a 2002 shipboard survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands (Figure 1; Barlow 2006). Recent analysis of Blainville's beaked whale movements off the Island of Hawaii suggest the existence of insular and offshore populations of this species in Hawaiian waters; however, further movement and genetic studies are needed to better understand individual movements and stock structure of Blainville's beaked whales in Hawaii (McSweeney et al. 2007, Baird et al. 2009, Schorr et al., 2009).. Some genetic samples have been collected recently from around the main Hawaiian islands, (R.W. Baird, pers. comm.). For the Marine Mammal Protection Act (MMPA) stock assessment reports, three *Mesoplodon* stocks are defined within the Pacific U.S. EEZ: 1) *M. densirostris* in Hawaiian waters (this report), 2) *M. stejnegeri* in Alaskan waters, and 3) all *Mesoplodon* species off California, Oregon and Washington. The Hawaiian stock of Blainville's beaked whales includes animals found both within the Hawaiian Islands EEZ and in adjacent international waters; however, because data on abundance, distribution, and human-caused impacts are largely lacking for international waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

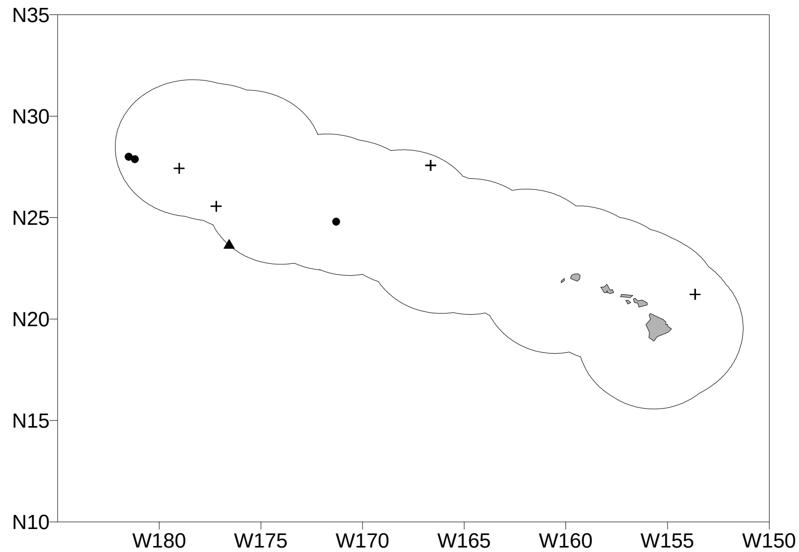

Figure 1. Sighting locations of *Mesoplodon densirostris* (filled circles), *Indopacetus pacificus* (triangle), and unidentified *Mesoplodon* beaked whales (cross) during the 2002 shipboard cetacean survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006; see Appendix 2 for details on timing and location of survey effort). Outer line indicates approximate boundary of survev area and U.S. EEZ.

POPULATION SIZE

Based on the photo-identification catalog for the island of Hawaii, a minimum of 55 individuals are known to occur there (McSweeney *et al.* 2007). A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 2,872 (CV=1.17) Blainville's beaked whales (Barlow 2006), including a correction factor for missed diving animals. This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate (Barlow 2006) is 1,314 Blainville's beaked whales within the Hawaiian Islands EEZ.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size within the U.S. EEZ of the Hawaiian Islands (1,314) 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 recent fishery mortality or serious injury within the Hawaiian Islands EEZ; Wade and Angliss 1997), resulting in a PBR of 13 Blainville's beaked whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Information on fishery-related mortality of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Gillnets appear to capture marine mammals wherever they are used, and float lines from lobster traps and longlines can be expected to occasionally entangle cetaceans (Perrin et al. 1994).

Interactions with cetaceans are reported for all pelagic fisheries (Nitta and Henderson 1993). There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2004 and 2008, no Blainville's beaked whale was observed killed or seriously injured in the SSLL fishery (100% observer coverage) or the DSLL fishery (20-28% observer coverage) (Forney 2009, McCracken 2009) and one Blainville's beaked whale was observed taken, but not seriously injured, in international waters in the DSLL fishery (20-28% observer coverage) (McCracken & Forney 2010). Average 5-yr estimates of annual mortality and serious injury for 2004-2008 are 0.7 (CV=0.9) Blainville's beaked whales outside of the U.S. EEZs, and zero within the Hawaiian Islands EEZ (Table 1).

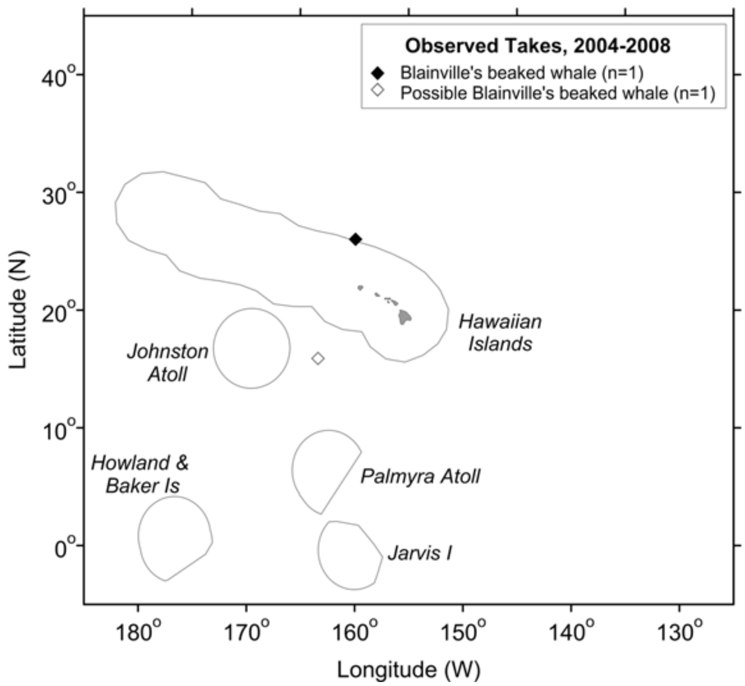

Figure 2. Location of the Blainville's beaked whale take (filled diamond) and the possible take of this species (open diamonds) in Hawaii-based longline fisheries, 2004-2008. Solid lines represent the U.S. EEZ. Fishery descriptions are provided in Appendix 1.

Other Mortality

In recent years, there has been increasing concern that loud underwater sounds, such as active sonar and seismic operations, may be harmful to beaked whales (Malakoff 2002). The use of active sonar from military vessels has been implicated in mass strandings of beaked whales in the Mediterranean Sea during 1996 (Frantzis 1998), the Bahamas during 2000 (U.S. Dept. of Commerce and Secretary of the Navy 2001), and the Canary Islands 2002 (Martel 2002). Similar military active sonar operations occur around the Hawaiian islands. It has been suggested that quick ascent from deep dives in response to acoustic exposure could lead to death in beaked whales (Cox *et al.* 2006). A modeling exercise based on dive data from Blainville's, Cuvier's and northern bottlenose whales suggest that the dive habits of all three species produce tissue nitrogen saturation levels that would normally cause decompression sickness in terrestrial mammals (Hooker *et al.* 2009). The impact of sonar exercises on resident versus offshore beaked whales may be significantly different with offshore animals less frequently exposed, possibly subject to more extreme reactions (Baird *et al.* 2009). No estimates of potential mortality or serious injury are available for U.S. waters.

Table 1. Summary of available information on incidental mortality and serious injury of Blainville's beaked whales (Hawaiian stock) in commercial fisheries, within and outside of the Hawaiian Islands EEZ (McCracken & Forney 2010). Mean annual takes are based on 2004-2008 data unless otherwise indicated.

Fishery Name	Year	Data Type	Percent Observer Coverage	Mortality and Serious Injury outside of U.S. EEZ			Mortality and Serious Injury within Hawaiian Islands EEZ		
				Observed	Estimated (CV)	Mean Annual Takes (CV)	Observed	Estimated (CV)	Mean Annual Takes (CV)
Hawaii-based deep-set longline fishery	2004 2005 2006 2007 2008	Observer data	25% 28% 22% 20% 22%	0 0 0 0 0	0 (-) 3 (0.3) 0 (-) 0 (-) 0 (-)	0.7 (0.9)	0 0 0 0 0	0 (-) 0 (-) 0 (-) 0 (-) 0 (-)	0 (-)
Hawaii-based shallow-set longline fishery	2004 2005 2006 2007 2008	Observer data	100% 100% 100% 100% 100%	0 0 0 0 0	Same as observed	0	0 0 0 0 0	Same as observed	0
Minimum total annual takes within U.S. EEZ waters									0 (-)

STATUS OF STOCK

The status of Blainville's beaked whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. It is not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. . Given the absence of recent fishery-related mortality or serious injuries within U.S. EEZs, the Hawaiian stock of Blainville's beaked whales is not considered strategic under the 1994 amendments to the MMPA, and the total fishery mortality and serious injury can be considered to be insignificant and approaching zero. However, the effect of potential interactions of Blainville's beaked whales and unidentified beaked whales (some of which may have been Blainville's beaked whales) with the Hawaii-based longline fishery in international waters is not known. The increasing level of anthropogenic noise in the world's oceans has been suggested to be a habitat concern for whales (Richardson et al. 1995), particularly for deep-diving whales like Blainville's beaked whales that feed in the oceans' "sound channel".

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Cuvier's beaked whales occur in all oceans and major seas (Heyning 1989). In Hawaii, five strandings have been reported from Midway Islands, Pearl and Hermes Reef, Oahu, and Hawaii Islands (Shallenberger 1981; Galbreath 1963; Richards 1952; Nitta 1991; Maldini et al. 2005). Sightings have been reported off Lanai and Maui (Shallenberger 1981) and Hawaii, Ni'ihau, and Kauai (Mobley 2000, Baird et al. 2004, 2009). Four sightings were made during a 2002 shipboard survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian islands (Figure 1; Barlow 2006). While nothing is known about stock structure, some genetic samples have been collected recently from around the island of Hawaii. Resightings of individual Cuvier's beaked whales during a 21-yr study suggests long-term site fidelity and year round occurrence off the island of Hawaii (McSweeney *et al* 2007). For the Marine Mammal Protection Act (MMPA) stock assessment reports, Cuvier's beaked whales within the Pacific U.S. EEZ are divided into three discrete, non-contiguous areas: 1) Hawaiian waters (this report), 2) Alaskan waters, and 3) waters off California, Oregon and Washington. The Hawaiian stock includes animals found both within the Hawaiian Islands EEZ and in adjacent international waters; however, because data on abundance, distribution, and human-caused impacts are largely lacking for international waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

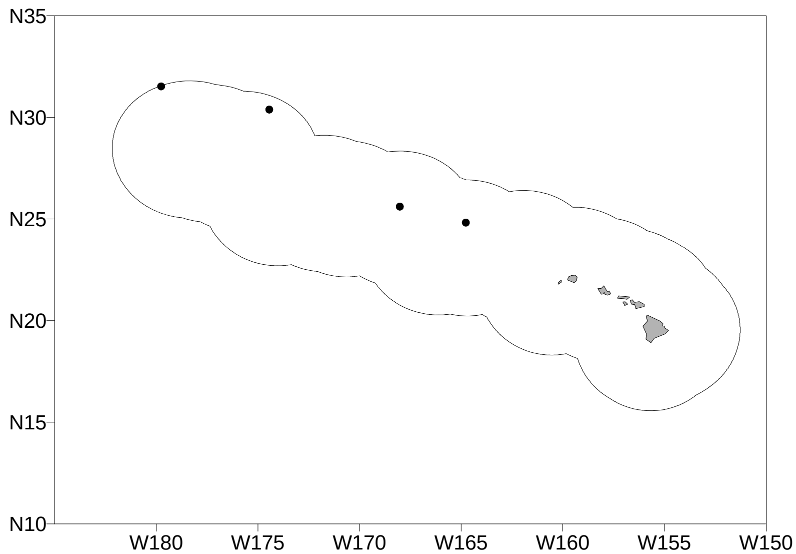

Figure 1. Cuvier's beaked whale sighting locations during the 2002 shipboard survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ.

POPULATION SIZE

Wade and Gerrodette (1993) made an estimate for Cuvier's beaked whales in the eastern tropical Pacific, but it is not known whether any of these animals are part of the same population that occurs around the Hawaiian Islands. The data on which this estimate was based are now over 8 years old. Based on the photo-identification catalog for the island of Hawaii, a minimum of 35 individuals are known to occur there (McSweeney *et al.* 2007). . A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 15,242 (CV=1.43) Cuvier's beaked whales (Barlow 2006), including a correction factor for missed diving animals. This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate (Barlow 2006) is 6,269 Cuvier's beaked whales within the Hawaiian Islands EEZ.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size within the U.S. EEZ of the Hawaiian Islands (6,269) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no known fishery mortality within the Hawaiian Islands EEZ; Wade and Angliss 1997), resulting in a PBR of 63 Cuvier's beaked whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Information on fishery-related mortality of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Gillnets appear to capture marine mammals wherever they are used, and float lines from lobster traps and longlines can be expected to occasionally entangle cetaceans (Perrin et al. 1994).

Interactions with cetaceans are reported for all pelagic fisheries (Nitta and Henderson 1993). There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2004 and 2008, no Cuvier's beaked whales were observed hooked or entangled in the SSLL fishery (100% observer coverage) or the DSLL fishery (20-28% observer coverage) (McCracken & Forney 2010) .However, one unidentified cetacean, which may have been a Cuvier's beaked whale, was taken in the DSLL fishery in international waters (Forney 2009). .

Other Mortality

In recent years, there has been increasing concern that loud underwater sounds, such as active sonar and seismic operations, may be harmful to beaked whales (Malakoff 2002). The use of active sonar from military vessels has been implicated in mass strandings of beaked whales in the Mediterranean Sea during 1996 (Frantzis 1998), the Bahamas during 2000 (U.S. Dept. of Commerce and Secretary of the Navy 2001), and the Canary Islands 2002 (Martel 2002). Similar military active sonar operations occur around the Hawaiian islands. It has been suggested that quick ascent from deep dives in response to acoustic exposure could lead to death in beaked whales (Cox *et al.* 2006). A modeling exercise based on dive data from Blainville's, Cuvier's and northern bottlenose whales suggest that the dive habits of all three species produce tissue nitrogen saturation levels that would normally cause decompression sickness in terrestrial mammals (Hooker *et al.* 2009). The longer dives and shorter surface intervals of Cuvier's beaked whales may put them at higher risk for decompression sickness than other species, possibly increasing their susceptibility to high-intensity underwater noise (Hooker *et al.* 2009). No estimates of potential mortality or serious injury are available for U.S. waters.

STATUS OF STOCK

The status of Cuvier's beaked whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. It is not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. Because there have been no reported fishery related mortality or injuries within the Hawaiian Islands EEZ, the Hawaiian stock of Cuvier's beaked whales is not considered strategic under the 1994 amendments to the MMPA, and the total mortality and serious injury can be considered to be insignificant and approaching zero. The increasing level of anthropogenic noise in the world's oceans has been suggested to be a habitat concern for whales (Richardson et al. 1995), particularly for deep-diving whales like Cuvier's beaked whales that feed in the oceans' "sound channel".

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Longman's beaked whale is considered one of the rarest and least known cetacean species (Jefferson et al. 1993; Rice 1998; Dalebout et al 2003). Until recently, it was known only from two skulls found in Australia and Somalia (Longman 1926; Azzaroli 1968). Recent genetic studies (Dalebout et al. 2003) have revealed that sightings of 'tropical bottlenose whales' (*Hyperoodon* sp.; Pitman et al. 1999) in the Indopacific region were in fact Longman's beaked whales, providing the first description of the external appearance of this species. Although originally described as *Mesoplodon pacificus* (Longman 1926), it has been proposed that this species is sufficiently unique to be placed within its own genus, *Indopacetus* (Moore 1968; Dalebout et al. 2003). The distribution of Longman's beaked whale, as determined from stranded specimens and sighting records of 'tropical bottlenose whales', includes tropical waters from the eastern Pacific westward through the Indian Ocean to the eastern coast of Africa. No strandings of Longman's beaked whales have been documented in Hawaiian waters, although numerous strandings of unidentified beaked whales have been reported (Nitta 1991; Maldini et al. 2005). One sighting of Longman's beaked whale was made during a 2002 survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands (Figure 1; Barlow 2006). For the Marine Mammal Protection Act (MMPA) stock assessment reports, there is one Pacific stock of Longman's beaked whales, found within waters of the Hawaiian Islands EEZ. This stock includes animals found both within the Hawaiian Islands EEZ and in adjacent international waters; however, because data on abundance, distribution, and human-caused impacts are largely lacking for international waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

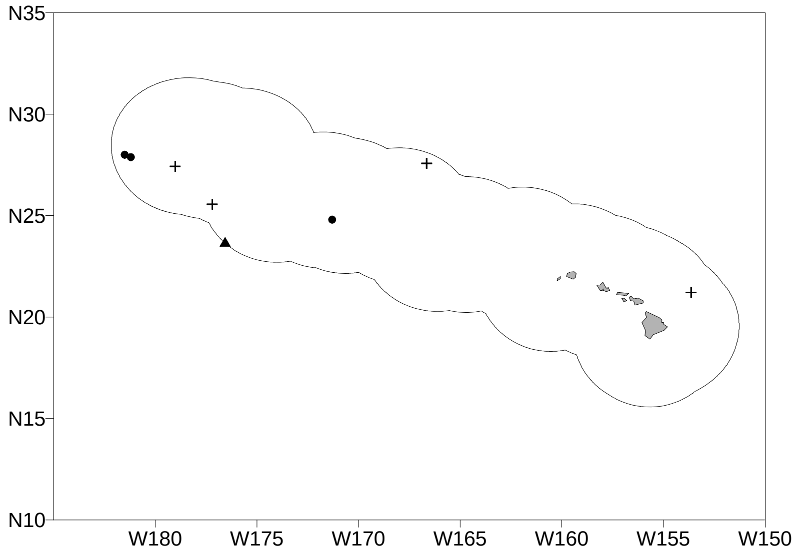

Figure 1. Sighting locations of *Indopacetus pacificus* (triangle), *Mesoplodon densirostris* (circle) and unidentified *Mesoplodon* beaked whales (crosses) during the 2002 shipboard cetacean survey of U.S. waters surrounding the Hawaiian Islands (Barlow 2006; see Appendix 2 for details on timing and location of survey effort). Outer line indicates approximate boundary of survey area and U.S. EEZ.

POPULATION SIZE

A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 1,007 (CV=1.25) Longman's beaked whales (Barlow 2006). This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate (Barlow 2006) is 443 Longman's beaked whales within the Hawaiian Islands EEZ.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate for Longman's beaked whales.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size within the U.S. EEZ of the Hawaiian Islands (443) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a stock of unknown status with no known fishery mortality or serious injury within the Hawaiian Islands EEZ; Wade and Angliss 1997), resulting in a PBR of 4.4 Longman's beaked whales per year.

HUMAN CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Information on fishery-related mortality and serious injury of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Gillnets appear to capture marine mammals wherever they are used, and float lines from lobster traps and longlines can be expected to occasionally entangle cetaceans (Perrin et al. 1994).

Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nitta and Henderson 1993). There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2004 and 2008, no Longman's beaked whales were observed hooked or entangled in the SSLL fishery (100% observer coverage) or the DSLL fishery (20-28% observer coverage) (McCracken & Forney 2010). However, one unidentified cetacean, which may have been a Longman's beaked whale, was taken in the DSLL fishery. .

Other Mortality

In recent years, there has been increasing concern that loud underwater sounds, such as active sonar and seismic operations, may be harmful to beaked whales (Malakoff 2002). The use of active sonar from military vessels has been implicated in mass strandings of beaked whales in the Mediterranean Sea during 1996 (Frantzis 1998), the Bahamas during 2000 (U.S. Dept. of Commerce and Secretary of the Navy 2001), and the Canary Islands 2002 (Martel, 2002). Similar military active sonar operations occur around the Hawaiian Islands. It has been suggested that quick ascent from deep dives in response to acoustic exposure could lead to death in beaked whales (Cox *et al.* 2006). A modeling exercise based on dive data from Blainville's, Cuvier's and northern bottlenose whales suggest that the dive habits of all three species produce tissue nitrogen saturation levels that would normally cause decompression sickness in terrestrial mammals (Hooker *et al.* 2009). No estimates of potential mortality or serious injury are available for U.S. waters.

STATUS OF STOCK

The status of Longman's beaked whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. It is not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. Given the absence of recent fishery-related mortality or serious injuries, the Hawaiian stock of Longman's beaked whales is not considered strategic under the 1994 amendments to the MMPA, and the total fishery mortality and serious injury can be considered to be insignificant and approaching zero. The increasing level of anthropogenic noise in the world's oceans has been suggested to be a habitat concern for whales (Richardson et al. 1995), particularly for deep-diving whales like Longman's beaked whales that feed in the oceans' "sound channel".

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Revised 01/15/2011

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Pygmy sperm whales are found throughout the world in tropical and warm-temperate waters (Caldwell and Caldwell 1989). Between the years 1949 and 2008, at least 35 strandings of this species were reported in the Hawaiian Islands (Shallenberger 1981, Tomich 1986; Nitta 1991; Maldini et al. 2005, NMFS database). A stranded calf was held for several days at Sea Life Park (Pryor 1975). Shallenberger (1981) reported three sightings off Oahu and Maui. Two sightings of pygmy or dwarf (*Kogia sima*) sperm whales were made between Hawaii and Maui during 1993-98 aerial surveys within about 25 nmi of the main Hawaiian Islands (Mobley et al. 2000). Two sightings were made during a 2002 shipboard survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands (Figure 1; Barlow 2006). Baird (2005) reported one sighting off Niihau and another off the island off Hawaii (R.W. Baird, pers. comm.). Nothing is known about stock structure for this species. For the Marine Mammal Protection Act (MMPA) stock assessment reports, pygmy sperm whales within the Pacific U.S. EEZ are divided into two discrete, non-contiguous areas: 1) Hawaiian waters (this report), and 2) waters off California, Oregon and Washington. The Hawaiian stock includes animals found both within the Hawaiian Islands EEZ and in adjacent international waters; however, because data on abundance, distribution, and human-caused impacts are largely lacking for international waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

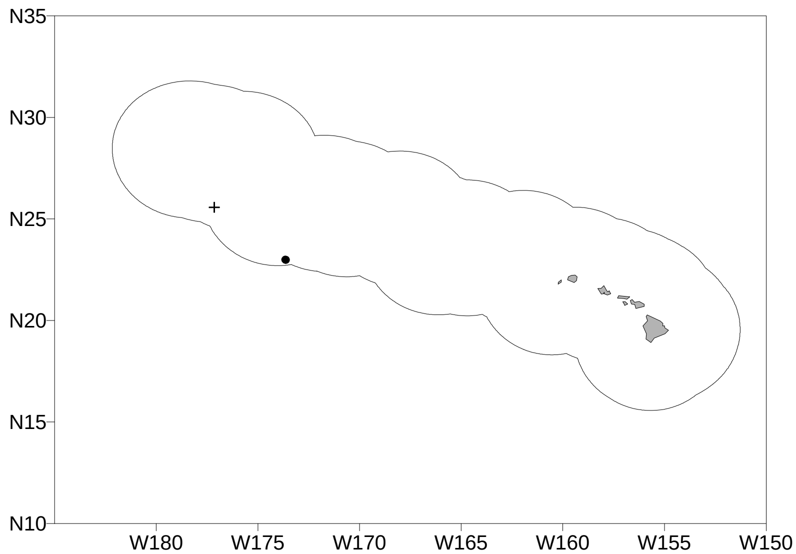

Figure 1. Sighting locations of pygmy sperm whales (filled circle) and unidentified *Kogia* (cross) during the 2002 shipboard cetacean survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006; see Appendix 2 for details on timing and location of survey effort). Outer line indicates approximate boundary of survey area and U.S. EEZ.

POPULATION SIZE

A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 7,138 (CV=1.12) pygmy sperm whales (Barlow 2006), including a correction factor for missed diving animals. This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate (Barlow 2006) is 3,341 pygmy sperm whales within the Hawaiian Islands EEZ.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size within the U.S EEZ of the Hawaiian Islands (3,341) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a stock of unknown status with no known fishery mortality or serious injury within the Hawaiian Islands EEZ; Wade and Angliss 1997), resulting in a PBR of 33 pygmy sperm whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Information on fishery-related mortality of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Gillnets appear to capture marine mammals wherever they are used, and float lines from lobster traps and longlines can be expected to occasionally entangle cetaceans (Perrin et al. 1994). Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nitta and Henderson 1993). There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2004 and 2008, one pygmy or dwarf sperm whale was observed hooked in the SSLL fishery (100% observer coverage) (Figure 2, McCracken & Forney 2010). Based on an evaluation of the observer's description of the interaction and following the most recently developed criteria for assessing serious injury in marine mammals (Andersen et al. 2008), this animal was considered not seriously injured (Forney 2009). No pygmy sperm whales were observed hooked or entangled in the DSLL fishery (20-28% observer coverage).

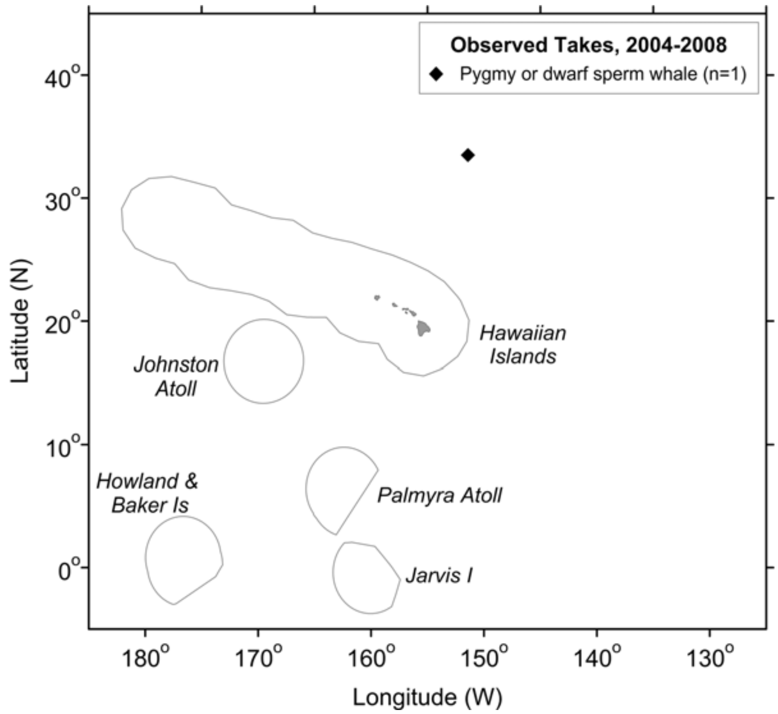

Figure 2. Location of pygmy or dwarf sperm whale take (filled diamond) in Hawaii-based longline fisheries, 2004-2008. Solid lines represent the U.S. EEZs. Fishery descriptions are provided in Appendix 1.

STATUS OF STOCK

The status of pygmy sperm whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. It is not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. Given the absence of recent fishery-related mortality or serious injuries within the Hawaiian Islands EEZ, the Hawaiian stock of pygmy sperm whales is not considered strategic under the 1994 amendments to the MMPA, and the total fishery mortality and serious injury can be considered to be insignificant and approaching zero. The increasing level of anthropogenic noise in the world's oceans has been suggested to be a habitat concern for whales (Richardson et al. 1995), particularly for deep-diving whales like pygmy sperm whales that feed in the oceans' "sound channel".

Table 1. Summary of available information on incidental mortality and serious injury of pygmy sperm whales (Hawaiian stock) in commercial fisheries, within and outside of the Hawaiian Islands EEZ (McCracken & Forney 2010). Mean annual takes are based on 2004-2008 data unless otherwise indicated; n/a = not available.

Fishery Name	Year	Data Type	Percent Observer Coverage	Mortality and Serious Injury outside of U.S. EEZ			Mortality and Serious Injury within Hawaiian Islands EEZ		
				Observed	Estimated (CV)	Mean Annual Takes (CV)	Observed	Estimated (CV)	Mean Annual Takes (CV)
Hawaii-based deep-set longline fishery	2004	observer data	25%	0	0 (-)	0 (-)	0	0 (-)	0 (-)
	2005		28%	0	0 (-)		0	0 (-)	
	2006		22%	0	0 (-)		0	0 (-)	
	2007		20%	0	0 (-)		0	0 (-)	
	2008		22%	0	0 (-)		0	0 (-)	
Hawaii-based shallow-set longline fishery	2004	observer data	100%	0	Same as observed	0.2	0	Same as observed	0
	2005		100%	0			0		
	2006		100%	0			0		
	2007		100%	0			0		
	2008		100%	1*			0		
Minimum total annual takes within U.S. EEZ waters									0

*One animal, which was either a pygmy sperm whale or dwarf sperm whales, observed not seriously injured.

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Revised 01/15/2011

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Dwarf sperm whales are found throughout the world in tropical to warm-temperate waters (Nagorsen 1985). Rice (1998) recently argued that the species name *simus*, was incorrect and should be replaced by *sima* to reflect rules of Latin usage. At least four strandings of dwarf sperm whales have been documented in Hawaii (Tomich 1986; Nitta 1991; Maldini et al. 2005). Two sightings of pygmy or dwarf sperms whales were made between Hawaii and Maui during 1993-98 aerial surveys within about 25 nmi of the main Hawaiian Islands (Mobley et al. 2000), and dwarf sperm whales were seen near Niihau, Kauai, Lanai, and Hawaii during small boat surveys between 2000 and 2003 (Baird et al 2005). Five sightings of dwarf sperm 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). For the Marine Mammal Protection Act (MMPA) stock assessment reports, dwarf sperm whales within the Pacific U.S. EEZ are divided into two discrete, non-contiguous areas: 1) Hawaiian waters (this report), and 2) waters off California, Oregon and Washington. The Hawaiian stock includes animals found both within the Hawaiian Islands EEZ and in adjacent international waters; however, because data on abundance, distribution, and human-caused impacts are largely lacking for international waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

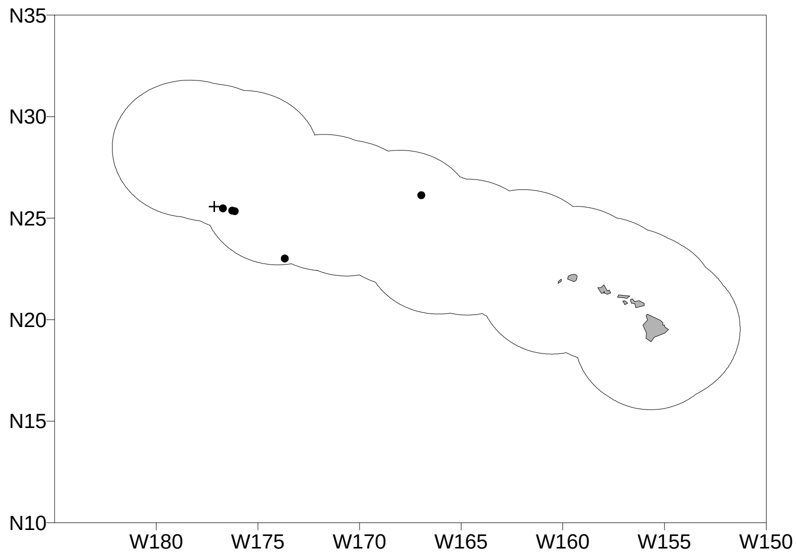

Figure 1. Sighting locations of dwarf sperm whales (filled circle) and unidentified *Kogia* (cross) during the 2002 shipboard cetacean survey of U.S. waters surrounding the Hawaiian Islands (Barlow 2006; see Appendix 2 for details on timing and location of survey effort). Outer line indicates approximate boundary of survey area and U.S. EEZ.

POPULATION SIZE

Wade and Gerrodette (1993) provided an estimate for the eastern tropical Pacific, but it is not known whether these animals are part of the same population that occurs in the central North Pacific. Baird (2005) reports that dwarf sperm whales are the sixth most commonly sighted odontocete around the Main Hawaiian Islands. This species' small size, tendency to avoid vessels, deep-diving habits, combined with the high proportion of *Kogia* sightings that are not identified to species, may result in negatively biased relative abundances in this region (R.W. Baird, pers. comm.). A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 17,519 (CV=0.74) dwarf sperm whales (Barlow 2006), including a correction factor for missed diving animals. This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate (Barlow 2006) is 10,043 dwarf sperm whales within the Hawaiian Islands EEZ.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size within the U.S. EEZ of the Hawaiian Islands (10,043) <u>times</u> one half the default maximum net growth rate for cetaceans (½ of 4%) <u>times</u> a recovery factor of 0.50 (for a stock of unknown status with no known fishery mortality or serious injury within the Hawaiian Islands EEZ; Wade and Angliss 1997), resulting in a PBR of 100 dwarf sperm whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Information on fishery-related mortality of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Gillnets appear to capture marine mammals wherever they are used, and float lines from lobster traps and longlines can be expected to occasionally entangle cetaceans (Perrin et al. 1994). Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nitta and Henderson 1993). There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2004 and 2008, one pygmy or dwarf sperm whale was observed hooked in the SSLL fishery (100% observer coverage) (Figure 2, McCracken & Forney 2010). Based on an evaluation of the observer's description of the interaction and following the most recently developed criteria for assessing serious injury in marine mammals (Andersen et al. 2008), this animal was considered not seriously injured (Forney 2009). No dwarf sperm whales were observed hooked or entangled in the DSLL fishery (20-28% observer coverage).

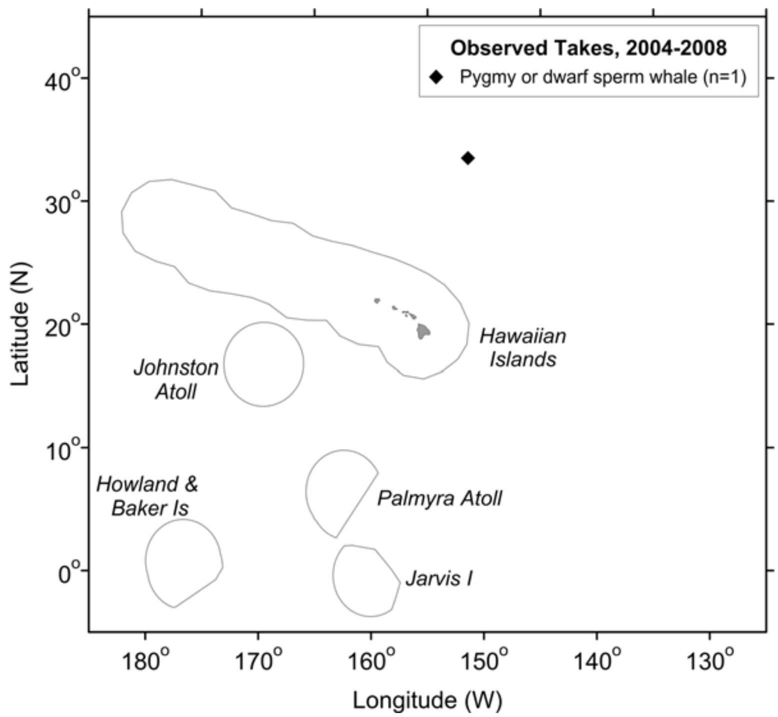

Figure 2. Location of pygmy or dwarf sperm whale take (filled diamond) in Hawaii-based longline fisheries, 2004-2008. Solid lines represent the U.S. EEZs. Fishery descriptions are provided in Appendix 1.

STATUS OF STOCK

The status of dwarf sperm whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. It is not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. Because there have been no reported fishery related mortality or injuries within the Hawaiian Islands EEZ, the Hawaiian stock of dwarf sperm whales is not considered strategic under the 1994 amendments to the MMPA, and the total mortality and serious injury can be considered to be insignificant and approaching zero. The increasing levels of anthropogenic noise in the world's oceans has been suggested to be a habitat concern for whales (Richardson et al. 1995), particularly for deep-diving whales like dwarf sperm whales that feed in the oceans' "sound channel".

Table 1. Summary of available information on incidental mortality and serious injury of pygmy sperm whales (Hawaiian stock) in commercial fisheries, within and outside of the Hawaiian Islands EEZ (McCracken & Forney 2010). Mean annual takes are based on 2004-2008 data unless otherwise indicated; n/a = not available.

Fishery Name	Year	Data Type	Percent Observer Coverage	Mortality and Serious Injury Outside of U.S. EEZ			Mortality and Serious Injury within Hawaiian Islands EEZ		
				Observed	Estimated (CV)	Mean Annual Takes (CV)	Observed	Estimated (CV)	Mean Annual Takes (CV)
Hawaii-based deep-set longline fishery	2004	observer data	25%	0	0 (-)	0 (-)	0	0 (-)	0 (-)
	2005		28%	0	0 (-)		0	0 (-)	
	2006		22%	0	0 (-)		0	0 (-)	
	2007		20%	0	0 (-)		0	0 (-)	
	2008		22%	0	0 (-)		0	0 (-)	
Hawaii-based shallow-set longline fishery	2004	observer data	100%	0	Same as observed	0.2	0	Same as observed	0
	2005		100%	0			0		
	2006		100%	0			0		
	2007		100%	0			0		
	2008		100%	1*			0		
Minimum total annual takes within U.S. EEZ waters									0 (-)

*One animal, which was either a pygmy sperm whale or dwarf sperm whales, observed not seriously injured.

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SPERM WHALE (*Physeter macrocephalus*): Hawaiian Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Sperm whales are widely distributed across the entire North Pacific and into the southern Bering Sea in summer but the majority are thought to be south of 40^{o}N in winter (Rice 1974, 1989; Gosho et al. 1984; Miyashita et al. 1995). For management, the International Whaling Commission (IWC) had divided the North Pacific into two management regions (Donovan 1991) defined by a zig-zag line which starts at 150^{o}W at the equator, is 160^{o}W between 40-50^{o}N, and ends up at 180^{o}W north of 50^{o}N; however, the IWC has not reviewed this stock boundary in many years (Donovan 1991). Summer/fall surveys in the eastern tropical Pacific (Wade and Gerrodette 1993) show that although sperm whales are widely distributed in the tropics, their relative abundance tapers off markedly westward towards the middle of the tropical Pacific (near the IWC stock boundary at 150^{o}W) and tapers off northward towards the tip of Baja California. The Hawaiian Islands marked the center of a major nineteenth century whaling ground for sperm whales (Gilmore 1959; Townsend 1935). Since 1936, at least 18 strandings have been reported from Oahu, Kauai and Kure Atoll (Woodward 1972; Nitta 1991; Maldini et al. 2005). Sperm whales have also been sighted around several of the Northwestern Hawaiian Islands (Rice 1960; Barlow 2006), off the main island of Hawaii (Lee 1993; Mobley et al. 2000) in the Kauai Channel and in the Alenuihaha Channel between Maui and the island of Hawaii (Shallenberger 1981). In addition, the sounds of sperm whales have been recorded throughout the year off Oahu (Thompson and Friedl 1982). A summer/fall 2002 shipboard survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands resulted in 43 sperm whale sightings throughout the study area (Figure 1; Barlow 2006).

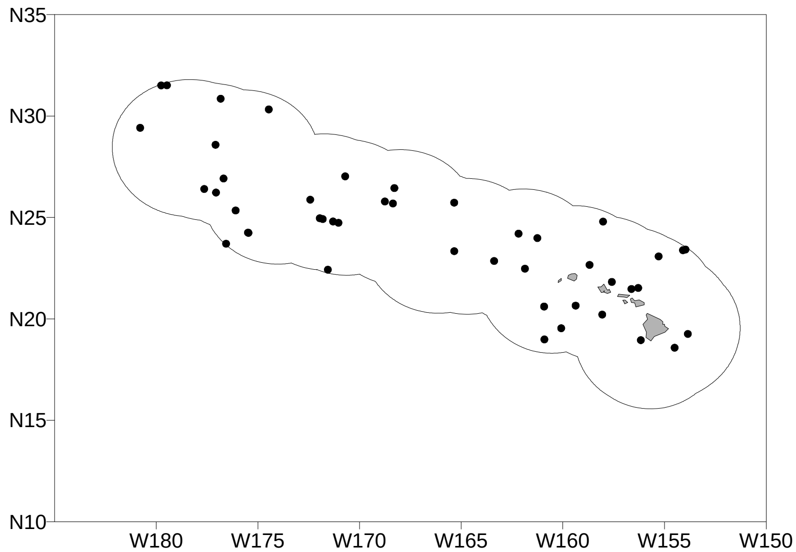

Figure 1. Sperm whale sighting locations during the 2002 shipboard survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ.

The stock identity of sperm whales in the North Pacific has been inferred from historical catch records (Bannister and Mitchell 1980) and from trends in CPUE and tag-recapture data (Ohsumi and Masaki 1977), but much uncertainty remains. A 1997 survey designed specifically to investigate stock structure and abundance of sperm whales in the northeastern temperate Pacific revealed no apparent hiatus in distribution between the U.S. EEZ off California and areas farther west, out to Hawaii (Barlow and Taylor 2005). Very preliminary genetic analyses revealed significant differences between sperm whales off the coast of California, Oregon and Washington and those sampled offshore to Hawaii (Mesnick et al., unpubl. data); analyses of additional genetic samples are ongoing at the NMFS, Southwest Fisheries Science Center. For the Marine Mammal Protection Act (MMPA) stock assessment reports, sperm whales within the Pacific U.S. EEZ are divided into three discrete, non-contiguous areas: 1) waters around Hawaii (this report), 2) California, Oregon and Washington waters, and 3) Alaskan waters. This stock includes animals found both within the Hawaiian Islands EEZ and in adjacent international waters; however, because data on abundance, distribution, and human-caused impacts are largely lacking for international waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

POPULATION SIZE

A large 1982 abundance estimate for the entire eastern North Pacific (Gosho et al. 1984) was based on a

CPUE method which is no longer accepted as valid by the International Whaling Commission. A spring 1997 combined visual and acoustic line-transect survey conducted in the eastern temperate North Pacific resulted in estimates of 26,300 (CV=0.81) sperm whales based on visual sightings, and 32,100 (CV=0.36) based on acoustic detections and visual group size estimates (Barlow and Taylor 2005). Sperm whales appear to be a good candidate for acoustic surveys due to the increased range of detection; however, visual estimates of group size are still required (Barlow and Taylor 2005). In the eastern tropical Pacific, the abundance of sperm whales has been estimated as 22,700 (95% C.I.=14,800-34,600; Wade and Gerrodette 1993). However, it is not known whether any or all of these animals routinely enter the U.S. EEZ of the Hawaiian Islands. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 6,919 (CV=0.81) sperm whales (Barlow 2006), including a correction factor for missed diving animals. This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate (Barlow 2006) is 3,805 sperm whales within the Hawaiian Islands EEZ.

Current Population Trend

No data on current population trend are available.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (3,805) within the U.S. EEZ of the Hawaiian Islands <u>times</u> one half the default maximum net growth rate for cetaceans (½ of 4%) <u>times</u> a recovery factor of 0.2 (for an endangered species with N_{min} > 1,500 and CV_{Nmin} > 0.50, with low vulnerability to extinction (Taylor et al. 2003)), resulting in a PBR of 15 sperm whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Information on fishery-related mortality of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Gillnets appear to capture marine mammals wherever they are used, and float lines from lobster traps and longlines can be expected to occasionally entangle cetaceans (Perrin et al. 1994).

Interactions with cetaceans are reported for all pelagic fisheries, and large whales have been entangled in longlines off the Hawaiian Islands (Nitta and Henderson 1993; Forney 2009). There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2004 and 2008, no sperm whales were observed hooked or entangled in the SSLL fishery (100% observer coverage) or the DSLL fishery (20-28% observer coverage) (McCracken & Forney 2010).

Historical Mortality

Between 1800 and 1909, about 60,842 sperm whales were estimated taken in the North Pacific (Best 1976). The reported take of North Pacific sperm whales by commercial whalers between 1947 and 1987 totaled 258,000 (C. Allison, pers. comm.). Factory ships operated as far south as 20^{o}N (Ohsumi 1980). Ohsumi (1980) lists an additional 28,198 sperm whales taken mainly in coastal whaling operations from 1910 to 1946. Based on the massive under-reporting of Soviet catches, Brownell et al. (1998) estimate that about 89,000 whales were additionally taken by the Soviet pelagic whaling fleet between 1949 and 1979. The Japanese coastal operations apparently also under-reported catches by an unknown amount (Kasuya 1998). Thus a total of at least 436,000 sperm whales were taken between 1800 and the end of commercial whaling for this species in 1987. Of this grand total, an estimated 33,842 were taken by Soviet and Japanese pelagic whaling operations in the eastern North Pacific from the longitude of Hawaii to the U.S. West coast, between 1961 and 1976 (Allen 1980, IWC statistical Areas II and III), and 965 were reported taken in land-based U.S. West coast whaling operations between 1947 and 1971 (Ohsumi 1980). In addition, 13 sperm whales were taken by shore whaling stations in California between 1919 and 1926 (Clapham et al. 1997). There has been a prohibition on taking sperm whales in the North Pacific since 1988, but large-scale pelagic whaling stopped earlier, in 1980. Some of the whales taken during the whaling era were certainly from a population or populations that occur within Hawaiian waters.

STATUS OF STOCK

The only estimate of the status of North Pacific sperm whales in relation to carrying capacity (Gosho et al. 1984) is based on a CPUE method which is no longer accepted as valid. The status of sperm whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Sperm whales are formally listed as "endangered" under the Endangered Species Act (ESA), and consequently the Hawaiian stock is automatically considered as a "depleted" and "strategic" stock under the MMPA. Given the absence of recent fishery-related mortality or serious injuries within the Hawaiian Islands EEZ, the Hawaiian stock of sperm whales is not considered strategic under the 1994 amendments to the MMPA, and the total fishery mortality and serious injury can be considered to be insignificant and approaching zero. The increasing level of anthropogenic noise in the world's oceans has been suggested to be a habitat concern for whales (Richardson et al. 1995), particularly for deep-diving whales like sperm whales that feed in the oceans' "sound channel".

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The International Whaling Commission (IWC) has formally considered only one management stock for blue whales in the North Pacific (Donovan 1991), but up to five populations have been proposed (Reeves et al. 1998). Rice (1974) hypothesized that blue whales from Baja California migrated far offshore to fed in the eastern Aleutians or Gulf of Alaska and returned to feed in California waters; however, he has more recently concluded that the California population is separate from the Gulf of Alaska population (Rice 1992). Length frequency analyses (Gilpatrick et al. 1996) and photo-identification studies (Calambokidis et al. 1995) support separate population status for blue whales feeding off California and those feeding in Alaskan waters. Whaling catch data indicate that whales feeding along the Aleutian Islands are probably part of a central Pacific stock (Reeves et al. 1998), which may migrate to offshore waters north of Hawaii in winter (Berzin and Rovnin 1966). Blue whale feeding aggregations have not been found in Alaska despite several surveys (Leatherwood et al. 1982; Stewart et al. 1987; Forney and Brownell 1996); however, blue whale calls have been recorded there between 1995 and 2001 (Stafford et al. 2001, Stafford 2003).

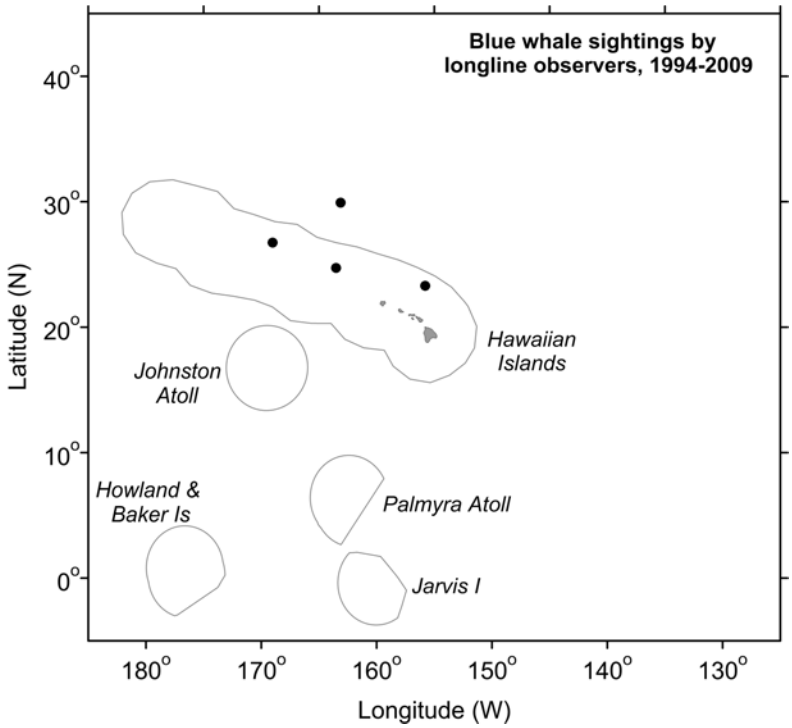

Figure 1. Locations of four blue whale sightings made by observers aboard Hawaii-based longline fishing vessels between July 1994 and December 2009 (NMFS/PIR unpublished data). Solid lines represent the U.S. Exclusive Economic Zone (EEZ).

Recent analyses of acoustic data obtained throughout the North Pacific Ocean (Stafford et al. 2001; Stafford 2003) has revealed two distinct blue whale call types, suggesting two North Pacific stocks: eastern and central (formerly western). The regional occurrence patterns indicate that blue whales from the eastern North Pacific stock winter off Mexico, central America, and as far south as 8° S (Stafford et al. 1999), and feed during summer off the U. S. West Coast and to a lesser extent in the Gulf of Alaska, . This stock has previously been documented to feed in waters off California (and occasionally as far north as British Columbia; Calambokidis et al. 1998) in summer/fall (from June to November) migrating south to productive areas off Mexico (Calambokidis et al. 1990) and as far south as the Costa Rica Dome (10° N) in winter/spring (Mate et al. 1999, Stafford et al. 1999). Blue whales belonging to the central Pacific stock appear to feed in summer southwest of Kamchatka, south of the Aleutians, and in the Gulf of Alaska (Stafford 2003; Watkins et al. 2000), and in winter they migrate to lower latitudes in the western Pacific and less frequently in the central Pacific, including Hawaii (Stafford et al. 2001). The only published sighting record of blue whales near Hawaii is that of Berzin and Rovnin (1966). Two sightings have been made by observers on Hawaii-based longline vessels (Figure 1; NMFS/PIR, unpublished data). Additional evidence that blue whales occur in this area comes from acoustic recordings made off Oahu and Midway Islands (Northrop et al. 1971; Thompson and Friedl 1982), which included at least some within the U.S. Exclusive Economic Zone (EEZ). The recordings made off Hawaii showed bimodal peaks throughout the year (Stafford et al. 2001), with central Pacific call types heard during winter and eastern Pacific calls heard during summer. For the Marine Mammal Protection Act (MMPA) stock assessment reports, there are two blue whale stocks within the

Pacific U.S. EEZ: 1) the central North Pacific stock (this report), which includes whales found around the Hawaiian Islands during winter and 2) the eastern North Pacific stock, which feeds primarily off California.

POPULATION SIZE

From ship line-transect surveys, Wade and Gerrodette (1993) estimated 1,400 blue whales for the eastern tropical Pacific. No blue whale sightings were made during a summer 1994 shipboard survey south of the Aleutian Islands (Forney and Brownell 1996), during twelve aerial surveys conducted in 1993-98 within about 25 nmi of the main Hawaiian Islands (Mobley et al. 2000), or during a summer/fall 2002 shipboard surveys of the entire Hawaiian Islands EEZ (Barlow 2006). Therefore, no estimate of abundance is available for the central Pacific blue whale stock.

Minimum Population Estimate

No data are available to provide a minimum population estimate.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

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

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Information on fishery-related mortality of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Gillnets appear to capture marine mammals wherever they are used, and float lines from lobster traps and longlines can be expected to occasionally entangle cetaceans (Perrin et al. 1994). Interactions with cetaceans are reported for all pelagic fisheries, and large whales have been entangled in longline gear off the Hawaiian Islands (Nitta and Henderson 1993, Forney 2009). . There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2004 and 2008, no blue whales were observed hooked or entangled in the SSLL fishery (100% observer coverage) or the DSLL fishery (20-28% observer coverage) (McCracken & Forney 2010).

Historical Mortality

At least 9,500 blue whales were taken by commercial whalers throughout the North Pacific between 1910 and 1965 (Ohsumi and Wada 1972). Some proportion of this total may have been from a population or populations that migrate seasonally into the Hawaiian EEZ. The species has been protected in the North Pacific by the IWC since 1966.

STATUS OF STOCK

The status of blue whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Blue whales are formally listed as "endangered" under the Endangered Species Act (ESA), and consequently the central Pacific stock is automatically considered as a "depleted" and "strategic" stock under the MMPA. Because there have been no reported fishery related mortality or serious injuries of blue whales within the Hawaiian Islands EEZ, the total fishery-related mortality and serious injury of this stock can be considered to be insignificant and approaching zero. Increasing levels of anthropogenic noise in the world's oceans has been suggested to be a habitat concern for blue whales (Reeves et al. 1998).

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Revised 01/15/2011

FIN WHALE (*Balaenoptera physalus physalus*): Hawaiian Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Fin whales are found throughout all oceans and seas of the world from tropical to polar latitudes. They have been considered rare in Hawaiian waters and are absent to rare in eastern tropical Pacific waters (Hamilton et al. 2009). Balcomb (1987) observed 8-12 fin whales in a multispecies feeding assemblage on 20 May 1966 approx. 250 mi. south of Honolulu. Additional sightings were reported north of Oahu in May 1976 and in the Kauai Channel in February 1979 (Shallenberger 1981). More recently, a single fin whale was observed north of Kauai in February 1994 (Mobley et al. 1996), and five sightings were made during a 2002 survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands (Barlow 2003; Figure 1). A single stranding has been reported on Maui (Shallenberger 1981). Thompson and Friedl (1982; and see Northrop et al. 1968) suggested that fin whales migrate into Hawaiian waters mainly in fall and winter, based on acoustic recordings off Oahu and Midway Islands. Although the exact positions of the whales producing the sounds could not be determined, at least some of them were almost certainly within the U.S. EEZ. More recently, McDonald and Fox (1999) reported an average of 0.027 calling fin whales per 1000^2 km (grouped by 8-hr periods) based on passive acoustic recordings within about 16 km of the north shore of Oahu.

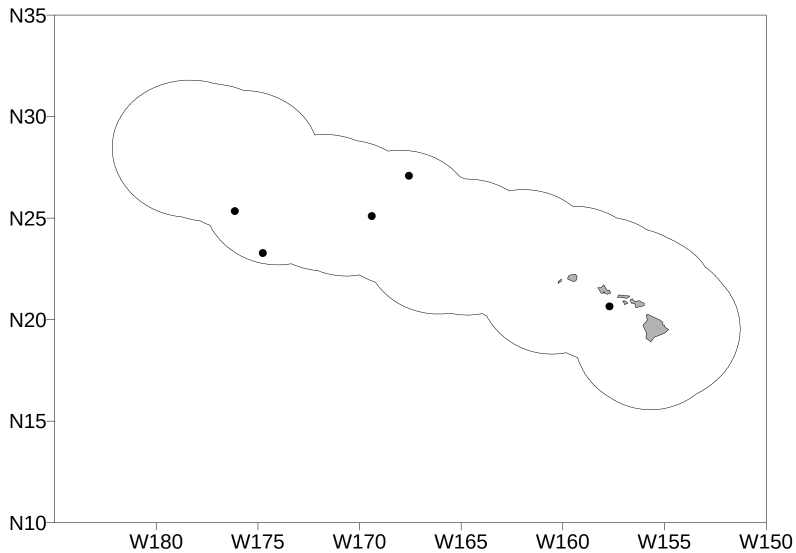

Figure 1. Fin whale sighting locations during the 2002 shipboard survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2003; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ.

The International Whaling Commission (IWC) recognized two stocks of fin whales in the North Pacific: the East China Sea and the rest of the North Pacific (Donovan 1991). Mizroch et al. (1984) cite evidence for additional fin whale subpopulations in the North Pacific. There is still insufficient information to accurately determine population structure, but from a conservation perspective it may be risky to assume panmixia in the entire North Pacific. In the North Atlantic, fin whales were locally depleted in some feeding areas by commercial whaling (Mizroch et al. 1984), in part because subpopulations were not recognized. The Marine Mammal Protection Act (MMPA) stock assessment reports recognize three stocks of fin whales in the North Pacific: 1) the Hawaii stock (this report), 2) the California/Oregon/Washington stock, and 3) the Alaska stock. The Hawaiian stock includes animals found both within the Hawaiian Islands EEZ and in adjacent international waters; however, because data on abundance, distribution, and human-caused impacts are largely lacking for international waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

POPULATION SIZE

Using passive acoustic detections from a hydrophone north of Oahu, MacDonald and Fox (1999) estimate an average density of 0.027 calling fin whales per 1000 km^2 within about 16 km from shore. However, the relationship between the number of whales present and the number of calls detected is not known, and therefore this acoustic method does not provide an estimate of absolute abundance for fin whales. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 174 (CV=0.72) fin whales (Barlow 2003). This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate is 101 fin whales within the Hawaiian Islands EEZ.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size within the U.S EEZ of the Hawaiian Islands (101) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.1 (the default value for an endangered species; Wade and Angliss 1997), resulting in a PBR of 0.2 fin whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Information on fishery-related mortality of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Gillnets appear to capture marine mammals wherever they are used, and float lines from lobster traps and longlines can be expected to occasionally entangle cetaceans (Perrin et al. 1994). Interactions with cetaceans are reported for all pelagic fisheries, and large whales have been entangled in longline gear off the Hawaiian Islands (Nitta and Henderson 1993, Forney 2009). There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2004 and 2008, no fin whales were observed hooked or entangled in the SSLL fishery (100% observer coverage) or the DSLL fishery (20-28% observer coverage) (McCracken & Forney 2010).

Historical Mortality

Large numbers of fin whales were taken by commercial whalers throughout the North Pacific from the early 20th century until the 1970s (Tønnessen and Johnsen 1982). Approximately 46,000 fin whales were taken from the North Pacific by commercial whalers between 1947 and 1987 (C. Allison, IWC, pers. comm.). Some of the whales taken may have been from a population or populations that migrate seasonally into the Hawaiian EEZ. The species has been protected in the North Pacific by the IWC since 1976.

STATUS OF STOCK

The status of fin whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Fin whales are formally listed as "endangered" under the Endangered Species Act (ESA), and consequently the Hawaiian stock is automatically considered as a "depleted" and "strategic" stock under the MMPA. Because there have been no reported fishery related mortality or serious injuries within the Hawaiian Islands EEZ, the total fishery-related mortality and serious injury of this stock can be considered to be insignificant and approaching zero. The increasing level of anthropogenic noise in the world's oceans has been suggested to be a habitat concern for whales (Richardson et al. 1995).

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

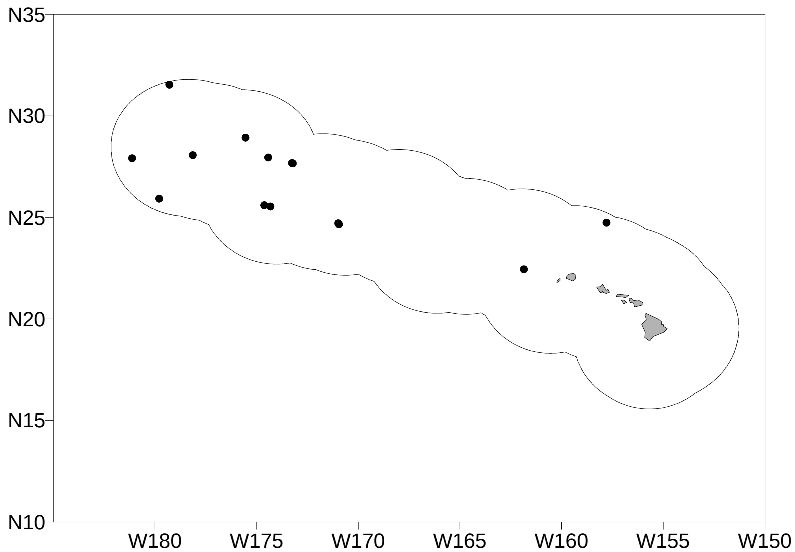

Figure 1. Bryde's whale sighting locations during the 2002 shipboard survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow2006; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ.

Bryde's whales occur in tropical and warm temperate waters throughout the world. Shallenberger (1981) reported a sighting of a Bryde's whale southeast of Nihoa in April 1977 (see DeLong and Brownell 1977; Leatherwood et al. 1982: Fig. 39c). Leatherwood et al. (1982) described the species as relatively abundant in summer and fall on the Mellish and Miluoki banks northeast of Hawaii and around Midway Islands, but the basis for this statement was not explained. Ohsumi and Masaki (1975) reported the tagging of "many" Bryde's whales between the Bonin and Hawaiian Islands in the winters of 1971 and 1972 (Ohsumi 1977). A summer/fall 2002 shipboard survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands resulted in 13 Bryde's whale sightings throughout the study area (Figure 1; Barlow 2006).With presently available evidence, there is no biological basis for defining separate stocks of Bryde's whales in the central North Pacific. Bryde's whales also occasionally occur off southern California (Morejohn and Rice 1973). For the MMPA stock assessment reports, Bryde's whales within the Pacific U.S. EEZ are divided into two areas: 1) Hawaiian waters (this report), and 2) the eastern Pacific (east of 150^{o}W and including the Gulf of California and waters off California). The Hawaiian stock includes animals found both within the Hawaiian Islands EEZ and in adjacent international waters; however, because data on abundance, distribution, and human-caused impacts are largely lacking for international waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

POPULATION SIZE

Tillman (1978) concluded from Japanese and Soviet CPUE data that the stock size in the North Pacific pelagic whaling grounds, mostly to the west of the Hawaiian Islands, declined from approximately 22,500 in 1971 to 17,800 in 1977. An estimate of 13,000 (CV=0.202) Bryde's whales was made from vessel surveys in the eastern tropical Pacific between 1986 and 1990 (Wade and Gerrodette 1993). The area to which this estimate applies is mainly east and somewhat south of the Hawaiian Islands, and it is not known whether these animals are part of the same population that occurs around the Hawaiian Islands. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 469 (CV=0.45) Bryde's whales (Barlow 2006). This is currently the best available abundance estimate for this stock.

Minimum Population Estimate

The log-normal 20th percentile of the 2002 abundance estimate (Barlow 2006) is 327 Bryde's whales within the Hawaiian Islands EEZ.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size within the U.S EEZ of the Hawaiian Islands (327) <u>times</u> one half the default maximum net growth rate for cetaceans (½ of 4%) <u>times</u> a recovery factor of 0.50 (for a stock of unknown status with no known fishery mortality or serious injury within the Hawaiian Islands EEZ; Wade and Angliss 1997), resulting in a PBR of 3.3 Bryde's whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Information on fishery-related mortality of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Gillnets appear to capture marine mammals wherever they are used, and float lines from lobster traps and longlines can be expected to occasionally entangle cetaceans (Perrin et al. 1994). Interactions with cetaceans are reported for all pelagic fisheries, and large whales have been entangled in longline gear off the Hawaiian Islands (Nitta and Henderson 1993, Forney 2009). There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2004 and 2008, one Bryde's whale was observed hooked or entangled in the SSLL fishery (100% observer coverage) in international waters (McCracken & Forney 2010). Based on an evaluation of the observer's description of the interaction and following the most recently developed criteria for assessing serious injury in marine mammals (Andersen et al. 2008), this animal was considered not seriously injured (Forney 2009). No Bryde's whales were observed hooked or entangled the DSLL fishery (20-28% observer coverage).

Table 1. Summary of available information on incidental mortality and serious injury of Bryde's whales (Hawaiian stock) in commercial fisheries, within and outside of the Hawaiian Islands EEZ (McCracken & Forney 2010). Mean annual takes are based on 2004-2008 data unless otherwise indicated; n/a = not available.

Fishery Name	Year	Data Type	Percent Observer Coverage	Mortality and Serious Injury outside of U.S. EEZ			Mortality and Serious Injury within Hawaiian Islands EEZ		
				Observed	Estimated (CV)	Mean Annual Takes (CV)	Observed	Estimated (CV)	Mean Annual Takes (CV)
Hawaii-based deep-set longline fishery	2004 2005 2006 2007 2008	observer data	25% 28% 22% 20% 22%	0 0 0 0 0	0 (-) 0 (-) 0 (-) 0 (-) 0 (-)	0 (-)	0 0 0 0 0	0 (-) 0 (-) 0 (-) 0 (-) 0 (-)	0
Hawaii-based shallow-set longline fishery	2004 2005 2006 2007 2008	observer data	100% 100% 100% 100% 100%	0 0* 0 0 0	Same as observed	0.2	0 0 0 0 0	Same as observed	0
Minimum total annual takes within U.S. EEZ waters									0

*One animal observed not seriously injured.

Historical Mortality

Small numbers of Bryde's whales were taken near the Northwestern Hawaiian Islands by Japanese and Soviet whaling fleets during the early 1970s (Ohsumi 1977). Pelagic whaling for Bryde's whales in the North Pacific ended after the 1979 season (IWC 1981), and coastal whaling for this species ended in the western Pacific in 1987 (IWC 1989).

STATUS OF STOCK

The status of Bryde's whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. It is not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. Given the absence of recent fishery-related mortality or serious injuries within the Hawaiian Islands EEZ, the Hawaiian stock of Bryde's whales is not considered strategic under the 1994 amendments to the MMPA, and the total fishery mortality and serious injury can be considered to be insignificant and approaching zero. The increasing level of anthropogenic noise in the world's oceans has been suggested to be a habitat concern for whales (Richardson et al. 1995).

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Revised 01/15/2011

SEI WHALE (*Balaenoptera borealis borealis*): Hawaiian Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The International Whaling Commission (IWC) only considers one stock of sei whales in the North Pacific (Donovan 1991), but some evidence exists for multiple populations (Masaki 1977; Mizroch et al. 1984; Horwood 1987). Sei whales are distributed far out to sea in temperate regions of the world and do not appear to be associated with coastal features. Whaling effort for this species was distributed continuously across the North Pacific between 45-55°N (Masaki 1977). Two sei whales that were tagged off California were later killed off Washington and British Columbia (Rice 1974) and the movement of tagged animals has been noted in many other regions of the North Pacific. There is still insufficient information to accurately determine population structure, but from a conservation perspective it may be risky to assume panmixia in the entire North Pacific. Four sightings of sei whales were recently made during a summer/fall 2002 shipboard survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands (Figure 1; Barlow 2003). For the Marine Mammal Protection Act (MMPA) stock assessment reports, sei whales within the Pacific U.S. EEZ are divided into three discrete, non-contiguous areas: 1) waters around Hawaii (this report), 2) California, Oregon and Washington waters, and 3) Alaskan waters. The Hawaiian stock includes animals found both within the Hawaiian Islands EEZ and in adjacent international waters; however, because data on abundance, distribution, and human-caused impacts are largely lacking for international waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

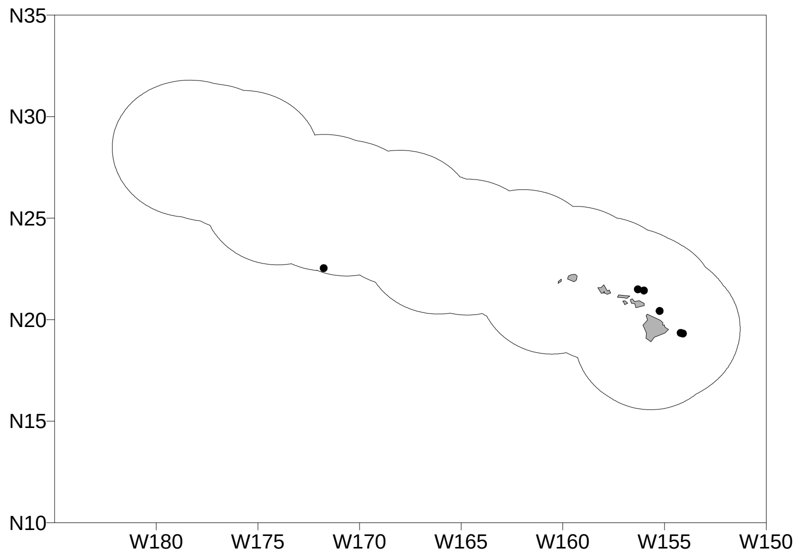

Figure 1. Sei whale sighting locations during the 2002 shipboard cetacean survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2003; see Appendix 2 for details on timing and location of survey effort). Outer line indicates approximate boundary of survey area and U.S. EEZ.

POPULATION SIZE

Ohsumi and Wada (1974) estimate the pre-whaling abundance of sei whales to be 58,000-62,000 in the North Pacific. Later, Tillman (1977) used a variety of different methods to estimate the abundance of sei whales in the North Pacific and revised this pre-whaling estimate to 42,000. His estimates for the year 1974 ranged from 7,260 to 12,620. All methods depend on using the history of catches and trends in CPUE or sighting rates; there have been no direct estimates of sei whale abundance in the entire North Pacific based on sighting surveys. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in a summer/fall abundance estimate of 77 (CV=1.06) sei whales (Barlow 2003). This is currently the best available abundance estimate for this stock, but the majority of sei whales would be expected to be at higher latitudes in their feeding grounds at this time of year.

Minimum Population Estimate

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

Current Population Trend

No data are available on current population trend. Although the population in the North Pacific is expected to have grown since being given protected status in 1976, the possible effects of continued unauthorized takes (Yablokov 1994) make this uncertain.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size within the U.S. EEZ of the Hawaiian Islands (37) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.1 (the default value for an endangered species; Wade and Angliss 1997), resulting in a PBR of 0.1 sei whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Information on fishery-related mortality of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Gillnets appear to capture marine mammals wherever they are used, and float lines from lobster traps and longlines can be expected to occasionally entangle cetaceans (Perrin et al. 1994). Interactions with cetaceans are reported for all pelagic fisheries, and large whales have been entangled in longline gear off the Hawaiian Islands (Nitta and Henderson 1993; Forney 2009). There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2004 and 2008, no sei whales were observed hooked or entangled in the SSLL fishery (100% observer coverage) or the DSLL fishery (20-28% observer coverage) (McCracken & Forney 2010).

Historical Whaling

The reported take of North Pacific sei whales by commercial whalers totaled 61,500 between 1947 and 1987 (C. Allison, IWC, pers. comm.). There has been an IWC prohibition on taking sei whales since 1976, and commercial whaling in the U.S. has been prohibited since 1972.

STATUS OF STOCK

Previously, sei whales were estimated to have been reduced to 20% (8,600 out of 42,000) of their pre-whaling abundance in the North Pacific (Tillman 1977). Sei whales are formally listed as "endangered" under the Endangered Species Act (ESA), and consequently the Hawaiian stock is automatically considered as a "depleted" and "strategic" stock under the MMPA. Because there have been no reported fishery related mortality or serious injuries of sei whales within the Hawaiian Islands EEZ, the total fishery-related mortality and serious injury can be considered to be insignificant and approaching zero. The increasing level of anthropogenic noise in the world's oceans has been suggested to be a habitat concern for whales (Richardson et al. 1995).

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Revised 01/15/2011

MINKE WHALE (*Balaenoptera acutorostrata scammoni*): Hawaiian Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The International Whaling Commission (IWC) recognizes 3 stocks of minke whales in the North Pacific: one in the Sea of Japan/East China Sea, one in the rest of the western Pacific west of 180°N, and one in the "remainder" of the Pacific (Donovan 1991). The "remainder" stock only reflects the lack of exploitation in the eastern Pacific and does not imply that only one population exists in that area (Donovan 1991). In the "remainder" area, minke whales are relatively common in the Bering and Chukchi seas and in the Gulf of Alaska, but are not considered abundant in any other part of the eastern Pacific (Leatherwood et al. 1982; Brueggeman et al. 1990). In the Pacific, minke whales are usually seen over continental shelves (Brueggeman et al. 1990). In the extreme north, minke whales are believed to be migratory, but in inland waters of Washington and in central California they appear to establish home ranges (Dorsey et al. 1990).

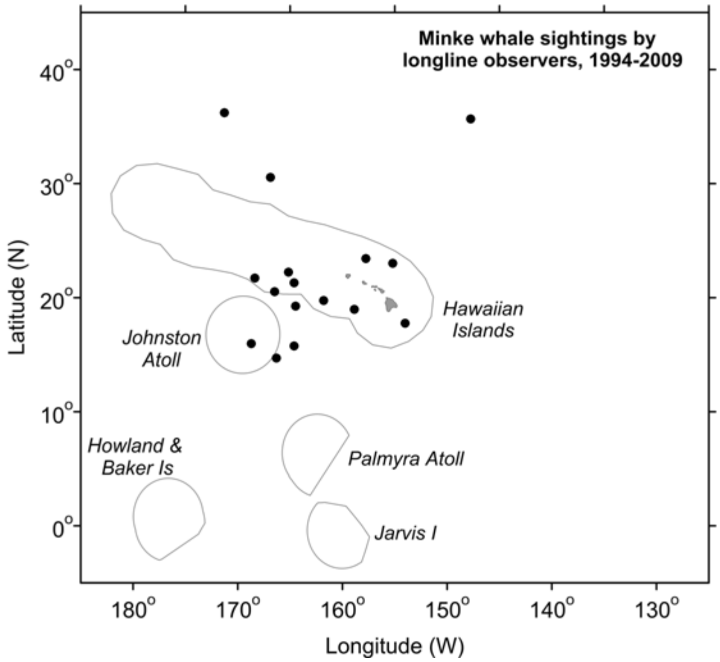

Figure 1. Locations of minke whale sightings from longline observer records (diamonds; NMFS/PIR, unpublished data), and sighting (closed circle) and acoustic detections (open circles) made during the 2002 shipboard survey of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2003; see Appendix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

Minke whales have only been recently confirmed to occur seasonally around the Hawaiian Islands (Barlow 2003, Rankin and Barlow, 2005), and their migration routes or destinations are not known. Minke whales were observed within 22km of Kauai during a nearshore survey in February 2005 (Rankin et al. 2007) and four reliable sightings of minke whales were made by observers in the Hawaii-based longline fishery during the months of December-March, 2000-2002 (Figure 1; NMFS/PIR unpublished data). One confirmed sighting of a minke whale was made in November 2002 during a survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands (Barlow 2003), and additional acoustic detections of this species' distinctive call (known as the 'boing') were made that could not be visually verified (Figure 1). There are no known stranding records of this species from the main islands (Nitta 1991; Maldini et al. 2005). For the Marine Mammal Protection Act (MMPA) stock assessment reports, there are three stocks of minke whale within the Pacific U.S. EEZ: 1) a Hawaiian stock (this report), 2) a California/Oregon/ Washington stock, and 3) an Alaskan stock. The Hawaiian stock includes animals found both within the Hawaiian Islands EEZ and in adjacent international waters; however, because data on abundance, distribution, and human-caused impacts are largely lacking for international waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

POPULATION SIZE

A summer/fall 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in one 'off effort' sighting of a minke whale following the acoustic detection of a so-called 'boing' (Barlow 2003; Rankin and Barlow, 2005). This sighting was not part of regular survey operations and, therefore, could not be used to calculate an estimate of abundance (Barlow 2003). Furthermore, the majority of this survey took place during summer and early fall, when the Hawaiian stock of minke whale would be expected to be farther north. There currently is no abundance estimate for this stock of minke whales, which appears to occur seasonally (about November - March) around the Hawaiian Islands.

Minimum Population Estimate

There is no minimum population estimate for the Hawaiian stock of minke whales.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

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

HUMAN CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Information on fishery-related mortality and serious injury of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Gillnets appear to capture marine mammals wherever they are used, and float lines from lobster traps and longlines can be expected to occasionally entangle cetaceans (Perrin et al. 1994). Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nitta and Henderson 1993), but none of these interactions are known to have involved minke whales (Forney 2009). There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2004 and 2008, no minke whales were observed hooked or entangled in the SSLL fishery (100% observer coverage) or the DSLL fishery (20-28% observer coverage) (McCracken & Forney 2010).

STATUS OF STOCK

The status of minke whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. It is not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. Although information on minke whales in Hawaiian waters is limited, this stock would not be considered strategic under the 1994 amendments to the MMPA because there has been no reported fisheries related mortality or serious injury within the Hawaiian Islands EEZ. Insufficient information is available to determine whether the total fishery mortality and serious injury for minke whales is insignificant and approaching zero mortality and serious injury rate. The increasing levels of anthropogenic sound in the world's oceans has been suggested to be a habitat concern for whales (Richardson et al. 1995).

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Revised 10/15/2009

HUMPBACK WHALE (*Megaptera novaeangliae*)

IUCN Oceania subpopulation – American Samoa Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The humpback whale has a global distribution. Humpback whales migrate long distances between their feeding grounds at mid- to high latitudes and their calving and mating grounds in tropical waters. The Oceania subpopulation (as defined by the IUCN Red List process, see Childerhouse *et al*. 2008) ranges throughout the South Pacific, except the west coast of South America, and from the equator to the edges of the Antarctic ice. Humpback whales have been recorded across most of the lower latitudes of the South Pacific from approximately 30°S northwards to the equator during the austral autumn and winter. Although there have been no comprehensive surveys of this huge area, humpback whale densities are known to vary extensively from high densities in East Australia to low densities at many island groups. Many regional research projects have documented the presence of these whales around various island groups, but they are also found in open water away from islands (SPWRC 2008). Movements of individual whales between the tropical wintering grounds and the Antarctic summer feeding grounds have been documented by a variety of methods including Discovery tagging, photo-identification, matching genotypes from biopsies or carcasses, and satellite telemetry (Mackintosh 1942; Chittleborough 1965; Dawbin 1966; Mikhalev 2000; Rock *et al*. 2006, Franklin *et al*. 2007, Robbins *et al*. 2008). However, migratory routes and specific destinations remain poorly known. Unlike the other humpback stocks found in U. S. waters, the IUCN Oceania subpopulation is defined by structure on its calving grounds (Garrigue *et al*. 2006b, Olavarria *et al*. 2006, 2007) rather than on its feeding grounds. The Oceania subpopulation consists of breeding stocks E (including E1, E2 and E3) and F recognized by the International Whaling Commission (IWC). It is found in the area defined by the following approximate boundaries: 145°E (eastern Australia) in the west, 120°W (between French Polynesia and South America) in the east, the equator in the north, and 30°S in the south (Childerhouse *et al.* 2008).

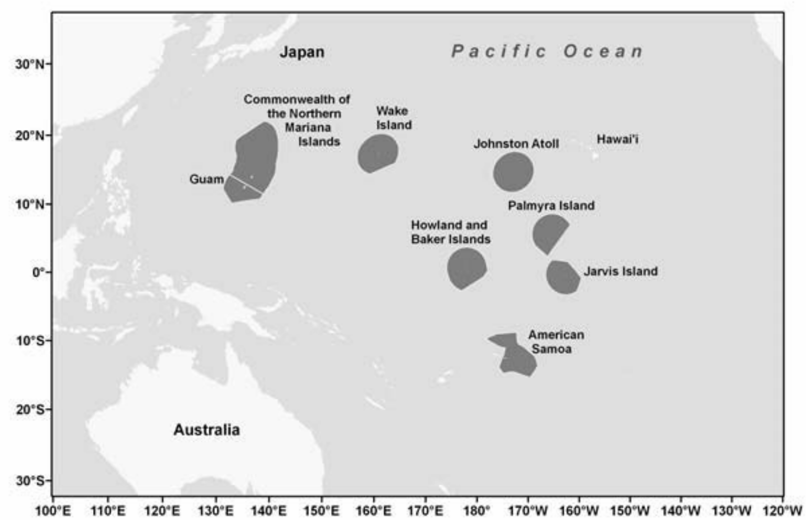

Figure 1. Western Pacific Exclusive Economic Zones for selected U.S. territories, including American Samoa. Information on the American Samoa stock of humpback whales in this report is derived from survey work conducted within the American Samoa EEZ, although animals range well outside this area (see text).

For the Marine Mammal Protection Act (MMPA) stock assessment reports, there is need for only one South Pacific Island region management stock of humpback whales, the American Samoa stock. American Samoa lies at the boundary of breeding stocks E3 and F. Surveys have been undertaken annually at the primary island of Tutuila since 2003. A total of 150 unique individuals were identified by fluke photographs during 58 days at sea, 2003-2008 (D. Mattila and J. Robbins, unpublished data). Individuals have been resighted on multiple days in a single breeding season, but only three inter-annual re-sightings have been made to date (two based on dorsal fin photographs) (D. Mattila and J. Robbins, unpublished data). Breeding behavior and the presence of very young calves has been documented in American Samoa waters. One whale that was sighted initially without a calf was re-sighted later in the season with a calf. Individual exchange has been documented with Western Samoa (SPWRC 2008), as well as Tonga, French Polynesia and the Cook Islands (Garrigue *et al*. 2007). Although the feeding range of American Samoan whales has not yet been defined, there has been one photo-ID match to the Antarctic Peninsula (IWC Antarctic Area I, Robbins *et al*. 2008). Whales at Tonga have exhibited exchange with both Antarctic Area V (Dawbin 1959) and Area I (Brown 1957, Dawbin 1956) and so whales from American Samoa may have a similarly wide feeding range.

On-going photographic studies indicate a higher frequency of certain types of skin lesions on humpback whales at American Samoa as compared to humpback whale populations at Hawaii or the Gulf of Maine (Mattila and Robbins, 2008). However, the cause and implications have yet to be determined. Some similar skin lesions on blue whales in Chilean waters have been observed (Brownell *et al*. 2008).

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Historic whaling

Southern Hemisphere humpback whales were hunted extensively during the last two centuries, and it is thought that populations have been reduced to a small percentage of their former levels (Chapman 1974). After correcting catch records for illegal Soviet whaling, (Clapham & Baker 2002) estimated that over 200,000 Southern Hemisphere humpback whales were killed from 1904 to 1980. Humpback whales were protected from commercial whaling in 1966 by the IWC but they continued to be killed illegally by the Soviet Union until 1972. Illegal Soviet catches of 25,000 humpback whales in two seasons (1959/60 and 1960/61) precipitated a population crash and the closure of land stations in Australia and New Zealand, including Norfolk Island (Mikhalev 2000; Clapham *et al*. 2005).

POPULATION SIZE

There is currently no estimate of abundance for humpback whales in American Samoan waters. The South Pacific Whale Research Consortium produced a number of preliminary mark-recapture estimates of abundance for Oceania and its subregions (SPWRC, 2006). A closed population estimate of 3,827 (CV 0.15) was calculated for eastern Oceania (breeding stocks E3 and F) for 1999-2004 and this may be the most relevant of those currently available, given observed exchange between American Samoa, Tonga, the Cook Islands, and French Polynesia (Garrigue *et al.* 2006a). However, the extent and biological significance of the documented interchange is still poorly understood.

Minimum Population Estimate

The minimum population estimate for this stock is 150 whales, which is the number of individual humpbacks identified in the waters around American Samoa between 2003-2008 by fluke photo identification (J. Robbins, personal communication). This is clearly an underestimation of the true minimum population size as photo ID studies have been conducted over a few weeks per year and there is also evidence of exchange with other areas in Oceania. There are also insufficient data to estimate the proportion of time Oceania humpback whales spend in waters of American Samoa.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No estimates of current or maximum net productivity rates are available for this species in Samoan waters. However, the maximum plausible growth rate for Southern Hemisphere humpback whale populations is estimated as 10.6% (Clapham *et al*. 2006).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) for this stock is calculated as the minimum population size (150) times one half the estimated maximum growth rate for humpback whales in the Southern Hemisphere (1/2 of 10.6%) times a recovery factor of 0.1 (for an endangered species with a total population size of less than 1,500), resulting in a PBR of 0.8. This stock of humpback whales is migratory and thus, it is reasonable to expect that animals spend at least half the year outside of the relatively small American Samoa EEZ. Therefore, the PBR allocation for U.S. waters is half of 0.8, or 0.4 whales.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

No human-related mortalities of humpback whales have been recorded in American Samoan waters. Human-related mortality of humpback whales due to entanglements in fishing gear and collisions with ship have been reported elsewhere in the Southern Hemisphere. Entanglement of humpback whales in pot lines has been reported in both New Zealand and Australia but there are no estimated rates available. There is little information from the rest of the South Pacific but a humpback mother (with calf) was reported entangled in a longline in 2007 in the Cook Islands (N. Hauser, reported in SPWRC 2008).

A photographic-based scar study of the humpback whales of American Samoa has been initiated and there is some indication of healed entanglement and ship strike wounds, although perhaps not at the levels found in some Northern Hemisphere populations (D. Mattila and J. Robbins, unpublished data). However, the sample size to date is insufficient for robust comparison and the study is ongoing.

STATUS OF STOCK

The status of humpback whales in American Samoan EEZ waters relative to OSP is unknown and there are insufficient data to estimate trends in abundance. However, humpback whale populations throughout the South Pacific were drastically reduced by historical whaling and IUCN classifies the Oceania subpopulation as "Endangered" (Childerhouse *et al.* 2008). Worldwide humpback whales are listed as "endangered" under the Endangered Species Act (1973) so the Samoan stock is automatically considered a "depleted" and "strategic" stock under the MMPA. There are no habitat concerns for the stock.

Japan has proposed killing 50 humpback whales as part of its program of scientific research under special permit (scientific whaling) called JARPA II in the IWC management areas IV and V in the Antarctic (Gales *et al.* 2005). Areas IV and V have demonstrated links with breeding stock E. Japan postponed their proposed catch in the 2007/08 and 2008/09 seasons but have not removed them from their future whaling program. The JARPA II program has the potential to negatively impact the recovery of humpbacks in Oceania.

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The Marine Mammal Protection Act (MMPA) requires NMFS to publish a list of commercial fisheries (List Of Fisheries or "LOF") and classify each fishery based on whether incidental mortality and serious injury of marine mammals is frequent (Category I), occasional (Category II), or unlikely or unknown (Category III). The LOF is published annually in the Federal Register. The categorization of a fishery in the LOF determines whether participants in that fishery are subject to certain provisions of the MMPA, such as registration, observer coverage, and take reduction plan requirements. The categorization criteria as they appear in the LOF is reprinted below:

The fishery classification criteria consist of a two-tiered, stock-specific approach that first addresses the total impact of all fisheries on each marine mammal stock, and then addresses the impact of individual fisheries on each stock. This approach is based on consideration of the rate, in numbers of animals per year, of incidental mortality and serious injury of marine mammals due to commercial fishing operations relative to the Potential Biological Removal (PBR) level for each marine mammal stock. The MMPA (16 U.S.C. 1362 (20)) defines the PBR level as the maximum number of animals, not including natural mortality, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population. This definition can also be found in the implementing regulations for section 118 at 50 CFR 229.2.

Tier 1: If the total annual mortality and serious injury across all fisheries that interact with a stock is less than or equal to 10 percent of the PBR level of the stock, all fisheries interacting with the stock would be placed in Category III. Otherwise, these fisheries are subject to the next tier (Tier 2) of analysis to determine their classification.

Tier 2, Category I: Annual mortality and serious injury of a stock in a given fishery is greater than or equal to 50 percent of the PBR level.

Tier 2, Category II: Annual mortality and serious injury of a stock in a given fishery is greater than 1 percent and less than 50 percent of the PBR level.

Tier 2, Category III: Annual mortality and serious injury of a stock in a given fishery is less than or equal to 1 percent of the PBR level.

While Tier 1 considers the cumulative fishery mortality and serious injury for a particular stock, Tier 2 considers fishery-specific mortality and serious injury for a particular stock. Additional details regarding how the categories were determined are provided in the preamble to the final rule implementing section 118 of the MMPA (60 FR 45086, August 30, 1995). Since fisheries are categorized on a per-stock basis, a fishery may qualify as one Category for one marine mammal stock and another Category for a different marine mammal stock. A fishery is typically categorized on the LOF at its highest level of classification (e.g., a fishery that qualifies for Category III for one marine mammal stock and for Category II for another marine mammal stock will be listed under Category II).

Other Criteria That May Be Considered

In the absence of reliable information indicating the frequency of incidental mortality and serious injury of marine mammals by a commercial fishery, NMFS will determine whether the incidental serious injury or mortality qualifies for Category II by evaluating other factors such as fishing techniques, gear used, methods used to deter marine mammals, target species, seasons and areas fished, qualitative data from logbooks or fisher reports, stranding data, and the species and distribution of marine mammals in the area, or at the discretion of the Assistant Administrator for Fisheries (50 CFR 229.2).

This appendix describes commercial fisheries that occur in California, Oregon, Washington, and Hawaiian waters and that interact or may interact with marine mammals. The first three sections describe sources of marine mammal mortality data for these fisheries. The fourth section describes the commercial fisheries for these states. A list of all known fisheries for these states was published as a proposed rule in the Federal Register, 71 FR 20941, 24 April 2006.

1. Sources of Mortality/Injury Data

There are three major sources of marine mammal mortality/injury data for the active commercial fisheries in California, Oregon, and Washington. These sources are the NMFS Observer Programs, the Marine Mammal Authorization

Program (MMAP) data, and the NMFS Marine Mammal Stranding Network (MMSN) data. Each of these data sources has an unique objective. Data on mammal mortality and injury are reported to the MMAP by fishers in any commercial fisheries. Marine mammal mortality and injury is also monitored by the NMFS Marine Mammal Stranding Network (MMSN). Data provided by the MMSN is not duplicated by either the NMFS Observer Program or MMAP reporting. Human-related data from the MMSN include occurrences of mortality due to entrainment in power station intakes, ship strikes, shooting, evidence of net fishery entanglement (net remaining on animal, net marks, severed flukes), and ingestion of hooks.

2. Marine Mammal Reporting from Fisheries

In 1994, the MMPA was amended to implement a long-term regime for managing mammal interactions with commercial fisheries (the Marine Mammal Authorization Program, or MMAP). Logbooks are no longer required - instead vessel owners/operators in any commercial fishery (Category I, II, or III) are required to submit one-page pre-printed reports for all interactions (including those that occur while an observer is onboard) resulting in an injury to or death of a marine mammal. The report must include owner/operator's name and address, vessel name and ID, where and when the interaction occurred, the fishery, species involved, and type of injury (if the animal was released alive). These postage-paid report forms are mailed to all Category I and II fishery participants that have registered with NMFS, and must be completed and returned to NMFS within 48 hours of returning to port for trips in which a marine mammal injury or mortality occurred. The number of self-reported marine mammal interactions is considerably lower than the number reported by fishery observers, even though observer reports are typically based on 20% observer effort. For example, from 2000-2004, there were 112 fisher self-reports of marine mammal interactions in the California swordfish/thresher shark drift gillnet fishery. This compares with 141 observed interactions over the same period, based on only 20% observer coverage. This suggests that fisher self-reports are negatively-biased.

3. NMFS Marine Mammal Stranding Network data

From 2000-2004, there were 1,022 cetacean and 13,215 pinniped strandings recorded in California, Oregon, and Washington states. Approximately 10% of all cetacean and 6% of all pinniped strandings showed evidence of human-caused mortality during this period. Human-related causes of mortality include: entrainment in power station intakes, shooting, net fishery entanglement, and hook/line, set-net and trap fishery interaction.

4. Fishery Descriptions

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

Number of permit holders: The numbers of eligible permit holders in California for 2002-2006 were 106, 100, 96, 90, and 88, respectively (data source: California Deparment of Fish and Game website: www.dfg.ca.gov/licensing). Permits are non-transferable and are linked to individual fishermen, not vessels.

Number of active permit holders: The numbers of vessels active in this fishery from 2002-2006 were 50, 43, 43, 40, and 43 respectively. Information on the number of permit holders is obtained from the Status of the U.S. west coast fisheries for Highly Migratory Species through 2004; Stock Assessment and Fishery Evaluation report available from the Pacific Fishery Management Council website (www.pcouncil.org) and the California Department of Fish and Game.

Total effort: Both estimated and observed effort for the drift-net fishery during the calendar years 1990 through 2006 are shown in Figure 2.

Geographic range: Effort in this fishery ranges from the U.S./Mexico border north to waters off the state of Oregon. For this fishery there are area-season closures (see below). Figures 1-5 show locations of observed sets and Figure 6 shows approximate locations of observed marine mammal entanglements for the period 1998-2002.

Seasons: This fishery is subject to season-area restrictions. From February 1 to May 15 effort must be further than 200 nautical miles (nmi) from shore; from May 16 to August 14, effort must be further than 75 nmi from shore, and from August 15 to January 31 there is only the 3 nmi off-shore restriction for all gillnets in southern California (see halibut and white seabass fishery below). The majority of the effort occurs from October through December. A season-area closure to protect leatherback sea turtles was implemented in this fishery in August 2001. The closure area prohibits drift gillnet fishing from August 15 through November 15, in the area bounded by straight lines from Point Sur, California (N36° 17') to

N 34^{o} 27' W 123^{o} 35', west to W129^{o}, north to N 45^{o}, then east to the Oregon coast. An additional season-area closure south of Point Conception and east of W120 degrees longitude is effective during the months of June, July, and August during El Niño years to protect loggerhead turtles (Federal Register, 68 FR 69962, 16 December 2003).

Gear type and fishing method: Typical gear used for this fishery is a 1000-fathom gillnet with a stretched mesh size typically ranging from 18-22 inches (14 inch minimum). The net is set at dusk and allowed to drift during the night after which, it is retrieved. The fishing vessel is typically attached to one end of the net. Soak duration is typically 12-14 hours depending on the length of the night. Net extender lengths of a minimum 36 ft. became mandatory for the 1997-1998 fishing season. The use of acoustic warning devices (pingers) became mandatory 28 October 1997.

Regulations: The fishery is managed under a Fishery Management Plan (FMP) developed by the Pacific Fishery Management Council and NMFS.

Management type: The drift-net fishery is a limited-entry fishery with seasonal closures and gear restrictions (see above). The state of Oregon restricts landing to swordfish only.

Comments: This fishery has had a NMFS observer program in place since July 1990. Due to bycatch of strategic stocks including short-finned pilot whales, beaked whales, sperm whales and humpback whales, a Take Reduction Team was formed in 1996. Since then, the implementation of increased extender lengths and the deployment of pingers have substantially decreased cetacean entanglement. The fraction of active vessels in this fishery that are not observed owing to a lack of berthing space for observers has been increasing as larger vessels drop out of this fishery.

Category I[1], CA halibut/white seabass and other species set gillnet fishery (>3.5 inch mesh).

Note: This fishery has not targeted angel sharks since 1994, when regulatory changes resulted in nets being fished >3 nmi from shore in southern California. Thus, there is a proposed name change to this fishery to reflect current fishing practices. Halibut are typically targeted using 8.5 inch mesh while the remainder of the fishery targets white seabass and yellowtail using 6.5 inch mesh. In recent years, there has been an increasing number of 6.0-6.5 inch mesh sets fished using drifting methods; this component is now identified as a separate fishery (see "**CA yellowtail, barracuda, white seabass, and tuna drift gillnet fishery (>3.5 and <14 in mesh)**" fishery described below).

Number of permit holders: There is no specific permit category for this fishery. Overall, the current number of legal permit holders for gill and trammel nets, excluding swordfish drift gillnets and herring gillnets for 2002-2006 are, 209, 193, 187, 172, and 166, respectively. Information on permit numbers is available from the California Department of Fish and Game website (http://www.dfg.ca.gov/licensing).

Number of active permit holders: Based on logbook data, there were at least 62 active permit holders during the period 2002-2006. Annual participation in the fishery appears to have declined, as the number of active permit holders by individual year (43, 42, 41, 31, 28) has declined.

Total effort: Fishing effort in the halibut fishery has declined from over 3,200 sets in 2002 to approximately 1,400 sets in 2006. A summary of estimated fishing effort and observer coverage for the years 1990-2003 is shown in Figure 8. Effort in the white seabass and yellowtail portion of this fishery has ranged between 456 and 948 days annually for the period 2002-2006. A portion of the effort in the white seabass and yellowtail fishery utilizes drifting nets (see "CA yellowtail, barracuda, white seabass, and tuna drift gillnet fishery (>3.5 and <14 in mesh)" fishery description in the Category II fishery section below).

Geographic range: Effort in this fishery previously ranged from the U.S./Mexico border north to Monterey Bay and was localized in more productive areas: San Ysidro, San Diego, Oceanside, Newport, San Pedro, Ventura, Santa Barbara, Morro Bay, and Monterey Bay. Fishery effort is now predominantly in the Ventura Flats area off of Ventura, the San Pedro area between Pt. Vicente and Santa Catalina Island and in the Monterey Bay area. The central California portion of the fishery

[1] Due to the closure of the fishery in central California, which has reduced the threat to stocks of harbor porpoise in this region, the draft 2009 NMFS MMPA List of Fisheries proposes to recategorize this fishery to 'Category II'.

from Point Arguello to Point Reyes has been closed since September 2002 when a ban on gillnets inshore of 60 fathoms took effect.

Seasons: This fishery operates year round. Effort generally increases during the summer months and declines during the last three months of a year.

Gear type and fishing method: Typical gear used for this fishery is a 200 fathom gillnet with a stretched mesh size of 8.5 inches. The component of this fishery that targets white seabass and yellowtail utilizes 6.5 inch mesh. The net is generally set during the day and allowed to soak for up to 2 days. Soak duration is typically 8-10, 19-24, or 44-49 hours. The depth of water ranges from 15-50 fathoms with most sets in water depths of 15-35 fathoms.

Regulations: This fishery is managed by the California Dept. of Fish and Game in accordance with state and federal laws.

Management type: The halibut and white seabass set-net fishery is a limited-entry fishery with gear restrictions and area closures.

Comments: An observer program for the halibut and white seabass portion of this fishery operated from 1990-94 and was discontinued after area closures were implemented in 1994, which prohibited gillnets within 3 nmi of the mainland and within 1 nmi of the Channel Islands in southern California. NMFS re-established an observer program for this fishery in Monterey Bay in 1999-2000 due to a suspected increase in harbor porpoise mortality in Monterey Bay. In 1999 and 2000, fishery mortality exceeded PBR for the Monterey Bay harbor porpoise stock, which at that time, was designated as strategic [the stock is currently non-strategic]. In the autumn of 2000, the California Department of Fish and Game implemented the first in a series of emergency area closures to set gillnets within 60 fathoms along the central California coast in response to concerns over mortality of common murres and threats to sea otters. This effectively reduced fishing effort to negligible levels in 2001 and 2002 in Monterey Bay. A ban on gill and trammel nets inside of 60 fathoms from Point Reyes to Point Arguello became effective in September 2002. Mortality of marine mammals continues in the southern California portion of this fishery, as evidenced by fisher self-reports under the Marine Mammal Authorization Program (MMAP) from 2000-2005. During this time, fishermen reported mortality of 60 California sea lions, 20 harbor seals, one northern elephant seal and one unidentified common dolphin. NMFS renewed observer coverage in halibut/white seabass set gillnet fishery in 2006 and through 2007, observers recorded bycatch data from 260 sets. No cetaceans were observed entangled during this period, but there were 34 California sea lions, two harbor seals, and one unidentified pinniped observed killed.

Category I, Hawaii deep-set (tuna target) longline/set line fishery

Note: The Hawaii-based longline fisheries of the Pelagic Fishery Ecosystem Plan (FEP) consist of two separately managed longline fisheries. One is the deep-set (tuna targeted) fishery which is classified as a Category I fishery under the MMPA. This fishery is discussed here. The classification of this fishery was elevated to Category I in 2004 based on revised PBR levels of false killer whales and observed false killer whale mortality in this fishery (Federal Register 69 FR 48407 1, 10 August 2004). The other Hawaii-based longline fishery is the Hawaii shallow-set longline (swordfish targeted) fishery which is classified as a Category II fishery under the MMPA and is discussed in the Category II section of this Appendix.

Number of permit holders: The number of Hawaii longline limited access permit holders is 164. Not all such permits are renewed and used every year. Permit holders may use the permits for either deep-set or shallow-set fishing, but must notify NMFS how they will fish before each trip. Most holders of Hawaii longline limited access permits are based in, or operate out of, Hawaii**.**

Number of active deep-set longline vessels targeting tuna: From 2005 to 2008, the number of active longline vessels based and landing in Hawaii was 124, 127, 129, and 127, respectively (http://www.pifsc.noaa.gov/fmsd/reports.php).

Total effort: The number of trips ranged from a low of approximately 500 (in 1992) to 1,400 in 2005. Figure 4 shows the number of fishing trips by longline vessels based and landing in Hawaii, by year and trip type, 1991-2009. The number of sets for the deep-set tuna fishery in 2005, 2006, 2007, and 2008 was 16,549, 16,397, 17,809, and 17,881, respectively. The number of hooks set in 2005, 2006, 2007, and 2008 was 33.7 million, 34.5 million, 38.8 million, and 40.1 million, respectively.

Geographic range: The Hawaii-based pelagic, deep-set longline fishery operates inside and outside the EEZ, primarily around the main Hawaiian Islands and Northwestern Hawaiian Islands, with some trips to the EEZs around the remote U.S. Pacific islands (however there are restricted areas, please refer to "Regulations"). Vessels vary their fishing grounds depending on their target species. Most of the deep-set fishing occurs south of 20° N.

Seasons: This fishery operates year-round, although vessel activity increases during the fall and is greatest during the winter and spring months.

Gear type: Deep-set longline gear typically consists of a continuous main line set on the surface and supported in the water column horizontally by floats with branch lines connected at intervals to the main line. In addition radio buoys are also used to keep track of the mainline as it drifts at sea. A line shooter is used on deep-sets to deploy the mainline faster than the speed of the vessel, thus allowing the longline gear to sink to its target depth (average target depth is 167 m, target depth for bigeye tuna is approximately 400 m). The main line is typically 30 to 100 km (18 to 60 nm) long. A minimum of 15, but typically 20 to 30, weighted branch lines (gangions) are clipped to the mainline at regular intervals between the floats. Each gangion terminates with a single baited hook. The branch lines are typically 11 to 15 meters (35 to 50 feet) long. Sanma (saury) or sardines are used for bait. Lightsticks are not typically attached to the gangions on this type of longline set. Deep-set longline gear is set in the morning and hauled in the afternoon.

Regulations: This fishery is managed under the Pelagics FEP and subject to Federal regulation. Measures that are currently applicable to the fishery include, but are not limited to, limited access (requirement for a permit), vessel and gear marking requirements, vessel length restrictions, Federal catch and effort logbooks, large longline restricted areas around the Hawaiian Archipelago, vessel monitoring system (VMS), annual protected species workshops, and the use of sea turtle, seabird, and marine mammal handling and mitigation gear and techniques. The vessel operator must notify NMFS prior to departure whether the vessel is undertaking a deep-set or shallow-set trip. Once the trip type is set, it cannot be changed during the trip. Vessel operators must take a NMFS contracted observer if requested by NMFS – target observer coverage is 20 percent of trips. If any marine mammal interaction (hooking or entanglement) resulting in injury or mortality occurs, the vessel operator must complete and mail a pre-addressed, postage paid form to NOAA Fisheries within 48 hours of the end of the trip. Additional information on all applicable regulations for the deep-set longline fishery is available at http://www.fpir.noaa.gov/SFD/SFD_regs_2.html.

Management type: Federal limited access program. This fishery is managed under a Fishery Ecosystem Plan (FEP) developed by the Western Pacific Fishery Management Council and NMFS.

Comments: Non-target species are caught incidentally. Interactions with common bottlenose dolphins, false killer whales, humpback whales, short-finned pilot whales, pantropical spotted dolphins, Blainville's beaked whale, and Risso's dolphins have been documented. Longline hooks have also been recovered from Hawaiian monk seals, but these were not observed during longline fishing operations. Due to interactions with protected species, especially turtles, this fishery has been observed since February 24, 1994. Initially, observer coverage was less than 5%, increased to 10% in 2000, and exceeded 20% in 2001, 2002, and 2003. Observer coverage was 20.1 %, 21.7%, and 20.6% in 2007, 2008, and 2009 respectively. *Observed* marine mammal injures in 2007 included 4 false killer whales, 1 short-finned pilot whale, and 2 unidentified cetaceans. Observed mortality included 1 Risso's dolphin. Observed marine mammal injuries in 2008 included 3 false killer whales, 3 short-finned pilots whales, 1 Risso's dolphin, 2 unidentified cetaceans, and 2 unidentified whales. Observed mortality in 2008 included 1 spotted dolphin. Observed injuries of marine mammals in 2009 included 9 false killer whales, 1 bottlenose dolphin, and 3 unidentified whales. Observed mortality of marine mammals in this fishery in 2009 included 1 false killer whale.

Category II, Hawaii shallow-set (swordfish target) longline/set line fishery

Note: The Hawaii-based longline fisheries of the Pelagic Fishery Ecosystem Plan (FEP) consist of two separately managed longline fisheries. One is the deep-set (tuna targeted) fishery which is classified as a Category I fishery under the MMPA. The other is the Hawaii shallow-set longline (swordfish targeted) fishery which is classified as a Category II fishery under the MMPA and is discussed here.

Number of permit holders: The number of Hawaii longline limited access permit holders is 164. Not all such permits are renewed and used every year. Permit holders may use the permits for either deep-set or shallow-set fishing, but must notify NMFS how they will fish before each trip. Most holders of Hawaii longline limited access permits are based in, or operate out of, Hawaii**.** Longline general permits are not limited by number. These general permits are open access and usable in Guam, CNMI, and the Pacific Remote Island Areas; they are usually not more than a half dozen a year.

Number of active shallow-set longline vessels targeting swordfish: From 2005 to 2008, the number of active shallow-set longline vessels based in and landing in Hawaii was 33, 35, 28, and 27, respectively

Total effort: The number of trips since 1991 has ranged from zero (2002-2003) to approximately 300 in 1993. Figure 4 shows the number of fishing trips by longline vessels based and landing in Hawaii, by year and trip type, 1991-2009. The number of sets for the shallow-set swordfish fishery in 2005, 2006, 2007, and 2008 was 1,645, 850, 1,570, and 1,587, respectively. The number of hooks set in 2005, 2006, 2007, and 2008 was 1.4 million, 0.7 million, 1.4 million, and 1.5 million, respectively.

Geographic range:
The most productive swordfishing areas for Hawaii-based longline vessels are north of Hawaii outside the U.S. Exclusive Economic Zone (EEZ) on the high seas, and this fishery operates almost entirely north of Hawaii (north of approximately 20° N). In some years, when influenced by seawater temperature, this fishery may operate mostly north of 30° N.

Seasons: Shallow-set effort is highest in either the first or second quarter of the calendar year and drops off substantially in the latter half of the year.

Gear type: Shallow-set longline gear typically consists of a continuous main line set on the surface and supported in the water column horizontally by floats with branch lines connected at intervals to the main line. In addition radio buoys are also used to keep track of the mainline as it drifts at sea. Longline fishing for swordfish is known as shallow-set longline fishing as the bait is set at depths of 30–90 m. The portion of the mainline with branchlines attached is suspended between floats at about 20–75 m of depth, and the branchlines hang off the mainline another 10–15 m. Only 4-6 branchlines are clipped to the mainline between floats, and a typical set for swordfish uses about 700–1,000 hooks. Shallow-set longline gear is set at night, with luminescent light sticks attached to the branchlines. Formerly, J-hooks and squid bait were used, but since 2004, circle hooks and mackerel-type bait have been required. These gear restrictions were implemented to reduce sea turtle bycatch.

Regulations: This fishery is managed under the Pelagics FEP and subject to Federal regulation. Measures that are currently applicable to the fishery include, but are not limited to, limited access (requirement for a permit), vessel and gear marking requirements, vessel length restrictions, Federal catch and effort logbooks, 100-percent observer coverage, large longline restricted areas around the Hawaiian Archipelago, vessel monitoring system (VMS), annual protected species workshops, and the use of sea turtle, seabird, and marine mammal handling and mitigation gear and techniques. The vessel operator must notify NMFS prior to departure whether the vessel is undertaking a shallow-set or a deep-set trip. Once the trip type is set, the type cannot be changed during the trip. All shallow-set trips must have a NMFS contracted observer. If any marine mammal interaction (hooking or entanglement) resulting in injury or mortality occurs, the vessel operator must complete and mail a pre-addressed, postage paid form to NOAA Fisheries within 48 hours of the end of the trip. More information on all applicable regulations is available at http://www.fpir.noaa.gov/SFD/SFD_regs_2.html.

Management type: Federal limited access program. This fishery is managed under a Fishery Ecosystem Plan (FEP) by the Western Pacific Fishery Management Council and NMFS.

Comments: Non-target species are caught incidentally. Interactions with common bottlenose dolphins, false killer whales, humpback whales, short-finned pilot whales, striped dolphins, Bryde's whales, Risso's dolphins, sperm whales, spinner dolphins, pygmy sperm or dwarf sperm whales, and common dolphins have been documented. The shallow-set fishery was completely closed in 2001 and reopened in 2004. One hundred percent observer coverage is required in this fishery. *Observed* injuries of marine mammals in this fishery October 2007 through 2008 included 1 false killer whale, 3 Risso's dolphins, 1 humpback whale, 1 pygmy sperm whale, 1 striped dolphin, and 1 unidentified whale. Observed mortality for the period included 1 Risso's dolphin. Observed injuries of marine mammals in 2009 included 1 false killer whale, 3 Risso's dolphins, and 1 unidentified whale. No observed mortality was reported in 2009.

Category II, Hawaii Shortline Fishery

Note: The Hawaii shortline fishery was added to the 2010 List of Fisheries as a Category II fishery under the MMPA based on analogy with the Category I "HI deep-set (tuna-target) longline/set line" and Category II "HI shallow-set (swordfish-target) longline/set line" fisheries (Federal Register 74 FR 58859, 16 November 2009).

Number of permit holders: There are no specific fishing permits issued for this fishery. However, all persons with a State of Hawaii Commercial Marine License (CML) may participate in any fishery, including the "HI shortline" fishery.

Number of active shortline vessels: Of those persons possessing CMLs, shortline participation has varied between 5 and 11 vessels from 2003 - 2008.

Total effort: From 2003-2008, there was an average of 135,757 pounds (lbs) of fish landed each year. In 2008 alone, 104,152 lbs of fish were landed.

Geographic range: The Category II "HI shortline" fishery is a small-scale system operating off the State of HI, and targeting bigeye tuna (*Thunnus obesus*) or the lustrous pomfret (*Eumigistes illustris*). This fishery was developed to target these fish species when they concentrate over the summit of Cross Seamount, 290 km (180 mi) south of the State of HI.

Seasons: This fishery has no seasonal component and may operate year-round.

Gear type: The gear style is designed specifically to target the aggregating fish species over seamount structures. The primary gear type used is a horizontal main line (monofilament) less than 1 nautical mile long, and includes two baskets of approximately 50 hooks each. The gear is set before dawn and has a short soak time, with the gear retrieved about two hours after it is set.

Regulations: All persons with a State of Hawaii Commercial Marine License (CML) may participate in the "HI shortline" fishery. The mainline length must be less than 1 nautical mile.

Management type: Hawaii State managed fishery.

Comments: Currently, there is no reporting system in place to document potential marine mammal interactions in this fishery. However, there are anecdotal reports of interactions off the north side of Maui, but the species and extent of interactions are unknown.

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

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

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

Total effort: From 2002-2006, there were 221, 193, 120, 184, and 175 small-mesh drift gillnet sets fished, respectively, as determined from California Department of Fish and Game logbook data.

Geographic range: This drift gillnet component of this fishery operates primarily south of Point Conception. Observed sets have been clustered around Santa Cruz Island, the east Santa Barbara Channel, and Cortez and Tanner Banks. Some effort has also been observed around San Clemente Island and San Nicolas Island.

Seasons: This fishery operates year round. Targeted species is typically determined by market demand on a short-term basis.

Gear type and fishing method: Typical gear used for this fishery is a 150 to 200-fathom gillnet, which is allowed to drift. The mesh size depends on the target species but typical values observed are 6.0 and 6.5 inches.

Regulations: This fishery is managed by the California Dept. of Fish and Game in accordance with State and Federal laws.

Management type: This fishery is a limited-entry fishery with gear restrictions and area closures.

Comments: This fishery primarily targets white seabass and yellowtail but also targets barracuda and albacore tuna. From 2002-2004, there have been 63 sets observed from 17 vessel trips. Marine mammal mortality includes two long-beaked common dolphin and 3 California sea lions. Also, 4 California sea lions were entangled and released alive during this period. In 2003, there was one coastal bottlenose dolphin stranded with 3.5-inch gillnet wrapped around its tailstock, the responsible fishery is unknown. Observer coverage in this fishery was 12% in 2002, 10% in 2003, and 17% in 2004.

Category II, CA swordfish longline fishery

Number of permit holders: As recently as 2004, there were 20-30 vessels participating in the fishery. Only one vessel was active in 2005. This decline in participation was due to the prohibition in shallow set swordfishing east of W150 longitude.

Number of active permit holders: In January 2006, there was only one vessel participating in this fishery, which fished for tuna using deep set methods outside the U.S. EEZ. The remaining vessels from this fishery now participate in the Hawaii longline fishery.

Total Effort: An estimated 1 - 1.5 million hooks were fished annually when 20-30 California-based vessels participated in the fishery. In 2005, there were only two trips fished by one vessel. Ten sets were observed in the first trip and it is unknown how many sets were made during the second trip because no observer was present.

Geographic range: The fishery management plan (FMP) for highly migratory species prohibits targeting swordfish with shallow set fishing methods east of W150 longitude. In March 2006, the Pacific Fishery Management Council approved an application for an exempted fishing permit (EFP) that would allow one vessel to utilize shallow set longline methods within the U.S. EEZ, with the same shallow-set regulations used in the Hawaii fishery (circle hooks and fish bait). An environmental assessment of this proposal will be prepared by the Highly Migratory Species Management Team (HMSMT) for review at a future Council meeting. This EFP will be effective no sooner than 2007 if it receives final approval.
Seasons: The fishery operates year-round.

Gear type: Typically, vessels fish 24 to 72 km of mainline, rigged with 22-m gangions at approximately 60-m intervals. Anywhere from 800 to 1,300 hooks are deployed in a set, with large squid (Illex sp.) used for bait. Variously colored lightsticks are used, for fishing takes place primarily during the night when more swordfish are available in surface waters. The mainline is deployed in 4-7 hours and left to drift unattached for 7-10 hours. Retrieval typically takes about 7-10 hours. A description of the gear used for deep sets targeting tuna is given in the Hawaii longline fishery section.

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

Management type: The California longline fishery is managed under a Highly Migratory Species Fishery Management Plan (FMP) developed by the Pacific Fishery Management Council and NMFS. . The FMP was partially approved by NMFS on February 4, 2004. NMFS published a final rule on March 11, 2004 which prohibits shallow longline sets of the type normally targeting swordfish on the high seas in the Pacific Ocean east of 150° W. longitude. A mandatory observer program became effective for this fishery in August 2002.

Comments: Between October 2001 and February 2004, 23 trips were observed by California-based longline observers, with 469 sets observed (<15% observer coverage). Between October 2001 and November 2003 the longline observer program reported one injured Risso's dolphin and one unidentified dolphin killed. Examination of photographs of the dead dolphin led marine mammal identification experts to conclude that the animal was most likely a striped dolphin.

Category II, California Anchovy, Mackerel, and Sardine Purse Seine Fishery. [2]

Number of permit holders: There are 63 limited-entry permits (Pacific Fishery Management Council. 2005. Status of the Pacific Coast coastal pelagic species fishery and recommended acceptable biological catches. Stock Assessment and Fishery Evaluation Report 2005).

Number of active permit holders: There are 61 vessels actively fishing.

Total effort: The fishery is managed under a capacity goal, with gross tonnage of vessels used as a proxy for fishing capacity. Capacity for the fleet is approximately 5,400 gross tons. Harvest guidelines for sardine and mackerel are also set annually.

Geographic range: These fisheries occur along the coast of California predominantly from San Pedro, including the Channel Islands, north to San Francisco.

Seasons: This fishery operates year round. Targeted species vary seasonally with availability and market demand.

Gear type and fishing method: Purse seine, drum seine and lampara nets utilizing standard seining techniques.

Regulations: This is a limited-entry fishery.

Management type: The fishery is managed under a Coastal Pelagic Species Fisheries Management Plan developed by the Pacific Fishery Management Council and NMFS.

A NMFS pilot observer program began in July 2004 and continued through January 2006. A total of 93 sets have been observed. Observed marine mammal interactions with the fishery have included one California sea lion killed, 54 sea lions released alive, and one sea otter released alive. Under the MMAP self-reporting program, the following mortality was reported: In 2003, four California sea lions drowned after chewing through a bait barge net used by the anchovy lampara net fishery.

Category II, California tuna purse seine fishery.

Note: This fishery was previously included in the CA anchovy, mackerel, and sardine purse seine fishery (see above). Vessels in the anchovy, mackerel, and sardine fishery target tuna when oceanographic conditions result in an influx of tuna into southern California waters. Data for this fishery were obtained from the 'Status of the U.S. West Coast Fisheries for Highly Migratory Species through 2004', available at the Pacific Fishery Management Council website (http://www.pcouncil.org).

Number of permit holders: There are 63 limited-entry permits (Pacific Fishery Management Council. 2005. Status of the Pacific Coast coastal pelagic species fishery and recommended acceptable biological catches. Stock Assessment and Fishery Evaluation Report 2005).

Number of active permit holders: Between one and 23 vessels actively purse seined for tunas during the period 2000-2004.

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[2] Information for this fishery came from the following sources: Pacific Fishery Management Council. 2005. Status of the Pacific Coast coastal pelagic species fishery and recommended acceptable biological catches. Stock assessment and fishery evaluation – 2005; California Coastal Pelagic Species Pilot Observer Program Informational Report 12 October 2005 (NMFS SW Region, unpublished); Lyle Enriquez NMFS Southwest Regional Office (personal communication) and the Marine Mammal Authorization Program, Registration and Reporting System. This fishery was formerly known as the "CA anchovy, mackerel, and tuna purse seine fishery" and was renamed in the NMFS MMPA List of Fisheries for 2007 (Federal Register Volume 72, No. 59, 14466). The "tuna" component of this fishery was designated as a separate fishery in the 2007 List of Fisheries and is named the "CA tuna purse seine fishery" (see fishery description below).

Total effort: The number of vessels landing bluefin, yellowfin, skipjack, and albacore in 2000-2004 varied between one and 23. Logbooks are not required for this fishery, and the overall number of sets fished is unknown.

Geographic range: Observed sets in this fishery have occurred in the southern California Bight.

Seasons: Observed sets occurred in August and September. The timing of fishing effort varies with the availability of tuna species in this region.

Gear type and fishing method: Small coastal purse seine vessels with a <640 mt carrying capacity target bluefin, yellowfin, albacore and skipjack tuna during warm-water periods in southern California.

Regulations: This is a limited-entry fishery.

Management type: This fishery is managed under a Highly Migratory Species Management Plan developed by the Pacific Fishery Management Council and NMFS.

Comments: A pilot observer program for this fishery began in July 2004 and ended in January 2006. A total of 9 trips and 15 sets were observed with no marine mammal interactions.

Category II, WA Puget Sound Region salmon drift gillnet fishery.

Number of permit holders: This commercial fishery includes all inland waters south of the US-Canada border and east of the Bonilla/Tatoosh line, at the entrance to the Strait of Juan de Fuca. Treaty Indian salmon gillnet fishing is not included in this commercial fishery. In 1999, the U.S. and Canada reached an agreement that significantly reduced the U.S. share of sockeye salmon. In order to compensate the non-treaty U.S. fishermen for the impact of this reduction, a federally funded buyback program was established. By the 2001 fishing season, the number of available drift gillnet permits had been reduced from 675 (1999) to 216. The intent of the buyback program was to reduce the number of drift gillnet permits to 200 (pers. comm., David Cantillon, NMFS, Northwest Region).

Number of active permit holders: Under the cooperative program that integrates issuance of Marine Mammal Authorization Certificates into the existing State license process, NMFS receives data on vessels that have completed the licensing process and are eligible to fish. These vessels are a subset of the total permits extant (725 in 2001), and the remainder of the permits are inactive and do not participate in the fishery during a given year. The number of "active" permits is assumed to be equal to or less than the number of permits that are eligible to fish. From 1997-2001, the number of active permits was 633, 559, 199, 248, and 182, respectively.

Total effort: Effort in the Puget Sound salmon drift gillnet fishery is regulated by systematic openings and closures that are specific to area and target salmon species. Since 1994, the number of active vessels in the Puget Sound drift gillnet fishery has declined. In addition, at least one major portion of the fishery, the previously observed sockeye fishery in areas 7 and 7A, has experienced reductions in available fishing time (openings). The number of days and total number of hours that the sockeye fishery remained open, approached the 1994 level only once (1997) in the period from 1995 through 1998. In the remaining years the available sockeye fishing time was less than half of the 1994 level. In recent years, poor sockeye returns and market conditions have combined to reduce participation in the fishery beyond the reductions created originally by the federal buyback program. In 2001, drift gillnets fished for only one opening, and 182 gear units were fished in all areas as compared to the 559 cited for 1998. Owing to the buyback program and reduced salmon runs, it is expected that the number of active permits will remain low.

Geographic Range: The fishery occurs in the inland marine waters south of the U.S./Canada border and east of the Bonilla/Tatoosh line at the entrance to the Strait of Juan de Fuca. The inland waters are divided into smaller statistical catch areas which are regulated independently.

Seasons: This fishery has multiple seasons throughout the year that vary among local areas dependent on local salmon runs. The seasons are managed to access harvestable surplus of robust stocks of salmon while minimizing impacts on weak stocks.

Gear type and fishing methods: Vessels operating in this fishery use a drift gillnet of single web construction, not exceeding 300 fathoms in length. Minimum mesh size for gillnet gear varies by target species. Fishing directed at sockeye and pink salmon are limited to gillnet gear with a 5-inch minimum mesh and a 6 inch maximum, with an additional "bird mesh" requirement that the first 20 meshes below the corkline be constructed of 5-inch opaque white mesh for visibility; the chinook season has a 7-inch minimum mesh; the coho season has a 5-inch minimum mesh; and the chum season has a 6- to 6.25-inch minimum mesh. The depth of gillnets can vary depending upon the fishery and the area fished. Normally they range from 180 to 220 meshes in depth, with 180 meshes as a common depth. It is the intention of the fisher to keep the net off the bottom. The vessel is attached to one end of the net and drifts with the net. The entire net is periodically retrieved onto the vessel and catch is removed. Drift times vary depending on fishing area, tidal condition and catch.

Regulations: The fishery is a limited-entry fishery with seasonal openings, area closures, and gear restrictions.

Management type: The fishery occurs in State waters and is managed by the Washington Department of Fish and Wildlife consistent with the U.S.-Canada Pacific Salmon Commission management regimes and the ocean salmon management objectives of the Pacific Fishery Management Council. U.S. and Canadian Fraser River sockeye and pink salmon fisheries are managed by the bilateral Fraser Panel in Panel Area waters. This includes the entire U.S. drift gillnet fishery for Fraser sockeye and pink salmon. For U.S. fisheries, Fraser Panel Orders are given effect by federal regulations that consist of In-season Orders issued by the NMFS Regional Administrator of the NMFS Northwest Region. These regulations are filed in the Federal Register post-season.

Comments: In 1993, observers were placed onboard vessels in a pilot program to monitor seabird and marine mammal interactions with fishing effort for several target salmon species in a number of areas throughout the Puget Sound region. In 1994 observer effort was concentrated in the sockeye fishery in areas 7 and 7A, where interactions with seabirds and marine mammals were most likely to occur. Incidental takes of harbor porpoise, Dall's porpoise and harbor seals have been documented in the fishery. The overall take of marine mammals for the salmon drift gillnet fisheries in Puget Sound is unlikely to have increased since the fisheries were last observed, owing to reductions in the number of participating vessels and available fishing time.

Category II, OR swordfish surface longline fishery.

Number of permit holders: The number of permits issued annually from 2000-2005 has ranged between one and seven (pers. comm., Jean McCrae, Oregon Department of Fish and Wildlife, Marine Resources Program).

Number of active permit holders: Based on landings of swordfish with this gear type, there were no active permit holders in this fishery from 2000-2005.

Total effort: From 2000-2005, there were no reported swordfish landings using longline gear.

Geographic range: The Fishery Management Plan prohibits targeting highly migratory species such as swordfish with longlines within the U.S. EEZ, thus any fishing would have to occur outside the EEZ. However, shallow set methods used for swordfish are also prohibited east of W150 longitude.

Seasons: This fishery could occur year-round, however, effort would generally terminate by late fall.

Gear type: Fishing gear consists of a buoyed mainline fitted with leaders and baited hooks. The mainline is fished near the surface suspended from buoys (rather than anchored to the bottom as in groundfish longline fisheries). Swordfish longlines may not exceed 1000 fathoms in length and must be attached at one end to the vessel when fishing. The gear is typically set in the evening and retrieved in the morning.

Regulations: The fishery is a limited-entry fishery with gear and bycatch restrictions.

Management type: The fishery is managed under a Highly Migratory Species Fisheries Management Plan developed by the Pacific Fishery Management Council and NMFS.

Category II, OR blue shark surface longline fishery.

Number of permit holders: The number of Oregon Developmental Fishery Permits for fishing blue shark using a floating longline is limited to 10. From 2000-2005, there were fewer than 5 permits issued annually for this fishery (pers. comm., Jean McCrae, Oregon Department of Fish and Wildlife, Marine Resources Program).

Number of active permit holders: There were no active permits in the blue shark longline fishery off Oregon from 2000-2005. The effort in this fishery prior to 1998 was estimated to be low based on the number of permits issued and very limited landings.

Total effort: From 2000-2005, there were no reported landings of blue sharks using longline gear.

Geographic range: This fishery occurs off the coast of Oregon. The Fishery Management Plan prohibits targeting highly migratory species such as blue sharks with longlines within the U.S. EEZ, thus any fishing would have to occur outside the EEZ.

Seasons: This fishery occurs year-round, however, effort in this fishery generally terminates by late fall.

Gear type: Fishing gear consists of a buoyed mainline fitted with leaders and baited hooks. The mainline is fished near the surface suspended from buoys (rather than anchored to the bottom as in groundfish longline fisheries). Shark longlines must be marked at each terminal surface end with a pole and flag, an operating light, a radar reflector, and a buoy showing clear identification and gear owner. The gear is typically set in the evening and retrieved in the morning.

Regulations: The fishery is a limited-entry fishery with gear and bycatch restrictions.

Management type: The fishery is managed under a Highly Migratory Species Fisheries Management Plan developed by the Pacific Fishery Management Council and NMFS.

Category II, CA squid purse seine fishery.[3]

Number of Permit Holders: A permit has been required to participate in the squid fishery since April 1998. Originally, only two types of permits were issued, either a vessel or light boat permit during the moratorium period from 1998 to 2004. Since the adoption of the Market Squid Fishery Management Plan (MSFMP) in 2005, a total of seven different permit types are now allowed under the restricted access program. Permit types include both transferable and non-transferable vessel, brail and light boat permits whose qualifying criteria are based on historical participation in the fishery during the moratorium period. Market squid vessel and brail permits allow a vessel to use lights to attract and capture squid using either purse seines or brail gear. Light boat owner permits only allow the use of attracting lights to attract and aggregate squid. In addition, three experimental non-transferable permits are allowed for vessel fishing outside of historical fishing areas north of San Francisco. In the 2006/2007 season there were 91 vessel permits, 14 brail permits, 64 light boat permits and 3 experimental permits issued. A permit is not required when fishing for live bait or when landing two short tons or less, which is considered incidental.

Number of Active Permit Holders: The number of active permits varies by year depending on market conditions and availability of squid. During the 2006/2007 season (1 April 2006 – 31 March 2007) there were approximately 84 vessels active during some portion of the year. Twenty-nine vessels harvested 86% of the total landings greater than two tons. The 1999/2000 season had the highest squid landings to date (115,437mt), with 132 vessels making squid landings.

Total Effort: Logbooks have been mandatory for the squid fishery since May 2000. Results for the 2006 calendar year indicate that each hour of fishing required 1.4 hours of search time by light boats. Combined searching and fishing effort

[3]This fishery description was provided by Dianna Porzio and Dale Sweetnam, California Department of Fish and Game. Details of marine mammal interactions with this fishery were obtained from NOAA Fisheries, Southwest Regional Office.

resulted in 6.9 metric tons (mt) of catch per hour. In the 2006/2007 season, the fishery made 1,611 landings. This is a 47% decrease from the previous season. In addition, the average landing decreased from 23.9 mt to 21.7 mt.

Geographic Range: Since the 1960's there have been two distinct fisheries in operation north and south of Point Conception. Since the mid-1980's the majority of the squid fishing harvest has occurred in the southern fishery, with efforts focused around the Channel Islands and along the mainland from Port Hueneme to La Jolla. In the 2006/2007 season, the southern fishery landed 98% of the catch with the majority of landings occurring around the northern Channel Islands. In contrast, during the 2005/2006 season, landings in the southern fishery were primarily around Catalina Island. The northern fishery, centered primarily in Monterey Bay, has been in operation since the mid-1860's and has historical significance to California. During the 2002/2003 season, a moderate El Niño condition resulted in nearly 60% of the catch being landed in northern California.

Seasons: The fishery can occur year-round; however, fishing efforts differ north and south of Point Conception. Typically, the northern fishery operates from April through September while the southern fishery is most active from October through March. El Niño conditions generally hamper the fishery in the southern fishery and squid landings are minimal during these events. In contrast, landings in the northern fishery often increase during El Niño events and then are depressed for several years after.

Gear Type: There are several gears employed in this fishery. From 1996 to 2006, the vast majority (95%) of vessels use either purse (69%) or drum (26%) seine nets. Other types of nets used include brail (5%) and lampara nets (<1%). Another gear type associated with the fishery is attracting lights (30,000 watts maximum) that are used to attract and aggregate spawning squid in shallow waters.

Regulations: Since March 2005, the fishery operates under a restricted access program that requires all vessels to be permitted. A mandatory logbook program for fishing and lighting vessels has been in place since May 2000. A /monitoring program has been in place since 2000 that samples the landings is designed to evaluate the impact of the fishery on the resource. Attracting lights were regulated with each vessel restricted to no more than 30,000 watts of light during fishing activities. These lights must also be shielded and oriented directly downward to reduce light scatter. The lighting restrictions were enacted to avoid risks to nesting brown pelicans and interactions with other seabird species of concern. A seabird closure area restricting the use of attracting lights for commercial purposes in any waters of the Gulf of the Farallones National Marine Sanctuary was enacted. A seasonal catch limitation of 107,047 mt (118,000 short tons) was established to limit further expansion of the fishery. Commercial squid fishing is prohibited between noon on Friday and noon on Sunday of each week to allow an uninterrupted consecutive two-day period of spawning. Additional closure areas to the fishery to protect squid spawning habitat include the Channel Islands Marine Protected Areas (MPAs) and the newly established MPAs along the central California coast as well as areas closed to the use of purse seine gear including the leeward side of Catalina Island, Carmel and Santa Monica Bays.

Management Type: The market squid fishery is under California State management. The fishery was largely unregulated until 1998 when it came under regulatory control of the California Fish and Game Commission and the Department of Fish and Game. The MSFMP was enacted on March 28, 2005. The MSFMP was developed to ensure sustainable long-term conservation and to be responsive to environmental and socioeconomic changes. Market squid is also considered a monitored species under the Pacific Fishery Management Council's (PFMC) Coastal Pelagic Species Fishery Management Plan.

Comments: During the 1980's, California's squid fishery grew rapidly in fleet size and landings when international demand for squid increased due to declining fisheries in other parts of the world. In 1997 industry-sponsored legislation halted the growth of fleet size with a moratorium on new permits. Landing records were set several times during the 1990's, but landings seem to fluctuate with changing environmental and atmospheric conditions of the California Current. Encounters with marine mammals and sea birds are documented in logbooks. Seal bombs are used regularly, but fishermen report that they no longer have an effect. A pilot observer program began in July 2004 and has documented one unidentified common dolphin death in 135 sets through January 2006. In addition, there have been 96 California sea lions and three harbor seals released alive (NMFS, Southwest Region, unpublished data). In addition to the observed death, there were three strandings of Risso's dolphin from 2002-2003 where evidence of gunshot wounds was confirmed, suggesting interaction with this fishery (NMFS Southwest Regional Office, unpublished data). The squid fishery operates primarily at night and targets spawning aggregations of adult squid. In recent years the amount of daylight fishing has increased, especially in Monterey, in part due to better sonar gear, but also to reduce interactions with California sea lions. The PFMC adopted the egg escapement method to monitor the impact of market squid fishery since no reliable biomass estimate has been developed. It is a proxy for Maximum Sustainable Yield (MSY), setting an egg escapement threshold level at which to evaluate the magnitude of fishing mortality on the spawning potential of the squid stock. The egg escapement method was developed on conventional spawning biomass "per-recruit" theory. In general, the MSY Control Rule for market squid is based on evaluating levels of egg escapement associated with the exploited population. The egg escapement threshold, initially set at 30%, represents a biological reference point from which to evaluate fishery related impacts.

Category III, CA Dungeness crab pot

Notes: NMFS is reviewing several pot and trap fisheries along the U.S. west coast, in response to entanglements of humpback whales in pot and trap gear. An update on these fisheries will appear in the MMPA Proposed List of Fisheries for 2009. For all commercial pot and trap fisheries in California, a general trap permit is required, in addition to any specific permits required for an individual fishery. All traps are required to be tended and serviced at least every 96 hours, weather permitting. Descriptions of those pot and/or trap fisheries for which interactions with marine mammals have been documented or suspected are included in this Appendix.

Number of permit holders: The Dungeness crab fishery is a limited access fishery requiring a vessel-based permit that is transferable. This program was initiated in 1994 based on landing histories. The number of vessels participating on an annual basis does vary, but approximately 400 vessels have been landing crab in recent years.

Number of active permit holders: Approximately 400 vessels have been landing crabs in recent years.

Total effort: There is no restriction on the number of traps that may be fished at one time by a single vessel. Some vessels use as many as 1000 or more traps at the peak of the season (December/January).

Geographic range: This fishery operates in central and northern California.

Seasons: The fishery is divided into two management areas. The central region (south of the Mendocino-Sonoma county line) fishery opens November 15 and continues through June 30. The northern region (north of the Mendocino-Sonoma county line) is annually scheduled to open on December 1, but may be delayed by CDF&G based on the condition of market size crabs, and continues until July 15.

Gear type: For each trap fished there is one vertical line in the water, though only in the northern region, is fishing strings illegal. All traps are required to be marked with buoys bearing the commercial fishing license number. The normal operating depth for Dungeness crab is between 35 and 70 m. Traps are typically tended on a daily basis.

Regulations: There is no daily logbook requirement for the commercial Dungeness crab fishery. There is a recreation fishery for Dungeness crab, which allows for 10 crab per day to be harvested except when fishing on a commercial passenger fishing vessel (CPFV) in central California, the limit is 6 crab per person. There is no reliable estimate for the effort or landings in the sport fishery except that CPFVs are required to track catch and effort by species.

Management type: The Dungeness crab pot fishery is managed by the California legislature, CDF&G and also by the tri-state committee for Dungeness, which includes the states of Oregon and Washington.

Comments: Humpback whale entanglements with Dungeness crab gear have not been confirmed, but are suspected as the responsible fishery based on the location and timing of fishing effort and observed humpback entanglements.

Category III, OR Dungeness crab pot

Notes: Dungeness crab is the most significant pot/trap fishery in the state of Oregon. Over the long term, the fishery has averaged around 10 million lb of landings per year; although since 2003, annual landings have been approximately 25 to 30 million lb. This fishery requires an Oregon issued limited-entry permit, which is transferable.

Number of permit holders: There were 433 permit holders in 2006.

Number of active permit holders: A total of 364 vessels landed crabs in 2006.

Total effort: In 2006, the fishery made a transition to a three-tiered pot limitation program which allows a maximum of 200, 300, or 500 pots to be fished at any one time depending on previous landing history. The pot limitation is implemented through a buoy tag requirement. All Dungeness crab pots require buoy tags with the identifying associated permit attached. The expected result of the buoy tags and tier limits is to reduce the number of pots in Oregon waters down from 200,000 to approximately 150,000.

Geographic range: Oregon waters.

Seasons: The Dungeness crab season runs from December 1 to August 14. The highest landings are always recorded in December through February, at the beginning of the season.

Gear type: Pots.

Regulations: All Oregon pot/trap gear must be marked on its terminal ends with pole and flag, light, radar reflector, and buoy with the owner/operator number clearly marked. By law, gear may not be left unattended for more than seven days. All vessel operators and deck hands must have a commercial fishing license or crewmembers license.

Management type: State management, Oregon Department of Fish and Wildlife.

Comments: Humpback whale entanglements with Dungeness crab gear have not been confirmed, but are suspected as the responsible fishery based on the location and timing of fishing effort and observed humpback entanglements.

Category III, CA spot prawn fishery

Number of permit holders: A three-tiered limited access permit system is used in this fishery to accommodate changes in the fishery that occurred when trawling methods were banned and replaced with trap fishing in 2003. Permits are linked to the vessel owner and only Tier 1 permits are transferable. Tier 1 permits allow a maximum of 500 traps in use at a time. Eighteen vessels had Tier 1 permits in 2007. Tier 2 permits allow 150 traps in use at a time. There were three vessels utilizing Tier 2 permits in 2007. Tier 3 permits were issued to allow vessels that previously used trawl gear to switch to trap gear to target spot prawn. There were nine Tier 3 permits issued in 2007. Information on 2007 license statistics was obtained from the CA Department of Fish and Game website, http://www.dfg.ca.gov/licensing/statistics/statistics.html.

Number of active permit holders: A total of 30 vessels participated in this fishery in 2007.

Total effort: Landings have increased every year since 2003. The total number of traps set is unknown, although the theoretical maximum number of traps that may be fished annually is approximately 13,000.

Geographic range: The fishery operates from Monterey south. Over half of the landings are made in Los Angeles and San Diego. Traps are typically set in waters of 182 m (100 fathoms) or more. South of Point Arguello, traps must be fished in waters 91 m (50 fathoms) or deeper.

Seasons: North of Point Arguello, the fishery is open from February 1 to October 30. North of Point Arguello, the open season is August 1 to April 30.

Gear type: Strings of 25 to 50 traps are fished in deep waters (>182 m).

Regulations: For all commercial pot and trap fisheries in California, a general trap permit is required, in addition to any specific permits required for an individual fishery. All traps are required to be tended and serviced at least every 96 hours, weather permitting. There is a daily logbook requirement in this fishery. There is no buoy marking requirement and no recreational fishery for this species.

Management type: This fishery is managed under state authority by the California Department of Fish and Game.

Comments: One humpback whale was seriously injured in 2006 as a result of entanglement in spot prawn trap gear.

Category III, WA/OR/CA sablefish pot

Notes: Sablefish is likely the most commonly targeted groundfish caught in pot gear in off the U.S. west coast.
Number of permit holders: There are 32 limited-entry permits (LEPs) to catch sablefish with pot gear. Open access privileges are also available to fishermen.

Number of active permit holders: Including all vessels which made landings with an LEP or under open access rules, a total of about 150 vessels participated in this fishery in 2007. This total fluctuates on an annual basis.
Total effort: Estimated annual landings indicate usually over 1 million lbs of sablefish are landed per year in this fishery.

Geographic range: The fishery is well distributed from central California north to the U.S./Canadian border. Most of the effort occurs out in deeper waters (200-400 m).

Seasons: Most fishing effort occurs January through September.

Gear type: Traps <6 ft. in any dimension.

Regulations: A general trap permit is all that is required for open access to this fishery by the states along the U.S. west coast. LEPs are divided into a three-tiered system which allocates annual landing limits to individual permits based on the status of the stock. Daily logbook reporting is required.

Management type: Sablefish is managed under the federal Groundfish Fishery Management Plan. This is the only trap fishery regulated by the federal government; all others are managed by the states.

Comments: One humpback whale was seriously injured in 2006 as a result of entanglement in sablefish trap gear.

Category III, CA rock crab

Number of permit holders: There were 134 permits issued in 2007.

Number of active permit holders: Unknown, but it is likely that most issued permits are active.

Total effort: Annual landings averaged approximately 1 million pounds from 2000 to 2005.

Geographic range: The fishery operates throughout California waters. Most landings are made south of Morro Bay, California, with approximately 65% of all landings coming from the Santa Barbara area.

Seasons: There are no seasonal restrictions, though some area closures exist.

Gear type: There is no restriction on the number of traps that may be fished at one time by the vessel but the typical number of traps operated at any given time is less than 200. Traps are usually buoyed singularly or in pairs, but fishing strings (multiple traps attached together between two buoys) is allowed. Buoys are required to be marked with the license number of the operator. The normal working depth of traps in this fishery is 10 to 35 fathoms.

Regulations: There is no daily logbook requirement for the commercial rock crab fishery.

Management type: The fishery is managed by the California Department of Fish and Game.

Comments: The recreational bag limit is 35 crabs per day, but there is no reliable estimate of the effort or landings in the sport fishery.

Category III, CA halibut bottom trawl.

Notes: This is a newly-listed fishery in the 2007 MMPA NMFS List of Fisheries (Federal Register Volume 72, No. 59, 14466). Information on fishing effort was provided by Stephen Wertz, California Department of Fish and Game.

Number of permit holders: There were 60 permits issued in 2006.

Number of active permit holders: There were 31 active permit holders in 2006.

Total effort: Thirty one vessels made 3,711 tows statewide in 2006, totaling 3,897 tow hours, in 332 days of fishing effort.

Geographic range: The fishery operates from Bodega Bay in northern California to San Diego in southern California, from 3 to 200 nautical miles offshore. Trawling is prohibited in state waters (0 to 3 nmi offshore) and within the entire Monterey Bay, except in the designated "California halibut trawl grounds", between Point Arguello and Point Mugu beyond 1 nautical mile from shore. Trawls used in this region must have a minimum mesh size of 7.5 in and trawling is prohibited here between 15 March and 15 June to protect spawning adults.

Seasons: Fishing is permitted year-round, except in state waters. State waters are closed between 15 March and 15 June.

Gear type: Otter trawls, with a minimum mesh size of 4.5 inches are required in federal waters, while fishing in state waters has a 7.5 inch mesh size requirement.

Regulations: Fishing in state waters is limited to the period 14 March – 16 June in the 'California halibut trawl grounds' in southern California between Point Arguello and Point Mugu. All other fishing must occur in federal waters beyond 3 nautical miles from shore.

Management type: The fishery is managed by the California Department of Fish and Game.

Comments: No marine mammal interactions have been documented for this fishery, but the gear type and fishing methods are similar to the WA/OR/CA groundfish trawl fishery (also category III), which is known to interact with marine mammals.

Category III, CA herring gillnet fishery.[4]

The herring fishery is concentrated in four spawning areas which are managed separately by the California Department of Fish and Game (CDFG); catch quotas are based on population estimates derived from acoustic and spawning-ground surveys. The largest spawning aggregations occur in San Francisco Bay and produces more than 90% of the herring catch. Smaller spawning aggregations are fished in Tomales Bay, Humboldt Bay, and Crescent City Harbor. During the early 1990's, there were 26 round haul permits (either purse seine or lampara nets). Between 1993 and 1998, all purse seine fishers converted their gear to gillnets with stretched mesh size less than 2.5 inches (which are not known to take mammals) as part of CDFG efforts to protect herring resources. The fishery is managed through a limited-entry program. The California Department of Fish and Game website lists a total of 447 herring gillnet permits for 2005

[4] Pers. Comm. Becky Ota, State Herring Manager, Senior Biologist.

(http://www.dfg.ca.gov/mrd/herring/index.html). Of these, 406 permits exist for San Francisco Bay, 34 in Tomales Bay, 4 in Humboldt Bay, and 3 in Crescent City Harbor. This fishery begins in December (San Francisco Bay) or January (northern California) and ends when the quotas have been reached, but no later than mid-March.

Category III, WA Willapa Bay salmon drift gillnet fishery.

Number of permit holders: The total number of permit holders for this fishery in 1995 and 1996 was 300, but this number has declined in subsequent years. In 1997 there were 264 total permits and 243 in 1998. The NMFS 2001 List of Fisheries lists an estimate of 82 vessels/persons in this fishery.

Number of active permit holders: The number of active permit holders is assumed to be equal to or less than the number of permits eligible to fish in a given year. The number of permits renewed and eligible to fish in 1996 was 300 but declined to 224 in 1997 and 196 permits were renewed for 1998. The 1996-98 counts do not include permits held on waivers for those years, but do include permits that were eligible to fish at some point during the year and subsequently entered into a buyback program. The number of permits issued for this fishery has been reduced through a combination of State and federal permit buyback programs. Vessels permitted to fish in the Willapa Bay are also permitted to fish in the lower Columbia River drift gillnet fishery.

Total effort: Effort in this fishery is regulated through area and species openings. The fishery was observed in 1992 and 1993 when fishery opening were greater than in recent years. In 1992 and 1993 there were 42 and 19 days of open fishing time during the summer "dip-in" fishery. The "dip-in" fishery was closed in 1994 through 1999. Available openings have also declined in the fall chinook/coho fisheries. In 1992/93 respectively there were 44 and 78 days of available fishing time. There were 43, 45, 22 and 16.5 available open fishing days during 1995 through 1998.

Geographic range: This fishery includes all inland marine waters of Willapa Bay. The waters of the Bay are further divided into smaller statistical catch areas.

Seasons: Seasonal openings coincide with local salmon run timing and fish abundance.

Gear type: Fishing gear used in this fishery is a drift gillnet of single web construction, not exceeding 250 fathoms in length, with a minimum stretched mesh size ranging upward from 5 inches depending on target salmon species. The gear is commonly set during periods of low and high slack tides. It is the intention of the fisher to keep the net off the bottom. The vessel is attached to one end of the net and drifts with the net. The entire net is periodically retrieved onto the vessel and catch is removed. Drift times vary depending on fishing area, tidal condition, and catch.

Regulations: This fishery is a limited-entry fishery with seasonal openings and gear restrictions.

Management type: The salmon drift gillnet fishery is managed by the Washington Department of Fish and Wildlife.

Comments: Observers were placed onboard vessels in this fishery to monitor marine mammal interactions in the early 1980s and in 1990-93. Five incidentally taken harbor seals were recovered by observers in the fishery from 1991through 1993 (3 in ‘92 and 2 in ‘93). Two incidentally taken northern elephant seals were recovered by observers from the fishery in 1991 but no takes of this species were observed. The summer fishery (July- August) in Willapa Bay has been closed since it was last observed in 1993 and available fishing time declined from 1996 through 1998.

Category III, WA Grays Harbor salmon drift gillnet fishery.

Number of permit holders: This commercial drift gillnet fishery does not include Treaty Indian salmon gillnet fishing. The total number of permit holders for this commercial fishery in 1995 and 1996 was 117 but this number has declined in subsequent years. In 1997 there were 101 total permits and 87 in 1998.

Number of active permit holders: The NMFS 2001 List of Fisheries lists a total of 24 vessels/persons operating in this fishery. The number of active permit holders is assumed to be equal to or less than the number of permits eligible to fish in a given year. The number of permits renewed and eligible to fish in 1996 was 117 but declined to 79 in 1997 and 59 permits were renewed for 1998. The 1996-98 counts do not include permits held on waivers for those years but do include permits that were eligible to fish at some point during the year and subsequently entered a buyback program. The number of permits issued for this fishery has been reduced through a combination of State and federal permit buyback programs. Vessels permitted to fish in Grays Harbor are also permitted to fish in the lower Columbia River salmon drift gillnet fishery.

Total effort: Effort in this fishery is regulated through area and species openings. The fishery was observed in 1992 and 1993 when fishery openings were greater than in recent years. In 1992 and 1993 there were 42 and 19 days of open fishing time during the summer "dip-in" fishery. The "dip-in" fishery was closed in 1994 through 1999. Available openings have also declined in the fall chinook/coho fisheries. There were 11, 17.5, 9 and 5 available open fishing days during the 1995 through 1998 fall season.

Geographic range: Effort in this fishery includes all marine waters of Grays Harbor. The waters are further divided into smaller statistical catch areas.

Seasons: This fishery is subject to seasonal openings which coincide with local salmon run timing and fish abundance.

Gear type: Fishing gear used in this fishery is a drift gillnet of single web construction, not exceeding 250 fathoms in length, with a minimum stretched mesh size ranging of 5 inches depending on target salmon species. The gear is commonly set during periods of low and high slack tides and retrieved periodically by the tending vessel. It is the intention of the fisher to keep the net off the bottom. The vessel is attached to one end of the net and drifts with the net. The entire net is periodically retrieved onto the vessel and catch is removed. Drift times vary depending on fishing area, tidal condition, and catch.

Regulations: The fishery is a limited-entry fishery with seasonal openings and gear restrictions.

Management type: The salmon drift gillnet fishery is managed by the Washington Department of Fish and Wildlife.

Comments: Observers were placed onboard vessels in this fishery to monitor marine mammal interactions in the early 1980s and in 1990-93. Incidental take of harbor seals was observed during the fishery in 1992 and 1993. In 1992, one harbor seal was observed entangled dead during the summer fishery and one additional seal was observed entangled during the fall fishery but it escaped uninjured. In 1993, one harbor seal was observed entangled dead and one additional seal was recovered by observers during the summer fishery. The summer fishery (July-August) in Grays Harbor has been closed since it was last observed in 1993. Available fishing time in the fall chinook fisheries declined from 1996 through 1998.

Category III, WA, OR lower Columbia River salmon drift gillnet fishery.

Number of permit holders: The total number of permit holders was 856 (344 from Oregon and 512 from Washington) when the fishery was last observed in 1993. In 1995 through 1998 the number of permits was 747, 693, 675 and 620 respectively. The number of permits issued for this fishery by Washington has been reduced through a combination of State and federal buy-back programs. This reduction is reflected in the overall decline in the total number of permits.

Number of active permit holders: The number of active permits is a subset of the total permits issued for the fishery. For example, in 1995, 110 vessels (of the 747 vessels holding permits) landed fish in the mainstem fishery.

Total effort: Effort in this fishery is regulated through species related seasonal openings and gear restrictions. The fishery was observed in 1991, 1992 and 1993 during several seasons of the year. The winter seasons (openings) for 1991 through 1993 totaled 13, 9.5, and 6 days respectively. The winter season has subsequently been reduced to remnant levels to protect upriver ESA listed salmon stocks. In 1995 there was no winter salmon season, in 1996 the fishery was open for 1 day. In 1997 and 1998 the season was shifted to earlier in the year and gear restrictions were imposed to target primarily sturgeon. The fall fishery in the mainstem was also observed 1992 and 1993 as was the Young's Bay terminal fishery in 1993, however, no marine mammal mortality was observed in these fisheries. The fall mainstem fishery openings varied from 1 day in 1995 to just under 19.5 days in 1997 and 6 days in 1998. The fall Youngs Bay terminal fishery fluctuated between 60 and 70 days for the 1995 through 1998 period which was similar to the fishery during the period observed.

Geographic range: This fishery occurs in the main stem of the Columbia river from the mouth at the Pacific Ocean upstream to river mile 140 near the Bonneville Dam. The lower Columbia is further subdivided into smaller statistical catch areas which can be regulated independently.

Seasons: This fishery is subject to season and statistical area openings which are designed to coincide with run timing of harvestable salmon runs while protecting weak salmon stocks and those listed under the Endangered Species Act. In recent years, early spring (winter) fisheries have been sharply curtailed for the protection of listed salmon species. In 1994, for example, the spring fishery was open for only three days with approximately 1900 fish landed. In 1995 the spring fishery was closed and in 1996 the fishery was open for one day but fishing effort was minimal owing to severe flooding. Only 100 fish were landed during the one day in 1996.

Gear type: Typical gear used in this fishery is a gillnet of single web construction, not exceeding 250 fathoms in length, with a minimum stretched mesh size ranging upwards from 5 inches depending on target salmon species. The gear is commonly set during periods of low and high slack tides. It is the intention of the fisher to keep the net off the bottom. The vessel is attached to one end of the net and drifts with the net. The entire net is periodically retrieved onto the vessel and catch is removed. Drift times vary depending on fishing area, tidal condition, and catch.

Regulations: The fishery is a limited-entry fishery with seasonal openings, area closures, and gear restrictions.

Management type: The lower Columbia River salmon drift gillnet fishery is managed jointly by the Washington Department of Fish and Wildlife and the Oregon Department of Fish and Wildlife.

Comments: Observers were placed onboard vessels in this fishery to monitor marine mammal interactions in the early 1980s and in 1990-93. Incidental takes of harbor seals and California sea lions were documented, but only during the winter seasons (which have been reduced dramatically in recent years to protect ESA-listed salmon). No mortality was observed during the fall fisheries.

Category III, WA, OR salmon net pens.

Number of permit holders: There were 12 commercial salmon net pen ("grow out") facilities licensed in Washington in 1998. There are no commercial salmon net pen or aquaculture facilities currently licensed in Oregon. Non-commercial salmon enhancement pens are not included in the list of commercial fisheries.

Number of active permit holders: Twelve salmon net pen facilities in Washington.

Total effort: The 12 licensed facilities on Washington operate year-round.

Geographic range: In Washington, net pens are found in protected waters in the Straits (Port Angeles), northern Puget Sound (in the San Juan Island area) as well as in Puget Sound south of Admirality Inlet. There are currently no commercial salmon pens in Oregon.

Seasons: Salmon net pens operate year-round.

Gear type: Net pens are large net impoundments suspended below a floating dock-like structure. The floating docks are anchored to the bottom and may also support guard (predator) net systems. Multiple pens are commonly rafted together and the entire facility is positioned in an area with adequate tidal flow to maintain water quality.

Regulations: Specific regulations unknown.

Management type: In Washington, the salmon net pen fishery is managed by the Washington Department of Natural Resources through Aquatic Lands Permits as well as the Washington Department of Fish and Wildlife.

Comments: Salmon net pen operations have not been monitored by NMFS for marine mammal interactions, however, incidental takes of California sea lions and harbor seals have been reported.

Category III, WA, OR, CA groundfish trawl.

Approximate number of vessels/persons: In 1998, approximately 332 vessels used bottom and mid-water trawl gear to harvest Pacific coast groundfish. This is down from 383 vessels in 1995. The NMFS List of Fisheries for 2001 lists 585 vessels as participating in this fishery. Groundfish trawl vessels harvest a variety of species including Pacific hake, flatfish, sablefish, lingcod, and rockfish. This commercial fishery does not include Treaty Indian fishing for groundfish.

All observed incidental marine mammal takes have occurred in the mid-water trawl fishery for Pacific hake. The annual hake allocation is divided between vessels that harvest and process catch at sea and those that harvest and deliver catch to shore-based processing facilities. At least one NMFS-trained observer is placed on board each at-sea processing vessel to provide comprehensive data on total catch, including marine mammal takes. In the California, Oregon, and Washington range of the fishery, the number of vessels fishing ranged between 12 and 16 (all with observers) during 1997-2001. Hake vessels that deliver to shore-based processors are issued Exempted Fishing Permits that requires the entire catch to be delivered unsorted to processing facilities where State technicians have the opportunity to sample. In 1998, 13% of the hake deliveries landed at shore-based processors were monitored. The following is a description of the commercial hake fishery.

Number of permit holders/active permit holders: A license limitation ("limited-entry") program has been in effect in the Pacific coast groundfish fishery since 1994. The number of limited-entry permits is limited to 404. Non-tribal trawl vessels that harvest groundfish are required to possess a limited-entry permit to operate in the fishery. Any vessel with a federal limited-entry trawl permit may fish for hake, but the number of vessels that do is smaller than the number of permits. In 1998, approximately 61 limited-entry vessels, 7 catcher/processors and 50 catcher vessels delivering to shoreside and mothership processors, made commercial landings of hake during the regular season. In addition, 6 unpermitted mothership processors received unsorted hake catch.

Total effort: The hake allocation continues to be fully utilized. From 1997 to 1999 the annual allocation was 232,000 mt/year, this is an increase over the 1996 allocation of 212,000 mt and the 1995 allocation of 178,400 mt. In 1998, motherships vessels received 50,087 mt of hake in 17 days, catcher/processors took 70,365 mt of hake in 54 days and shore-based processors received 87,862 mt of hake over a 196 day period.

Geographic range: The fishery extends from northern California (about 40° 30' N. latitude) to the U.S.-Canada border. Pacific hake migrate from south to north during the fishing season, so effort in the south usually occurs earlier than in the north.

Seasons: From 1997 to 1999, season start dates have remained unchanged. The shore-based season in most of the Eureka area (between 42°- 40°30' N latitude) began on April 1, the fishery south of 40°30' N latitude opened April 15, and the fishery north of 42° N latitude started on June 15. In 1998, the primary season for the shore-based fleet closed on October 13, 1998. The primary seasons for the mothership and catcher/processor sectors began May 15, north of 42^0 N. lat. In 1998, the mothership fishery closed on May 31, the catcher/processor fishery closed on August 7.

Gear type: The Pacific hake trawl fishery is conducted with mid-water trawl gear with a minimum mesh size of 3 inches throughout the net.

Regulations/Management type: This fishery is managed through Federal regulations by the Pacific Fishery Management Council under the Groundfish Fishery Management Plan.

Comments: Since 1991, incidental takes of Steller sea lions, Pacific white-sided dolphins, Dall's porpoise, California sea lions, harbor seals, northern fur seals, and northern elephant seals have been documented in the hake fishery. From 1997-2001, 4 California sea lions, 2 harbor seals, 2 northern elephant seals, 1 Pacific white-sided dolphin, and 6 Dall’s porpoise were reported taken in California/Oregon/Washington regions by this fishery.

Category III, Hawaii gillnet fishery.[5]

Number of active permit holders: In 1997 there were 129 active commercial fishers. In 1995 there were approximately 115.

Total effort: In 1997 there were 2,109 trips for a total catch of 864,194 pounds with 792,210 pounds sold. This fishery operates in nearshore and coastal pelagic regions.

Seasons: This fishery operates year-round with the exception of juvenile big-eyed scad less than 8.5 inches which cannot be taken from July through October.

Gear type: Gillnets are of stretched mesh greater than 2 inches and stretched mesh size greater than 2.75 inches for stationary gillnets. Stationary nets must be inspected every 2 hours and total soak time cannot exceed four hours in the same location. New restrictions implemented in 2002 include that nets may not: 1) be used more than once in a 24-hour period; 2) exceed a 12 ft stretched height limit; 3) exceed a single-panel; 4) be used at night; 5) be set within 100 ft. of another lay net; 6) be set in more than 80 ft depths; 7) be left unattended for more than ½ hour; 8) break coral during retrieval and nets must be 1) registered with the Division of Aquatic Resources; 2) inspected within two hours after being set; 2) tagged with two marker buoys while fished. In addition to these gear restrictions, non-commercial users of lay nets may not use a net longer than 500 ft, while commercial users may use nets up to 1200 ft in length. Additional mesh restrictions are in place for taking big-eyed scad.

Regulations: Gear and season restrictions (see above).

Management type: Managed by the State of Hawaii Division of Aquatic Resources.

Comments: The principle catches include reef fishes and big-eyed scad (akule) and mackerel scad (opelu). Interactions have been documented with bottlenose dolphins and spinner dolphins.

Category III, Hawaii lobster trap fishery.[6 7]

Note: The portion of this fishery managed by the State of Hawaii and operating in the MHI is about 1% of the size (total pounds of lobster caught) of the federally managed fishery operating primarily in the NWHI. The description that follows refers to the NWHI fishery unless stated otherwise.

Number of permit holders: There are 15 permit holders under a (1991) federal limited access program.

Number of active permit holders: In 1998 and 1999 there were 5 and 6 vessels that participated, respectively. In the MHI there were 5 active fishers in 1997.

Total effort: The number of trap hauls for 1999 is not available at this time. However, the majority of the effort took place in the 4 harvest guideline areas; Necker Bank, Gardner Pinnacles and Maro Reef, with the remaining effort spread out over 10 unique areas. In 1998 171,000 trap hauls were made by the 5 vessels during 9 trips and in 1997 a total of 177,700 hauls were made. In the MHI 19 trips were made in 1997.

Geographic range: Lobster permits allow fishing operations in the US EEZ from 3 to 200 nmi offshore American Samoa, Guam and Hawaii (including the EEZ areas of the NWHI and MHI). However, no vessels have operated in the EEZ's of American Samoa or Guam since 1983.

[5] Descriptions of Hawaii State managed fisheries provided by William Devick, State of Hawaii, Department of Land and Natural Resources, Division of Aquatic Resources, Honolulu Hawaii.

[6] Kawamoto, K. and Samuel G. Pooley. 1999. Draft Annual report of the 1998 western pacific lobster fishery.

[7] Kawamoto, K. 1999. Summary of the 1999 NWHI Lobster Fishing Season. NMFS Honolulu Laboratory.

Seasons: This fishery operates under a seasonal harvest guideline system opening on July 1. The season ends once the harvest guideline is met, but no later than December 31. In 1998, the harvest guideline was divided into the 4 areas mentioned above with total lobster catch set at (in thousands) 70, 20, 80, and 116, respectively. Area closure occurs once an area's harvest guideline is met. In the MHI, open season is from September through April.

Gear type: One string consists of approximately 100-fathom-plus plastic lobster traps. About 10 such strings are pulled and set each day. Since 1987 escape vents that allow small lobsters to escape from the trap have been mandatory. In 1996, the fishery became "retain all", i.e. there are no size limits or prohibitions on the retention of berried female lobsters. The entry-way of the lobster trap must be less than 6.5 inches to prevent monk seals from getting their heads stuck in the trap. In the MHI, rigid trap materials must have a dimension greater than 1 inch by 2 inches, with the trap not exceeding 10 feet by six feet.

Regulations: Season, gear and quota restrictions (see above) for the NWHI were formulated by the Western Pacific Regional Fishery Management Council and implemented by NMFS. The MHI fishery is managed by the State of Hawaii, Division of Aquatic Resources with season and gear restrictions (see above).

Management type: Limited-access program with bank specific quotas and closures. In the MHI, open access.

Comments: The NWHI fishery targets the red spiny lobster and the common slipper lobster. The ridgeback slipper lobster is also taken. Protected species of concern include monk seals (mentioned above) and turtles. There have been no interactions with these species since 1995, but they have been seen in the vicinity of the fishing gear.

Category III, Hawaii inshore handline fishery.

In 1997 a total of 750 fishers made 8,526 fishing trips in the main Hawaiian Islands, caught 531,449 pounds and sold 475,562 pounds for an ex-vessel landing value of $1,010,758. This fishery occurs in nearshore and coastal pelagic regions. The principal catches include reef fishes and big-eyed scad (akule) and mackerel scad (opelu). In 1995 approximately 650 fishers were active. Interactions have been documented for bottlenose dolphins.

Category III, Hawaii deep sea bottomfish handline and jig fishery.

Note: There are two commercial bottomfish fisheries in Hawaii: a distant water Northwestern Hawaiian Islands (NWHI) limited-entry fishery under federal jurisdiction and the main Hawaiian Islands bottomfish fishery primarily under the State of Hawaii jurisdiction.

Number of permit holders: The main Hawaiian Islands fishery is open-access with close to 2,000 bottomfish vessels registered with the State of Hawaii, whereas the NWHI is restricted to a maximum of 17 vessels.

Number of active permit holders: In 1997 in the MHI a total of 750 fishers were active. The NWHI are divided into the Mau Zone (closer to MHI) and the Hoomalu Zone. The Hoomalu Zone is a limited-entry zone with 6 vessels participating in 1998, 7 vessels fished the Mau Zone in the same year. Restrictions on new entry into the Mau Zone were implemented in 1998.

Total effort: In 1998 in the MHI approximately 8,500 trips were made with a total catch of 424,000 pounds for an ex-vessel landing value of $1,336,000. This fishery occurs primarily in offshore banks and pinnacles. In the NWHI 332,000 pounds ($894,000) were caught in 1998, below average since 1990.

Seasons: Year round.

Gear type: This fishery is a hook-and-line fishery that takes place in deep water. In the NWHI fishery, vessels are 30 ft or greater and conduct trips of about 10 days. In the MHI the vessels are smaller than 30 ft and trips last from 1 to 3 days.

Regulations: In the MHI, the sale of snappers (opakapaka, onaga and uku) and jacks less than one pound is prohibited. In June of 1998, Hawaii Division of Aquatic Resources (HDAR) closed 19 areas to bottomfishing, and regulations pertaining to seven species (onaga, opakapaka, ehu, kalekale, gindai, hapuupuu and lehi) were enacted.

Management type: The MHI is managed by the HDAR with catch, gear and area restrictions (see above) but no permit limits. The NWHI is a limited access federal program.

Comments: The deep-slope bottomfish fishery in Hawaii concentrates on species of eteline snappers, carangids, and a single species of grouper concentrated at depths of 30-150 fathoms. These fish have been fished on a subsistence basis since ancient times and commercially for at least 90 years. NMFS is considering the possibility of re-categorizing the NWHI bottomfish fishery from Category III to Category II due to concerns for potential interactions between bottomfish fishing vessels and Hawaiian monk seals, although there were none observed during 26 NWHI bottomfish trips during 1990-1993, and none reported. On 12 of the 26 trips, bottlenose dolphins have been observed stealing fish from the lines, but no hookings or entanglements occurred. Effort in this fishery increases significantly around the Christmas season because a target species, a true snapper, is typically sought for cultural festivities.[11] No data are collected for recreational or subsistence fishermen, but their MHI catch is estimated to be about equal to the MHI commercial catch.

Category III, Hawaii tuna handline and jig fishery.

In 1997 a total of 543 fishers made 6,627 trips in the MHI, and caught 2,014,656 pounds and sold 1,958,759 pounds for an ex-vessel value of $3,788,391. This fishery occurs around offshore fish aggregating devices and mid-ocean seamounts and pinnacles. The principal catches are small to medium sized bigeye, yellowfin and albacore tuna. There are several types of handline methods in the Hawaiian fisheries. Baited lines with chum are used in day fishing operations (palu-ahi), another version uses squid as bait during night operations (ika-shibi), and an operation called “danglers” uses multiple lines with artificial lures suspended or dangled over the water. Interactions have been documented for rough-toothed dolphins, bottlenose dolphins, and Hawaiian monk seals.

Table 1. Characteristics of Category I and Category II gillnet fisheries in California.

Fishery	Species	Mesh Size	Water Depth	Set Duration	Deployment	Miscellaneous
Category I CA/OR thresher shark and swordfish drift gillnet fishery	swordfish/shark	14 to 22 inches	Ranges from 90 to 4600 meters	Typically 8 to 15 hrs	Drift net only	Nets 500 to 1800 meters in length; other species caught: opah, louver, tuna, thresher, blue shark, mako shark
Category I CA halibut and white seabass set gillnet fishery (>3.5 inch mesh)	Halibut	8.5 inch	< 70 meters	24 hrs	Set net	
	Barracuda	3.5 inch		< 12 hrs	Drift net	April – July
	Leopard Shark	7.0 to 9.0 inch	< 90 meters			Fished similar to halibut.
	Perch/Croaker	3.5 to 4.0 inch	< 40 meters	< 24 hrs	Set net	Few boats target these species
	Rockfish	4.5 to 7.5 inch	> 90 meters	12 to 18 hrs	Set net	Net lengths 450 to 1800 meters. Soupfin shark is major bycatch.
	Soupfin shark/white seabass	6.0 to 8.5 inch	> 50 meters	24 hrs	Set net	Few boats target this species.
	Miscellaneous shark	6.0 to 14 inch	< 70 meters	8 to 24 hrs	Drift, some set net	Species include thresher and swell sharks.
Category II CA Yellowtail, barracuda, white seabass, and tuna drift gillnet fishery	White seabass, yellowtail, barracuda, white seabass, and tuna	Typically 6.5 inch	15 to 90 meters	8 to 24 hrs	Mostly drift net	White seabass predominant target species.

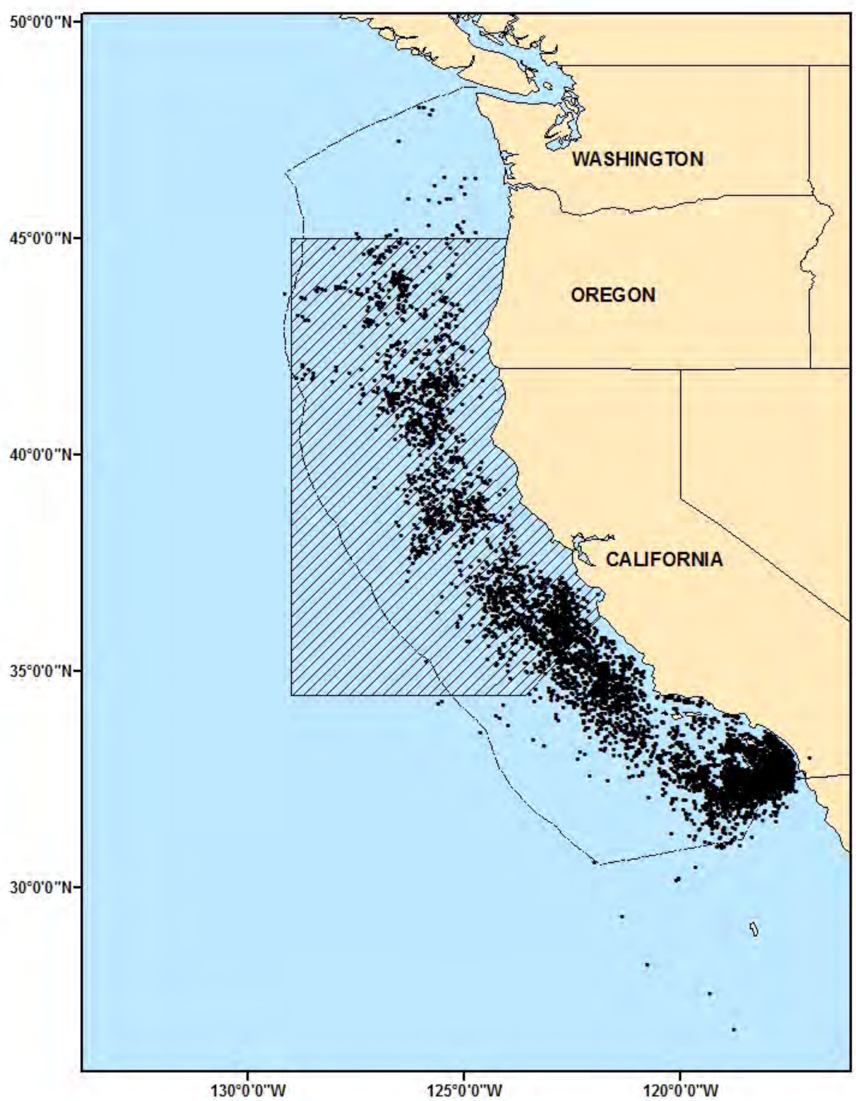

Figure 1. Locations of 7,660 sets observed in the California/Oregon large-mesh drift gillnet fishery for thresher shark and swordfish, 1990-2006. The cross-hatched area has been closed to gillnetting from 15 August to 15 November each year since 2001 to protect leatherback turtles. The outer dashed line represents the U.S. Exclusive Economic Zone. Total estimates of fishing effort over this period are approximately 48,000 sets.

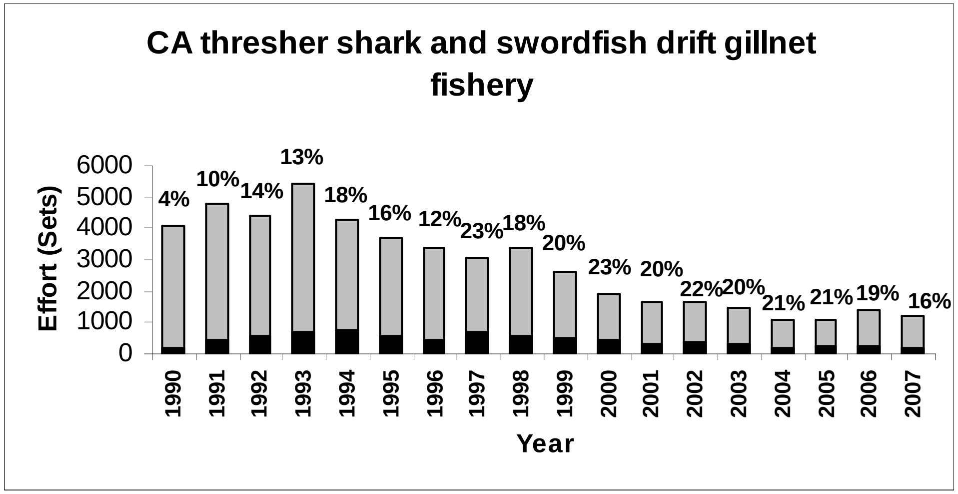

Figure 2. Estimated (gray) and observed (black) days of fishing effort for 1990-2007 in the California/Oregon thresher shark/swordfish drift gillnet fishery (≥ 14 inch mesh). One fishing day is equal to one set in this fishery. Percent observer coverage for each year is shown above the bars.

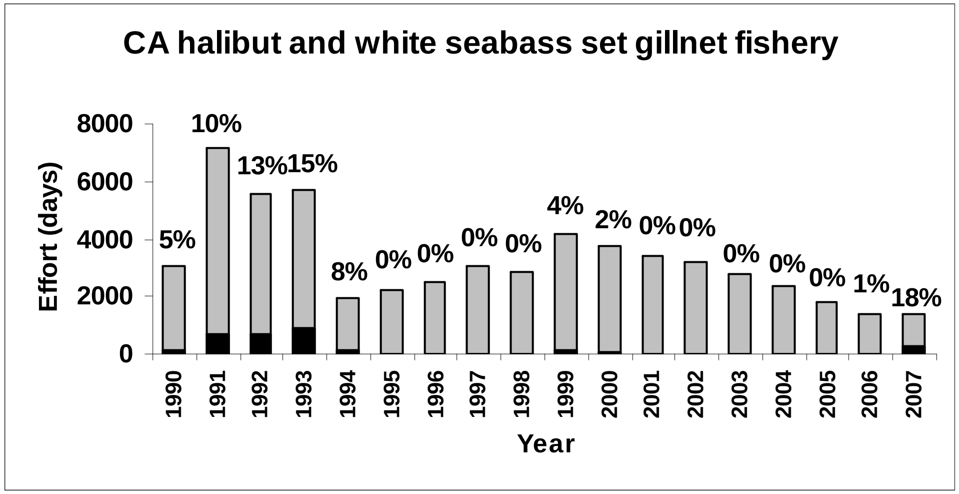

Figure 3. Estimated (gray) and observed (black) days of fishing effort for 1990- 2007 in the California halibut/white seabass set gillnet fishery (> 3.5 inch mesh). The fishery has been observed only sporadically since 1994. Percent observer coverage for each year is shown above the bars. The observer coverage estimate for 2007 is based on the number of sets observed in 2007 (n=248 sets) and 2006 fishing effort obtained from logbooks (n = 1,387 sets).

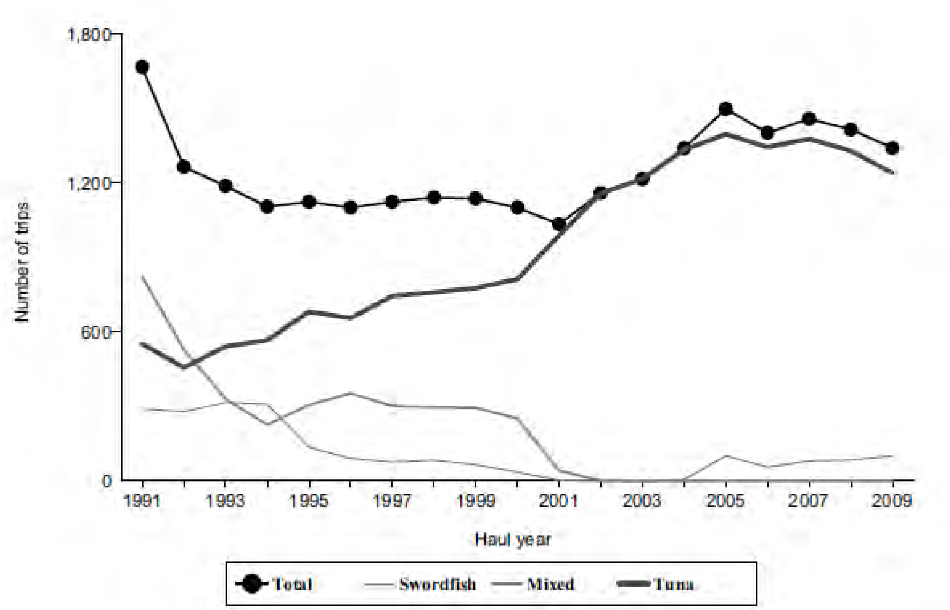

Figure 4. Number of fishing trips by longline vessels based and landing in Hawaii, by year and trip type, 1991-2009. Source: http://www.pifsc.noaa.gov/fmsd/reports.php.

Appendix 2. Cetacean Survey Effort

Documentation of cetacean abundance estimates used in the 2008 draft Pacific Marine Mammal Stock Assessments.

Cetacean abundance estimates reported in the Pacific Marine Mammal Stock Assessments originate from several sources: vessel line-transect surveys of U.S. west coast and Pacific Island Exclusive Economic Zone (EEZ) waters (Barlow 2006, Barlow and Rankin 2007, Barlow and Forney 2007, Forney 2007); aerial line-transect surveys of harbor porpoises (Carretta and Forney 2004, Laake et al. 1998); photographic mark-recapture analyses of large whales (Calambokidis et al. 2007); Hawaiian small cetaceans (Baird et al. 2005); and southern resident killer whales (Center For Whale Research, unpublished data). Often, multiple abundance estimates are available for a given cetacean stock and decisions about which estimates to utilize in the stock assessment report must be made, based on what is known about the stock. Considerable interannual variability in abundance estimates can occur because the range of many cetacean stocks extends beyond the U.S. EEZ boundaries where surveys are conducted. For this reason, multi-year averages are utilized in the stock assessments when possible.

Abundance estimates for U.S. west coast coast cetacean stocks are available in two separate publications (Barlow and Forney 2007, Forney 2007). The Barlow and Forney (2007) paper presents a 1991-2005 time series of abundance estimates, based on large-scale vessel line-transect surveys of California, Oregon, and Washington waters out to 300 nmi. The Forney (2007) report presents estimates from a 2005 vessel line transect survey that is included in the Barlow and Forney (2007) paper, however, the Forney (2007) report includes additional analyses from fine-scale strata from coastal waters of the Olympic, Farallones, and Monterey Bay National Marine Sanctuaries. These coastal strata appear to represent seasonally important habitat for some species as Dall's porpoise, northern right whale dolphin, humpback whales, Pacific white-sided dolphin, and blue whales. Inclusion of these coastal strata resulted in improved estimates of abundance for several species and thus, the Forney (2007) report is used for reporting 2005 abundance estimates, while the Barlow and Forney (2007) paper is used for 2001 estimates. For most U.S. west coast cetaceans, average abundances reported in the draft 2008 Pacific Marine Mammal Stock Assessments represent the geometric mean* of 2001 estimates reported by Barlow and Forney (2007) and 2005 estimates reported by Forney (2005). In the case of humpback and blue whales, mark-recapture estimates may sometimes be substituted for line-transect estimates if the precision of the mark-recapture estimate is superior.

* Current stock assessment preparation guidelines currently recommend reporting a weighted arithmetic mean, weighted by the inverse of the variances of the individual abundance estimates. However, the authors of the Pacific stock assessment reports have found that the unweighted geometric mean is a more appropriate measure of mean abundance for cases where estimates are log-normally distributed. The problem with the weighted arithmetic mean is easily understood by example. Consider a case where two equally precise abundance estimates are available; one relatively large, the other small (e.g., N_1 = 20,000, CV_1 = 0.3; N_2 = 5,000, CV_2 = 0.3). Calculating a mean abundance using the inverse variance method arbitrarily underweights the larger estimate (due to its larger variance), resulting in a negatively biased mean estimate (N_{mean} = 5,882). By comparison, the geometric mean of the two estimates is $N_{geomean}$ = 10,000, which is equivalent to calculating the mean of the logarithms of N_1 and N_2.

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Appendix 3. 2012 Pacific Marine Mammal Stock Assessment Reports. S=strategic stock; N=non-strategic stock. Shaded lines indicate reports revised in 2012. unk=unknown, undet=undetermined, n/a=not applicable.

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			SAR Last Revised
California sea lion	U.S.	SWC	296,750	n/a	153,337	0.12	1	9,200	≥431	≥337	N	2006	2007	2008	2011
Harbor seal	California	SWC	30,196	n/a	26,667	0.12	1	1,600	31	18	N	2002	2004	2009	2011
Harbor seal	Oregon/Washington Coast	AKC	unk	unk	unk	0.12	1	unk	≥3.8	≥1.8	N	1999			2010
Harbor seal	Washington Inland Waters	AKC	unk	unk	unk	0.12	1	unk	≥13.0	≥3.8	N	1999			2010
Northern Elephant Seal	California breeding	SWC	124,000	n/a	74,913	0.117	1	4,382	≥10.4	≥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	S	1993			2000
Northern Fur Seal	San Miguel Island	AKC	9,968	n/a	5,395	0.12	1	324	1.2	0	N	2004	2005	2007	2010
Monk Seal	Hawaii	PIC	1,212	n/a	1,170	0.07	0.1	undet	0.6	unk	S	2008	2009	2010	2012
Harbor porpoise	Morro Bay	SWC	2,044	0.40	1,478	0.04	0.5	15	0	0	N	1999	2002	2007	2009
Harbor porpoise	Monterey Bay	SWC	1,492	0.4	1,079	0.04	0.45	10	≥1.0	≥1.0	N	1999	2002	2007	2009
Harbor porpoise	San Francisco – Russian River	SWC	9,189	0.38	6,745	0.04	0.5	67	0	0	N	1999	2002	2007	2009
Harbor porpoise	Northern CA/Southern OR	SWC	39,581	0.39	28,833	0.04	1	577	≥4	≥4	N	1999	2002	2007	2009
Harbor porpoise	Northern Oregon/Washington Coast	AKC	15,674	0.39	11,383	0.04	0.5	114	≥1.4	≥1.4	N	1991	1997	2002	2011
Harbor porpoise	Washington Inland Waters	AKC	10,682	0.38	7,841	0.04	0.4	63	≥2.2	≥2.6	N	1996	2002	2003	2011
Dall's porpoise	California/Oregon/Washington	SWC	42,000	0.33	32,106	0.04	0.4	257	≥0.4	≥0.4	N	2001	2005	2008	2010
Pacific white-sided dolphin	California/Oregon/Washington	SWC	26,930	0.28	21,406	0.04	0.45	193	15.1	10.5	N	2001	2005	2008	2010
Risso's dolphin	California/Oregon/Washington	SWC	6,272	0.30	4,913	0.04	0.4	39	1.6	1.6	N	2001	2005	2008	2010
Common Bottlenose dolphin	California Coastal	SWC	323	0.13	290	0.04	0.5	2.4	0.2	0.2	N	2000	2004	2005	2008
Common Bottlenose dolphin	California/Oregon/Washington Offshore	SWC	1,006	0.48	684	0.04	0.4	5.5	≥0.2	≥0.2	N	2001	2005	2008	2010
Striped dolphin	California/Oregon/Washington	SWC	10,908	0.34	8,231	0.04	0.5	82	0	0	N	2001	2005	2008	2010
Common dolphin, short-beaked	California/Oregon/Washington	SWC	411,211	0.21	343,990	0.04	0.5	3,440	64	64	N	2001	2005	2008	2010
Common dolphin, long-beaked	California	SWC	107,016	0.42	76,224	0.04	0.4	610	13.8	13	N	2005	2008	2009	2012
Northern right whale dolphin	California/Oregon/Washington	SWC	8,334	0.40	6,019	0.04	0.4	48	4.8	3.6	N	2001	2005	2008	2010
Killer whale	Eastern North Pacific Offshore	SWC	240	0.49	162	0.04	0.5	1.6	0	0	N	2001	2005	2008	2010
Killer whale	Eastern North Pacific Southern Resident	NWC	87	n/a	87	0.032	0.1	0.14	0	0	S	2009	2010	2011	2012
Short-finned pilot whale	California/Oregon/Washington	SWC	760	0.64	465	0.04	0.4	4.6	0	0	N	2001	2005	2008	2010
Baird's beaked whale	California/Oregon/Washington	SWC	907	0.49	615	0.04	0.5	6.2	0	0	N	2001	2005	2008	2010
Mesoplodont beaked whales	California/Oregon/Washington	SWC	1,024	0.77	576	0.04	0.5	5.8	0	0	N	2001	2005	2008	2010
Cuvier's beaked whale	California/Oregon/Washington	SWC	2,143	0.65	1,298	0.04	0.5	13	0	0	N	2001	2005	2008	2010
Pygmy Sperm whale	California/Oregon/Washington	SWC	579	1.02	271	0.04	0.5	2.7	0	0	N	2001	2005	2008	2010
Dwarf sperm whale	California/Oregon/Washington	SWC	unk	unk	unk	0.04	0.5	undet	0	0	N	2001	2005	2008	2010
Sperm whale	California/Oregon/Washington	SWC	971	0.31	751	0.04	0.1	1.5	4.0	3.8	S	2001	2005	2008	2012
Gray whale	Eastern North Pacific	SWC	19,126	0.07	18,017	0.062	1.0	558	128	3	N	2009	2010	2011	~~2011~~
Humpback whale	California/Oregon/Washington	SWC	2,043	0.10	1,878	0.08	0.3	11.3	≥ 3.6	≥ 3.2	S	2001	2005	2008	2010
Blue whale	Eastern North Pacific	SWC	2,497	0.24	2,046	0.04	0.3	3.1	1.0	0	S	2001	2005	2008	2010
Fin whale	California/Oregon/Washington	SWC	3,044	0.18	2,624	0.04	0.3	16	1.0	0	S	2001	2005	2008	2010
Sei whale	Eastern North Pacific	SWC	126	0.53	83	0.04	0.1	0.17	0	0	S	2001	2005	2008	2010
Minke whale	California/Oregon/Washington	SWC	478	1.36	202	0.04	0.5	2.0	0	0	N	2001	2005	2008	2010
Rough-toothed dolphin	Hawaii	SWC	8,709	0.45	6,067	0.04	0.5	61	unk	unk	N			2002	2010
Rough-toothed dolphin	American Samoa	PIC	unk	unk	unk	0.04	0.5	unk	unk	unk	unk	n/a	n/a	n/a	2010

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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			SAR Last Revised
Risso's dolphin	Hawaii	SWC	2,372	0.97	1,195	0.04	0.5	12	0	0	N			2002	2010
Common Bottlenose dolphin	Hawaii Pelagic	SWC	3,178	0.59	2,006	0.04	0.45	18	≥0.4	≥0.4	N			2002	2010
Common Bottlenose dolphin	Kaua'I and Ni'ihau	SWC	147	0.11	134	0.04	0.5	1.3	unk	unk	N	2003	2004	2005	2010
Common Bottlenose dolphin	O'ahu	SWC	594	0.54	388	0.04	0.5	3.9	unk	unk	N	2002	2003	2006	2010
Common Bottlenose dolphin	4 Islands Region	SWC	153	0.24	125	0.04	0.5	1.3	unk	unk	N	2002	2003	2006	2010
Common Bottlenose dolphin	Hawaii Island	SWC	102	0.13	91	0.04	0.5	0.9	unk	unk	N	2002	2003	2006	2010
Pantropical Spotted dolphin	Hawaii	PIC	8,978	0.48	6,701	0.04	0.5	61.0	0	0	N			2002	2010
Spinner dolphin	Hawaii Pelagic	PIC	unk	unk	unk	0.04	0.5	undet	0	0	N	2002	2004	2010	2012
Spinner dolphin	Hawaii Island	PIC	790	0.17	685	0.04	0.5	6.9	unk	unk	N		1994	2003	2012
Spinner dolphin	Oahu / 4 Islands	PIC	355	0.09	329	0.04	0.5	3.3	unk	unk	N	1993	1998	2007	2012
Spinner dolphin	Kaua'I / Ni'ihau	PIC	601	0	509	0.04	0.5	5.1	unk	unk	N	1995	1998	2005	2012
Spinner dolphin	Kure / Midway	PIC	unk	unk	unk	0.04	0.5	undet	unk	unk	N		1998	2010	2012
Spinner dolphin	Pearl and Hermes Reef	PIC	unk	unk	unk	0.04	0.5	undet	unk	unk	N	n/a	n/a	n/a	2012
Spinner dolphin	American Samoa	PIC	unk	unk	unk	0.04	0.5	unk	unk	unk	unk	n/a	n/a	n/a	2010
Striped dolphin	Hawaii Pelagic	PIC	13,143	0.46	9,088	0.04	0.45	82	unk	unk	N			2002	2010
Fraser's dolphin	Hawaii	PIC	10,226	1.16	4,700	0.04	0.5	47	0	0	N			2002	2010
Melon-headed whale	Hawaii	PIC	2,950	1.17	1,350	0.04	0.5	14	0	0	N			2002	2010
Pygmy killer whale	Hawaii	PIC	956	0.83	520	0.04	0.5	5.2	0	0	N			2002	2010
False killer whale	Northwestern Hawaiian Islands	PIC	552	1.09	262	0.04	0.5	2.6	0	0	N			2010	2012
False killer whale	Hawaii Pelagic	PIC	1,503	0.66	906	0.04	0.5	9.1	13.8	13.8	S		2002	2010	2012
False killer whale	Palmyra Atoll	PIC	1,329	0.65	806	0.04	0.4	6.4	0.3	0.3	N			2005	2012
False killer whale	Main Hawaiian Islands Insular	PIC	151	0.20	129	0.04	0.1	0.3	0.5	0.5	S	2007	2008	2009	2012
False killer whale	American Samoa	PIC	unk	unk	unk	0.04	0.5	unk	unk	unk	unk	n/a	n/a	n/a	2010
Killer whale	Hawaii	PIC	349	0.98	175	0.04	0.5	1.8	0	0	N			2002	2010
Pilot whale, short-finned	Hawaii	PIC	8,846	0.49	5,986	0.04	0.4	48	0.7	0.7	N			2002	2010
Blainville's beaked whale	Hawaii	PIC	2,872	1.17	1,314	0.04	0.5	13.0	0	0	N			2002	2010
Longman's Beaked Whale	Hawaii	PIC	1,007	1.25	443	0.04	0.5	4.4	0	0	N			2002	2010
Cuvier's beaked whale	Hawaii	PIC	15,242	1.43	6,269	0.04	0.5	63	0	0	N			2002	2010
Pygmy sperm whale	Hawaii	PIC	7,138	1.12	3,341	0.04	0.5	33	0	0	N			2002	2010
Dwarf sperm whale	Hawaii	PIC	17,519	0.74	10,043	0.04	0.5	100	0	0	N			2002	2010
Sperm whale	Hawaii	PIC	6,919	0.81	3,805	0.04	0.1	7.6	0	0	S			2002	2010
Blue whale	Central North Pacific	PIC	unk	unk	unk	0.04	0.1	undet	0	0	S			2002	2010
Fin whale	Hawaii	PIC	174	0.72	101	0.04	0.1	0.2	0	0	S			2002	2010
Bryde's whale	Hawaii	PIC	469	0.45	327	0.04	0.5	3.3	0	0	N			2002	2010
Sei whale	Hawaii	PIC	77	1.06	37	0.04	0.1	0.1	0	0	S			2002	2010
Minke whale	Hawaii	PIC	unk	unk	unk	0.04	0.5	undet	0	0	N			2002	2010
Humpback whale	American Samoa	SWC	unk	unk	150	0.106	0.1	0.4	0	0	S	2006	2007	2008	2009
Sea Otter	Southern	USFWS	2,826	n/a	2,723	0.06	0.1	8	≥0.8	≥0.8	S	2006	2007	2008	2008
Sea Otter	Washington	USFWS	n/a	n/a	1,125	0.2	0.1	11	≥0.2	≥0.2	N	2006	2007	2008	2008

SOUTHERN SEA OTTER (*Enhydra lutris nereis*)

U.S. Fish and Wildlife Service, Ventura, California

STOCK DEFINITION AND GEOGRAPHIC RANGE

Southern sea otters are listed as threatened under the Endangered Species Act. They occupy nearshore waters along the mainland coastline of California from San Mateo County to Santa Barbara County (Figure 1). A small colony of southern sea otters also exists at San Nicolas Island, Ventura County, as a result of translocation efforts initiated in 1987. The San Nicolas Island colony is considered to be a "non-essential experimental" population under the Endangered Species Act.

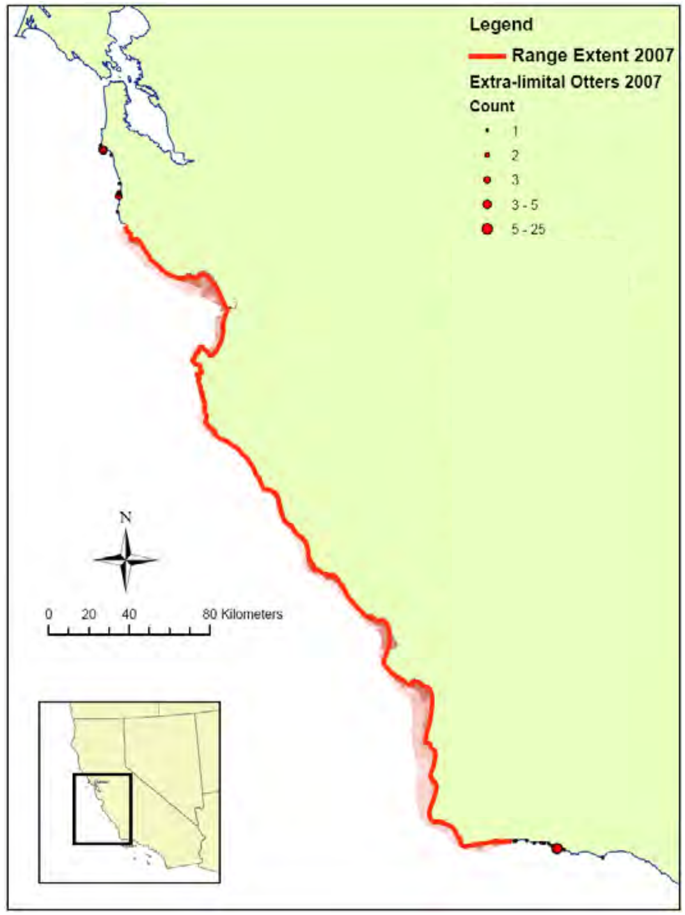

Figure 1. Current range and densities of the southern sea otter (2008 sea otter census). Data source: U.S. Geological Survey, http://www.werc.usgs.gov/otters/ca-surveys.html.

Historically, southern sea otters ranged from Punta Abreojos, Baja California, Mexico to northern California (Wilson *et al.* 1991) or Oregon, or possibly as far north as Prince William Sound, Alaska (reviewed in Riedman and Estes 1990). During the 1700s and 1800s, the killing of sea otters for their pelts extirpated the subspecies throughout most of its range. A small population of southern sea otters survived near Bixby Creek in Monterey County, California, numbering an estimated 50 animals in 1914 (Bryant 1915). Since receiving protection under the International Fur Seal Treaty in 1911, southern sea otters have gradually expanded northward and southward along the central California coast. The estimated carrying capacity of California is approximately 16,000 animals (Laidre *et al.* 2001).

Mating and pupping of southern sea otters takes place year round, but a birth peak extending over several months occurs in the spring, and a secondary birth peak occurs in the fall (Siniff and Ralls 1991; Riedman *et al.* 1994). Male sea otters typically aggregate at the northern and southern limits of the range in winter and early spring, when some males that have maintained breeding territories in the predominantly female center of the range abandon their territories and join other males at its ends (Jameson 1989; Ralls *et al.* 1996).

All sea otters of the subspecies *Enhydra lutris nereis* are considered to belong to a single stock because of their recent descent from a single remnant population. Southern sea otters are geographically isolated from the other two recognized subspecies of sea otters, *E. l. lutris* and *E. l. kenyoni*, and have been shown to be distinct from these subspecies in studies of cranial morphology (Wilson *et al.* 1991) and variation at the molecular level (Sanchez 1992; Cronin *et al.* 1996; Larson *et al.* 2002).

POPULATION SIZE

Data on population size have been gathered for more than 50 years. In 1982, a standardized survey technique was adopted to ensure that subsequent counts were comparable (Estes and Jameson 1988). This survey method involves shore-based censuses of approximately 60% of the range, with the remainder surveyed from the air. These surveys are conducted twice each year (in spring and fall). At San Nicolas Island, counts are conducted from shore on a quarterly basis. The highest of the four counts is used as the official count for the year.

Minimum Population Estimate

The 2007 3-year running average (2006-2008) is 2,826 individuals (U.S. Geological Survey, http://www.werc.usgs.gov/otters/ca-surveys.html) for the mainland population. The San Nicolas Island colony numbers about 42 animals (based on the high count for 2008), 37 independent sea otters and 5 dependent pups (U.S. Geological Survey unpub. data). Given the log-normal distribution of combined counts for the mainland and San Nicolas Island for 2006-2008, the estimate corresponding to the 20th percentile of this distribution, or N_{min}, is 2723 for the southern sea otter stock.

Current Population Trend

As recommended in the Final Revised Recovery Plan for the Southern Sea Otter (U.S. Fish and Wildlife Service 2003), three-year running averages are used to characterize population trends to dampen the effects of anomalous counts in any given year. Based on three-year running averages of the annual spring counts, the mainland southern sea otter population increased by an average of about three percent per year from 2003 to the present (Figure 2). Growth rates are highest at the southern end of the range, whereas growth in the northern and central portions of the range has been more sluggish, suggesting that sea otters may be approaching local carrying capacity in some areas (Tinker *et al.* 2006). The colony at San Nicolas Island has grown by an average of approximately nine percent annually since the early 1990s (Tinker *et al.* 2008).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The maximum growth rate (R_{max}) for southern sea otters along the mainland coastline appears to be six percent per year. Recovering or translocated populations at Attu Island, southeast Alaska, British Columbia, and Washington state have all exhibited growth rates of up to 17 or 20 percent annually (Estes 1990, Jameson

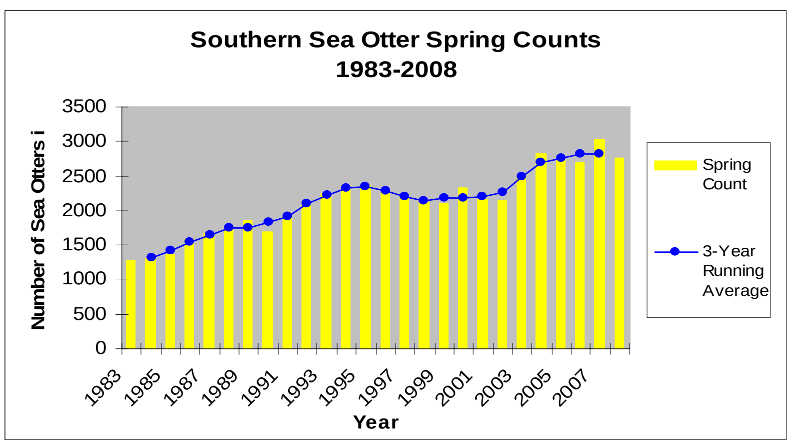

Figure 2. Southern sea otter counts 1983-2008 (mainland population). Data source: U.S. Geological Survey, http://www.werc.usgs.gov/otters/ca-surveys.html.

and Jeffries 1999, Jameson and Jeffries 2005), but the mainland southern sea otter population has grown much more slowly. From the early 1900s to the mid-1970s, it increased at about five percent annually (Estes 1990). From 1983 to 1995, annual growth averaged about six percent. The population declined during the late 1990s but resumed growth in the early 2000s. Recent growth has leveled off, averaging approximately three percent per year from 2003 to the present. Growth rates at San Nicolas Island are higher, averaging approximately nine percent annually (Tinker *et al.* 2008), but these higher rates have never been seen in the mainland population as a whole. The sea otters at San Nicolas Island are a very small component of the southern sea otter stock. This small population is geographically removed from the mainland range and is subject to different threats and limitations than the mainland range. The higher growth rate for the San Nicolas Island animals is not representative of the overall stock, and it is not foreseeable that the mainland population will ever achieve the growth rate of the San Nicolas Island animals. Therefore, for the overall stock, we use an R_{max} of 6 percent. This R_{max} reflects the threats and limitations to which approximately 98 percent of the stock is exposed and is the maximum observed rate for that 98 percent of the stock.

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of three elements: the minimum population estimate (N_{min}); half the maximum net productivity rate (0.5 R_{max}); and a recovery factor (F_r). For the southern sea otter stock, N_{min} = 2,723, R_{max} = 6 percent, and F_r = 0.1. A recovery factor of 0.1 is used for the southern sea otter stock because, although its numbers are currently increasing, N_{min} is below 5,000 and the species is vulnerable to a natural or human-caused catastrophe, such as an oil spill, due to its restricted geographic distribution in nearshore waters (Taylor *et al.* 2002). Therefore, the PBR for the southern sea otter stock is 8 animals. It should be noted that because southern sea otters are not covered under section 118 of the MMPA, PBR does not apply to the governance of incidental take of southern sea otters in commercial fisheries.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Sea otters are susceptible to entanglement and drowning in gill nets. The set gill net fishery in California is estimated to have killed from 48 to 166 (average of 103) southern sea otters per year from 1973 to 1983 (Herrick and Hanan 1988) and 80 sea otters annually from June 1982 to June 1984 (Wendell *et al.* 1986). A 1991 closure restricted gill and trammel nets to waters deeper than 30 fathoms throughout most of the southern sea otter's range (California Senate Bill No. 2563). In 1990, NMFS started an observer program using at-sea observers, which provided data on incidental mortality rates relative to the distribution of fishing effort. The observer program was active through 1994, discontinued from 1995 to 1998, and reinstated in the Monterey Bay area in 1999 and 2000 because of concern over increased harbor porpoise mortality. Based on a detailed analysis of fishing effort, sea otter distributions by depth, and regional entanglement patterns during observed years, NMFS estimated southern sea otter mortality in the halibut set gill net fishery to have been 64 in 1990, zero from 1991 to 1994, 3 to 13 in 1995, 2 to 29 in 1996, 6 to 47 in 1997, 6 to 36 in 1998, 5 in 1999, and zero in 2000 (Cameron and Forney 2000; Carretta 2001; Forney *et al.* 2001). The increase in estimated mortality from 1995 to 1998 was attributed to a shift in set gill net fishing effort into areas where sea otters are found in waters deeper than 30 fathoms.

Fishing with set gill nets has since been further restricted throughout the range of the southern sea otter. An order prohibiting the use of gill and trammel nets year-round in ocean waters of 60 fathoms or less from Point Reyes, Marin County, to Point Arguello, Santa Barbara County was made permanent in September 2002. In the waters south of Point Arguello, the Marine Resources Protection Act of 1990 (California Constitution Article 10B) defined a Marine Resources Protection zone in which the use of gill and trammel nets is banned. This zone includes waters less than 70 fathoms (128 meters) or within one mile, whichever is less, around the Channel Islands, and waters generally within three nautical miles offshore of the mainland coast from Point Arguello to the Mexican border. Although sea otters occasionally dive to depths of 100 meters, the vast majority (>99 percent) of dives are to depths of 40 meters or less.[1] Therefore, because of these restrictions and the current extent of the southern sea otter's range, southern sea otter mortalities resulting from entanglement in gill nets are believed to be currently at or near zero. An estimated 58 vessels participate in the CA angel shark/halibut and other species set gillnet (>3.5" mesh) fishery [72 FR 66048, November 27, 2007]. Approximately 24 vessels participate in the CA yellowtail, barracuda, and white seabass drift gillnet fishery (mesh size ≥3.5" and <14") [72 FR 66048, November 27, 2007].

Three southern sea otter interactions with the California purse seine fishery for Northern anchovy and Pacific sardine have been documented during the past five years. In 2005, a contract observer in the NOAA Fisheries California Coastal Pelagic Species observer program documented the incidental, non-lethal capture of two sea otters that were temporarily encircled in a purse seine net targeting Northern anchovy but escaped unharmed by jumping over the corkline. In 2006, a contract observer in the same program documented the incidental, non-lethal capture of a sea otter in a purse seine net targeting Pacific sardine. Again, the sea otter escaped the net at end of the haul without assistance.[2] Based on these observations and the levels of observer coverage in each year, 58 and 20 such interactions are estimated to have occurred in the CA sardine purse seine fishery in 2005 and 2006, respectively, but these estimates are accompanied by considerable uncertainty because of the low levels of observer coverage.[3] In documented interactions, sea otters have been able to escape purse seine nets without assistance, but these incidents do not preclude mortality or serious injury. There are no additional data available to assess the risk of mortality or serious injury resulting from interactions with this fishery. The 2007 list of fisheries reorganized purse seine fisheries targeting anchovy and sardines into the "CA anchovy, mackerel, sardine purse seine" fishery. An estimated 63 vessels participate in the CA anchovy, mackerel, and sardine purse seine fishery [72 FR 66048, November 27, 2007].

The potential exists for sea otters to drown in traps set for crabs, lobsters, and finfish, but only limited documentation of mortalities is available. Hatfield and Estes (2000) summarize records of 18 sea otter mortalities in trap gear, 14 of which occurred in Alaska. With the exception of one sea otter, which was found in a crab trap, all of the reported Alaska mortalities involved Pacific cod traps and were either recorded by NMFS observers or reported to NMFS observers by fishers. Four sea otters are known to have died in trap gear in California: one in a

[1] Personal communication, M. Tim Tinker, 2008. Research Wildlife Biologist, USGS-Western Ecological Research Center, Santa Cruz Field Station, and Department of Ecology & Evolutionary Biology, University of California at Santa Cruz, 100 Shaffer Road, Santa Cruz, CA 95060.

[2] Personal communication, Lyle Enriquez, 2006. Southwest Regional Office, NOAA, U.S. National Marine Fisheries Service, 501 West Ocean Boulevard, Long Beach, CA 90802.

[3] Personal communication, Jim Carretta, 2008. Southwest Fisheries Science Center, NOAA, U.S. National Marine Fisheries Service, 8604 La Jolla Shores Drive, La Jolla, CA 92037.

lobster trap near Santa Cruz Island in 1987; a mother and pup in a trap with a 10-inch diameter opening (presumed to be an experimental trap) in Monterey Bay in 1987; and one in a rock crab trap 0.5 miles off Pt. Santa Cruz, California (Hatfield and Estes 2000). In 1995, the U.S. Geological Survey began opportunistic efforts to observe the finfish trap fishery in California. These efforts were supplemented with observations by the California Department of Fish and Game (CDFG) in 1997 and two hired observers in 1999. No sea otters were found in the 1,624 traps observed (Hatfield and Estes 2000). However, a very high level of observer coverage would be required to see any indication of trap mortality, even if mortality levels were high enough to substantially reduce the rate of population recovery (Hatfield *et al.*, in prep.).

Controlled experiments conducted by the U.S. Geological Survey and the Monterey Bay Aquarium demonstrated that sea otters would enter a baited commercial finfish trap with inner trap funnel openings of 5.5 inches in diameter (Hatfield and Estes 2000). Hatfield *et al.* (in prep.) confirmed that some sea otters exposed to finfish, lobster, and mock Dungeness crab traps in a captive setting would succeed in entering them. Based on experiments with carcasses and live sea otters, they concluded that finfish traps with 5-inch-diameter circular openings would largely exclude diving sea otters; that circular openings of 5.5 to 6 inches in diameter and rectangular openings 4 inches high (typical of Dungeness crab pots) would allow the passage of sea otters up to about 2 years of age; and that the larger fyke openings of spiny lobster pots and finfish traps with openings larger than 5 inches would admit larger sea otters. Reducing the fyke-opening height of Dungeness crab traps by one inch (to 3 inches) would exclude nearly all diving sea otters while not significantly affecting the number or size of harvested crabs (Hatfield *et al.* in prep.).

Since January 2002, CDFG has required 5-inch sea-otter-exclusion rings to be placed in live-fish traps used along the central coast from Pt. Montera in San Mateo County to Pt. Arguello in Santa Barbara County. No rings are required for live-fish traps used in the waters south of Point Conception, and no rings are currently required for lobster or crab traps regardless of their location in California waters.

Data on the number of participating vessels in these fisheries are provided by CDFG and represent those vessels making at least one landing in each of the respective fisheries. Numbers of participating vessels are given by region, North (Oregon Border to Cape Mendocino), North-Central (Cape Mendocino to Point Año Nuevo), South-Central (Point Año Nuevo to Point Conception), and South (Point Conception to Mexico). From North to South, the average number of vessels participating in the Dungeness and rock crab fisheries from 2002-2006 was 215, 240, 43, and 113, respectively. The average number of vessels participating in the California spiny lobster fishery during this period was 0, 0, 2, and 163, respectively. The average number of vessels participating in the live-fish trap fishery during this period was 213, 86, 58, and 212, respectively. It should be noted that most of the sea otter range is coincident with the two central coast regions.

Available information on incidental mortality and serious injury of southern sea otters in commercial fisheries is very limited. Fisheries believed to have the potential to kill or injure southern sea otters are listed in Table 1. It should be noted that, due to the nature of potential interactions (entrapment or entanglement followed by drowning), serious injury is unlikely to be detected prior to the death of the animal.

Table 1. Summary of available information on incidental mortality and serious injury of southern sea otters in commercial fisheries that might take southern sea otters. n/a indicates that data are not available or are insufficient to estimate mortality/serious injury.

Fishery Name	DataType	Year(s)	Percent Observer Coverage	Observed Mortality/Serious Injury	Estimated Mortality/Serious Injury	Mean Takes
CA angel shark/halibut and other species set gillnet fishery (>3.5”)[1]	no fishery-wide observer program since 1994	2002 2003 2004 2005 2006	0% 0% 0% 0% <10%	n/a n/a n/a n/a 0	n/a	n/a
CA yellowtail, barracuda, and white seabass drift gillnet fishery (≥3.5” and <14”)	observer	2002 2003 2004 2005 2006	11.5% 10.4% 17.6% 0% 0%	0 0 0 n/a n/a	n/a	n/a
CA anchovy, mackerel, and tuna purse seine	observer (since July 2004)	2002 2003 2004 2005 2006	0% 0% 0% 1.3% <5%	n/a n/a n/a 0 0	n/a	n/a
CA sardine purse seine	observer (since July 2004)	2002 2003 2004 2005 2006	0% 0% 0% 1.7% <5%	n/a n/a n/a 0 0	n/a	n/a
CA lobster, prawn, shrimp, rock crab, fish pot	n/a	2002 2003 2004 2005 2006	not observed[2]	n/a	n/a	n/a
WA/OR/CA crab pot (central CA portion only)	n/a	2002 2003 2004 2005 2006	not observed[2]	n/a	n/a	n/a
CA finfish and shellfish live trap/hook and line	n/a	2002 2003 2004 2005 2006	not observed[2]	n/a	n/a	n/a
Unknown hook and line fishery	stranding data	2002 2003 2004 2005 2006	-	0 1 2 1 0	≥4	≥0.8

[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. Observer coverage in this fishery resumed in 2006 (12 sets observed) and continued into 2007 (248 sets observed). Despite no or low observer coverage in some years, mortality/serious injury of sea otters in this fishery is estimated to be at or near zero because of depth restrictions in place throughout the current mainland range of the southern sea otter.

[2]This fishery is classified as a Category III fishery [72FR66048]. Category III fisheries are not required to accommodate observers aboard vessels due to the remote likelihood of mortality and serious injury of marine mammals.

Other Mortality

A study of 3,105 beach-cast carcasses salvaged from 1968 through 1999 identified several patterns in the strandings that occurred during periods of population decline: increased percentages of (1) prime-age (3 to 10 years) animals, (2) deaths caused by white shark bites, (3) carcasses recovered in spring and summer, and (4) animals for which the cause of death was unknown (Estes *et al.* 2003). Analysis of beach-cast carcasses recovered from October 1997 to May 2001 showed that 13 percent of the mortalities resulted directly or indirectly from infection by acanthocephalans of the genus *Profilicollis* (Mayer *et al.* 2003). Common causes of death identified for fresh beach-cast carcasses necropsied from 1998 to 2001 included protozoal encephalitis, acanthocephalan-related disease, shark attack, and cardiac disease (Kreuder *et al.* 2003, Kreuder *et al.* 2005). Encephalitis caused by *Toxoplasma gondii* was associated with shark attack and heart disease, and these causes of death were more common in prime-age animals than in juveniles (Kreuder *et al.* 2003). Diseases (due to parasites, bacteria, fungi, or unspecified causes) were identified as the primary cause of death in 63.8 percent of the sea otter carcasses examined (Kreuder *et al.* 2003).

An unusually high number of stranded southern sea otters was recovered in 2003, prompting declaration of an Unusual Mortality Event for the period from 23 May to 1 October 2003. The number of strandings relative to the spring sea otter count from 1983 to 2007 is shown in Figure 3. In 2003, the relative number of strandings exceeded 10 percent of the spring count. No one cause appears to have been responsible for the increase in mortality. Relative mortality has remained nearly as high in subsequent years. The relative number of strandings in 2004, 2005, 2006, and 2007 constituted approximately 9.9 percent of the spring count.

Shootings and boat strikes are relatively low but persistent sources of mortality. Other rare sources of mortality include debris entanglement and complications associated with research activities. During the period from 2002-2006, 13 sea otters were shot, 17 were suspected to have been struck by boats, 1 was found entangled in plastic debris, and 2 died as a result of complications related to research activities (U.S. Geological Survey and CDFG unpub. data). Total observed mortality due to anthropogenic causes, excluding fisheries, is 33, yielding an estimated mortality of ≥33 and a mean annual mortality of ≥6.6.

It should be noted that mean annual mortalities reported here and in Table 1 are minimum estimates. Documentation of these sources of mortality comes primarily from necropsies of beach-cast carcasses. Because it is unknown to what extent the levels of human-caused mortality documented in beach-cast carcasses are representative of the relative contributions of known causes or of human-caused mortality as a whole, we are unable to give upper bounds for these estimates. Disease has been identified as the primary cause of

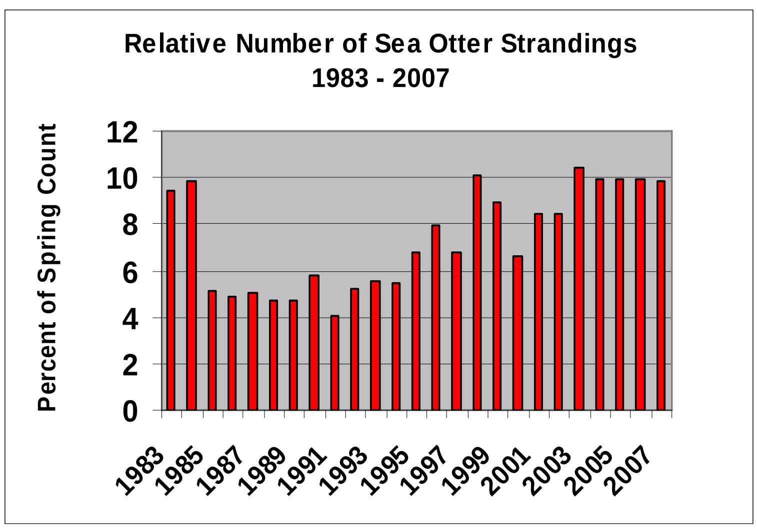

Figure 3. Southern sea otter strandings relative to the spring count, 1983-2007. Data source: U.S. Geological Survey unpub. data.

death in more than half of the beach-cast carcasses necropsied (Kreuder *et al.* 2003), but the anthropogenic contribution to disease levels in sea otters is currently unknown. Therefore, animals that died of disease are not included in the number of mortalities reported here.

STATUS OF STOCK

The southern sea otter is designated a fully protected mammal under California state law (California Fish and Game Code §4700) and was listed as a threatened species in 1977 (42 FR 2965) pursuant to the federal Endangered Species Act, as amended (16 U.S.C. 1531 et seq.). As a consequence of its threatened status, the southern sea otter is considered by default to be a "strategic stock" and "depleted" under the Marine Mammal Protection Act of 1972, as amended (16 U.S.C. 1361 et seq.).

The status of the southern sea otter in relation to its optimum sustainable population (OSP) level has not been formally determined, but population counts are well below the estimated lower bound of the OSP level for southern sea otters, about 8,400 animals (U.S. Fish and Wildlife Service 2003), which is roughly 50 percent of the estimated carrying capacity of California (Laidre *et al.* 2001). Because of the lack of observer data for several fisheries that may interact with sea otters, it is not possible to determine whether the total fishery mortality and serious injury for sea otters is insignificant and approaching zero mortality and serious injury rate.

Habitat Issues

Sea otters are particularly vulnerable to oil contamination (Kooyman and Costa 1979; Siniff *et al.* 1982), and oil spill risk from large vessels that transit the California coast remains a primary threat to the southern sea otter. Studies of contaminants have documented accumulations of dichlorodiphenyltrichloro-ethane (DDT), dichlorodiphenyl-dichloroethylene (DDE) (Bacon 1994; Bacon *et al.* 1999), and polychlorinated biphenyls (PCBs) in stranded sea otters (Nakata *et al.* 1998), as well as the presence of butyltin residues, which are known to be immunosuppressant (Kannan *et al*. 1998). Kannan *et al.* (2006, 2007) found a significant association between infectious diseases and elevated concentrations of perfluorinated contaminants and polychlorinated biphenyls (PCBs) in the livers of sea otters, suggesting that chemical contaminants may play a role in driving patterns of sea otter mortality. Food limitation and nutritional deficiencies may also contribute to sea otter mortality (Bentall 2005, Tinker *et al.* 2006, Tinker *et al.* 2008).

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SEA OTTER (*Enhydra lutris kenyoni*)
WASHINGTON STOCK

U.S. Fish and Wildlife Service
Lacey, Washington

STOCK DEFINITION AND GEOGRAPHIC RANGE

The northern sea otter, *Enhydra lutris kenyoni*, historically ranged throughout the North Pacific, from Asia along the Aleutian Islands, originally as far north as the Pribilof Islands and in the eastern Pacific Ocean from the Alaska Peninsula south along the coast to Oregon (Wilson et al. 1991). In Washington, areas of sea otter concentration were reported from the Columbia River to along the Olympic Peninsula coast (Scheffer 1940). Sea otters were extirpated from most of their range during the 1700s and 1800s as the species was exploited for its fur. Washington's sea otter population was extirpated by the early 1900s. In 1969 and 1970, a total of 59 sea otters were captured at Amchitka Island, Alaska, and released near Point Grenville and LaPush off Washington's Olympic Peninsula coast (Jameson et al. 1982; Jameson et al. 1986). Washington's current sea otter population originated from the Amchitka Island genotype (*Enhydra lutris kenyoni*).

Figure 1. Approximate distribution of Washington sea otter stock.

For management purposes pursuant to the Marine Mammal Protection Act (MMPA), the range of the Washington sea otter stock is within the marine waters of Washington State. However, if the stock expands southward into Oregon or northward into British Columbia, a revised stock assessment would consider this expanded range.

In 2006, the distribution of the majority of the Washington sea otter stock ranged from Pillar Point in the Strait of Juan de Fuca, west to Cape Flattery and as far south as Cape Elizabeth on the outer Olympic Peninsula coast (Figure 1). However, scattered individuals (usually one or two individuals at a time) have been seen outside of this range. For example, sick or injured sea otters have come ashore as far south as Ocean Shores and repeated sightings have been reported in Grays Harbor and as far east as Port Townsend. Sightings around the San Juan Islands, near Deception Pass, off Dumas Bay, off the Nisqually River, and in southern Puget Sound near Squaxin and Hartstene Islands have also been reported. Several of the sea otters in Puget Sound became relatively "tame," and in some cases local residents were feeding these individuals and promoting their "friendly" behavior. The U. S. Fish and Wildlife Service (USFWS) and Washington Department of Fish and Wildlife (WDFW) intervened, to the extent necessary, when these individual sea otters exhibited behaviors that presented a danger to themselves or to human health and safety.

In waters to the north of the Washington stock is the British Columbia sea otter population, which originated from animals also translocated from Amchitka Island and additional individuals from Prince William Sound, Alaska (Watson 2000). British Columbia's sea otter population, which is also increasing, includes at least 3,180 animals distributed mainly along the west coast of Vancouver Island from Barkley Sound to Cape Scott with a separate population along the mainland coast near Goose Island in Queen Charlotte Sound (COSEWIC 2007). Although most of the British Columbia sea otter population remains north of Estevan Point along the west coast of Vancouver Island, groups of 100 to 150 animals have recently been observed south of Estevan Point near Hesquiat Harbor and Flores Island just north of Tofino. Small numbers of animals have also been reported in Barkley Sound and scattered along the coast of the Strait of Juan de Fuca to Victoria. Currently there is no evidence of interchange between the Washington and British Columbia sea otter populations. However, as the Washington and British Columbia populations grow and expand their respective ranges, movement between these populations can be expected.

Sea otters breed and give birth year-round (Riedman and Estes 1990). Pupping period for Washington's sea otter stock is not well defined, with dependent pups observed in all months. However, births in Washington sea otters are believed to occur primarily from March to April, with peak numbers of dependent pups expected to be present from May to September (Ron Jameson, pers. comm.).

POPULATION SIZE

Original Washington Translocation

Fifty-nine sea otters were released off the Washington coast in 1969 and 1970, although almost half of the otters released in 1969 died. Sightings of sea otters were sporadic for several years after the translocations and during surveys through 1976, no more than 10 otters were observed at a time (Jameson et al. 1982). The current Washington sea otter population descended from no more than 43 otters and possibly as few as 10 (Jameson et al. 1982). Reproduction was first documented in 1974 (Jameson et al. 1982) and pups have been observed in all subsequent surveys.

Minimum Population Estimate

The first comprehensive post-release surveys of Washington's sea otter population were conducted by boat in 1977 and again in 1981 (Jameson et al. 1986). Boat, ground, and aerial surveys for sea otters were conducted biennially from 1981 to 1989. Starting in 1989 and continuing to present, Washington's sea otter population estimate has been developed from a combined aerial and ground survey conducted in early July by United States Geological Survey and/or WDFW. Based on the 2007 survey (actual count), the minimum population estimate of the Washington sea otter population is 1,125 individuals (Jameson and Jeffries 2008). No correction factor for missed animals has been applied to count data to determine a total population estimate from survey counts for Washington.

Current Population Trend

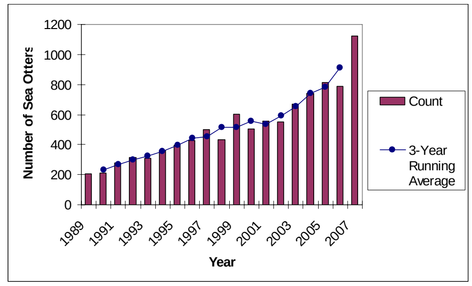

Figure 2. Annual and three-year running average of population estimates (1989-2007).

Based on count totals from 1977 to 1989, the Washington sea otter population increased at an annual rate of 20 percent (Jameson and Jeffries 1999). As has been done for the southern sea otter (*Enhydra lutris nereis*), three-year running averages are used to characterize population trends to dampen the effects of anomalous counts in any given year (U.S. Fish and Wildlife Service 2003). Jameson and Jeffries (2006) indicate "the finite rate of increase for this population since 1989 is 8 percent." Survey data indicate the Washington stock is nearing equilibrium density north of La Push, where the rate of increase has shown no growth since 2000 (Jameson and Jeffries 2008). South of La Push, the stock has been growing at about 20 percent per year since 1989 (Jameson and Jeffries 2006).

Laidre et al. (2002) provides a carrying capacity (K) estimate of 1,019 sea otters (95 percent CI 754-1,284) for Washington's sea otter stock to reoccupy rocky habitat from Destruction Island to Neah Bay (e.g., Seal and Sail Rocks). Laidre et al. (2002) also provide a total carrying capacity estimate for Washington of 1,836 sea otters (95 percent CI 1,386-2,286) based on an assumption that sea otters will reoccupy most of their historic habitat along the outer Washington coast (excluding reoccupation of the Columbia River, Willapa Bay, and Grays Harbor estuaries due to significant human alterations and use) and eastward into the Strait of Juan de Fuca as far as Protection Island. The Washington sea otter stock appears to be approaching equilibrium in the rocky habitat along the Olympic Peninsula coast; the reasons why the population has not dispersed into the unoccupied portions of its historic range are unclear.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The maximum annual growth rate (R_{max}) for sea otter populations for which data are available has been reported as 17 to 20 percent (Estes 1990). From 1977 to 1989, the Washington stock grew at 20 percent (Jameson and Jeffries 1999) and appears to still be growing at this rate south of La Push (Jameson and Jeffries 2008). However, between 1989 and 2007, the growth rate of the entire Washington sea otter stock has slowed to an annual rate of 8 percent (Jameson and Jeffries 2008).

POTENTIAL BIOLOGICAL REMOVAL

The Potential Biological Removal (PBR) is the product of three elements: the minimum population estimate (N_{min}); half the maximum net productivity rate (0.5 R_{max}); and a recovery factor (F_r). For the Washington sea otter stock, N_{min}=1,125; R_{max} uses a maximum sea otter growth rate of 20 percent; and F_r=0.1. A F_r of 0.1 was used for the Washington sea otter stock because even though the population is increasing, the minimum population size is less than 1,500 and the population is restricted in its geographical range making it vulnerable to natural or human-caused catastrophe (Taylor et al. 2002). Therefore, the calculated PBR for the Washington sea otter stock is 11 animals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Sea otters are susceptible to drowning in gillnets and have been taken in the Makah Northern Washington Marine Set-gillnet Fishery (Gearin et al. 1996). Based on observer data collected from 1988 through 2001, a total of 11 sea otters were taken when fishing effort occurred (Makah Tribe/Makah Tribal Resources and National Marine Fisheries Service (NMFS)/National Marine Mammal Lab (NMML) observer data). Although the fishing effort in this fishery began declining in the mid 1990s, sea otters continue to be taken in this fishery (Table 1). Pre-2000 data indicates sea otter mortalities are likely to occur when there is fishing effort in Areas 4 and 4A (Makah Bay). Only mortalities, not serious injuries, are reflected in Table 1 because the nets set by the Makah fishery do not rise to the surface of the water and any otters that get caught in the nets will likely drown. Due to inconsistent reporting between fishing areas, years, and the associated fishing effort, observer coverage, and otter mortalities (see Table 1), a reliable estimation of the annual sea otter mortality and serious injury in the Makah Northern Washington Marine Set Gillnet Fishery is assumed to be a minimum of 2 when there is fishing effort. In order to provide a more accurate estimate of the annual mortality and serious injury associated with this fishery, the USFWS requested information from the NMFS and the Makah Tribe. The information provided by the NMFS and the Makah Tribe was not sufficient to provide a more accurate estimate.

Table 1. Summary of sea otter incidental mortality in Northern Washington Marine Set-Gillnet Fishery. (Source: NMFS/NMML observer program, BIA, and Makah Tribe)

Fishery Name	Year	Fishing Effort[a] (Yes/No)	Observer Coverage	Observed/Reported mortality (Number of Otters)
Northern WA Marine Set Gillnet Areas 4/4A/4B/5	2003	Yes	None	-
	2004	Yes	1-11 net days observed[b]	2
	2005	Yes	None	-
	2006	Yes	None	-
	2007	Yes	None	-

[a]Overall fishing effort is not available
[b]Observer coverage is presented in format supplied to USFWS

Other fisheries that occur within the range of the sea otter in Washington include treaty and non-treaty gillnet fisheries in the Strait of Juan de Fuca, Puget Sound, and Grays Harbor. Neither the USFWS or the NMFS have received any voluntary or observer reports of sea otters killed or seriously injured in these fisheries. However, the lack of information cannot be interpreted to mean that no sea otters have been killed or seriously injured because there has not been marine mammal observer coverage of these fisheries since 1994, rather, incidental takings of marine mammals in these fisheries are reported to NMFS through self-reporting (Sources: Treaty/Non-treaty sum of landings submitted to the USFWS as part of Biological Opinion reporting requirements, USDC NMFS 2003). The fisheries subject to self-reporting do not include tribal fisheries. An accurate estimate of sea otter mortality and serious injury associated with these fisheries requires instituting an observer program and obtaining fishing effort data. Because this information is not currently available, we cannot provide an accurate estimate of the annual mortality and serious injury associated with these fisheries. Sea otter densities along the Strait of Juan de Fuca in the summer and fall are low, when the fisheries generally operate, so few entanglements would be expected. However, as the Washington sea otter population continues to grow, the possibility of fisheries-related incidental take in these gillnet fisheries will grow.

Other fisheries that also occur within the range of the Washington sea otter stock include: 1) treaty set-gillnet fisheries that occur in the coastal rivers (Quinault, Queets, Hoh, Quillayute, Hoko, and Waatch); 2) treaty and non-treaty groundfish trawl fisheries that occur offshore of the Olympic Peninsula coast; and 3) treaty and non-treaty drift gillnet fisheries that occur in Willapa Bay. These fisheries are unlikely to result in mortality or serious injury because sea otters are unlikely to occur in these areas.

As sea otters expand their range eastward into the Strait of Juan de Fuca or south along the outer Washington coast, they will also encounter important sport and commercial shellfish fisheries (urchins, razor clams, Dungeness crabs, steamer clams, geoducks). "Evidence from California and Alaska suggests that the potential for incidental take of sea otters in crab traps will increase as the population expands its range south of Destruction Island into prime Dungeness crab habitat" (Lance et al. 2004). In addition, the potential exists for increased interactions with invertebrate fisheries, particularly sea urchins and geoducks, as the sea otter population expands eastward into the Strait of Juan de Fuca (Gerber and VanBlaricom 1999).

Other Human-Caused Mortality and Serious Injury

Other sources of human-caused mortality and serious injury affecting the Washington sea otter population are not well documented. Documented sources of human-caused mortality for the southern sea otter include shooting, boat strikes, capture and relocation efforts, oil spills, and possibly elevated levels of polychlorinated biphenyls and other toxic contaminants. In 2003, one Washington sea otter death was presumed to have been caused by a boat strike because of the type of injuries observed during necropsy. However, these injuries could also have been sustained in a variety of other ways.

In the past decade, a number of oil spills have occurred within the range of Washington's sea otter population, with one documented oil related death recorded during one of these spills (Jameson 1996). Additionally, with the increasing volume of shipping traffic into and out of the Strait of Juan de Fuca, the potential for a catastrophic spill exists and most, if not all, of the Washington sea otter population and range is vulnerable to the effects of such a spill. Significant oil-related mortalities and habitat damage would be expected to occur if an oil spill of this nature were to happen and impinge directly on sea otter habitat along Washington's Olympic Peninsula and Strait of Juan de Fuca coastlines.

However, due to the lack of documented mortalities or serious injuries resulting from other human-caused sources and the unpredictability of oil spills, we are unable to provide an estimate of the annual mortality and serious injuries associated with other human-caused mortality and serious injury.

Harvest by Northwest treaty Indian tribes

A number of Native American tribes of the Pacific Northwest have treaty rights to harvest various fish and wildlife resources in Washington State. Currently there is no authorization for harvest of sea otters by Native Americans; however, there is a developing interest in such a program. As affirmed by the Court of Appeals for the Ninth Circuit in Anderson v. Evans (9th Cir. June 7, 2004), any take of sea otters by Native Americans other than Alaskan natives residing in Alaska has to be authorized under the MMPA.

STATUS OF STOCK

The Washington sea otter stock is not listed as "depleted" under the MMPA nor listed as "threatened" or "endangered" under the Endangered Species Act. Sea otters are listed by the State of Washington as "State endangered" under Revised Code of Washington 77.12.020 and Washington Administrative Code (WAC) 232.12.014 due to small population size, restricted distribution, and vulnerability (Lance et al. 2004). The WDFW finalized their sea otter recovery plan in 2004 (Lance et al. 2004).

This stock is not classified as strategic because the population is growing and is not listed as "depleted" under the MMPA or "threatened" or "endangered" under the Endangered Species Act of 1973.

The lower end of the Optimum Sustainable Population (OSP) range is assumed to occur at approximately 60 percent of the maximum population size the environment will support (i.e. carrying capacity) (DeMaster et al. 1996). The total carrying capacity estimate for Washington is 1,836 sea otters (95 CI 1,386 – 2,286) (Laidre et al. 2002). The current population estimate of 1,125 (Jameson and Jeffries 2008) is above the lower end of the OSP (60 percent of 1,836).

The mortality and serious injury for the Makah Northern Washington Marine Set Gillnet Fishery is estimated to be a minimum of two mortalities annually when there is fishing effort. We are unable to provide an estimate of the annual mortality and serious injury associated with other fisheries and other sources of human-caused mortality and serious injury, due to the lack of information. Therefore, we are unable to determine whether the level of human-caused mortalities and serious injuries are insignificant and approaching a zero mortality and serious injury rate.

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