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U.S. Pacific Marine Mammal Stock Assessments

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NOAA Technical Memorandum NMFS

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NOAA Technical Memorandum NMFS

The National Oceanic and Atmospheric Administration (NOAA). organized in 1970, has evolved into an agency which establishes national policies and manages and conserves our oceanic, coastal, and atmospheric resources. An organizational element within NOAA, the Office of Fisheries is responsible for fisheries policy and the direction of the National Marine Fisheries Service (NMFS).

In addition to its formal publications, the NMFS uses the NOAA Technical Memorandum series to issue informal scientific and technical publications when complete formal review and editorial processing are not appropriate or feasible. Documents within this series, however, reflect sound professional work and may be referenced in the formal scientific and technical literature.

TABLE OF CONTENTS

PREFACE

Under the 1994 amendments to the Marine Mammal Protection Act, the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) were required to produce stock assessment reports for all marine mammal stocks in waters within the U.S. Exclusive Economic Zone. This document contains the stock assessment reports for the U.S. Pacific marine mammal stocks under NMFS jurisdiction. Marine mammal species which are under the management jurisdiction of the USFWS are not included in this report. A separate report containing background, guidelines for preparation, and .a summary of all stock assessment reports is available from the NMFS Office of Protected Resources.

This report was prepared by staff of the Southwest Fisheries Science Center, NMFS and the Alaska Fisheries Science Center, NMFS. The information presented here was compiled primarily from published sources, but additional unpublished information was included where it contributed to the assessments.

The authors wish to thanks the members of the Pacific Scientific Review Group for their valuable contributions and constructive criticism: Hannah Bernard, Robin Brown, Mark Fraker, Doyle Hanan, John Heyning, Steve Jeffries, Katherine Ralls, Michael Scott, and Terry Wright. Their comments greatly improved the quality of these reports, We also thanks the Marine Mammal Commission, The Humane Society of the United States, The Marine Mammal Center, The Center for Marine Conservation, and Friends of the Sea Otter for their careful reviews and thoughtful comments. Special thanks to Paul Wade of the Office of Protected Resources for his exhaustive review and comments, which greatly enhanced the consistency and technical quality of the reports. Any ommissions or errors are the sole responsibility of the authors.

This is a working document and individual stock assessment reports will be updated as new information becomes available and as changes to marine mammal stocks and fisheries occur; therefore, each stock assessment report is intended to be a stand alone document. The authors solicit any new information or comments which would improve future stock assessment reports.

This is Southwest Fisheries Science Center Technical Memorandum NOAA-TM-NMFS-SWFSC-219, July 1995.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

POPULATION SIZE

The entire population cannot be counted because all age and sex classes are never ashore at the same time. In lieu of counting all sea lions, pups are counted during the breeding season because this is the only age class that is ashore in its entirety. The census is made after all pups are born, near the end of the breeding season. An estimate of the mortality that occurs prior to the census is added to the count of pups to estimate the total number of births for that year. The size of the population is then estimated from the number of births and the proportion of pups in the population.

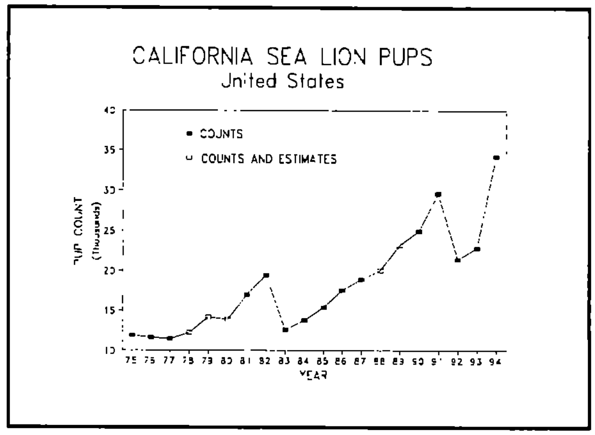

Figure 1. U.S. pup counts for California sea lions.

Because the age structure of California sea lions is unknown, the proportion of pups in the population is computed from a life table derived for the northern fur seal *(Callorhinus ursinus)* (Boveng 1988, Lowry et al. 1992). The number of births is estimated from pup counts using an estimated 15% pre-census mortality rate (Boveng 1988, Lowry et al. 1992). An estimate of 161,066 to 181,355 California sea lions was derived for the U.S. stock based on (1) counts of 36,184 pups made in 1994, (2) a pre-census mortality rate of 15%, and (3) for growth rates of 8.2% and 5.2%, respectively (see below). The two estimates are equivalent to multiplying the estimate of births for 1994 by 3.871 or 4.358.

Minimum Population Size

The minimum population size was determined from counts of all age and sex classes that were ashore at all the major rookeries and haulout sites during the 1994 breeding season. The minimum population size of the U.S. stock is 84,195 (NMFS unpubl. data). It includes all California sea lions counted during the July 1994 census at the four rookeries in southern California and at the haulout sites located at Año Nuevo Island and Richardson Rock. *An additional unknown number of California sea lions are at sea or hauled out at locations that were not censused.*

Current Population Trend

Records of pup counts from 1975 to 1994 (Figure 1) were compiled from the literature, NMFS reports, and unpublished NMFS data (the literature is listed in Lowry et al. 1992). Pup counts from 1975 through 1994 were examined for four rookeries in southern California. Log-linear interpolation between adjacent counts was used to estimate counts for rookeries when they were not censused in a given year: (1) 1980 at Santa Barbara Is.; (2) 1978-1980 at San Clemente Is.; (3) 1978, 1979, 1988, and 1989 at San Nicolas Is. The mean was used when more than one count was available for a given rookery. Also, an index was used for San Miguel Island because some years lacked data for certain areas. Two major declines in the number of pups counted occurred during El Niño events in 1983 and 1992 (Figure 1). The natural logarithm of the pup counts, against year, indicate that the counts of pups increased at an annual rate of 5.2% between 1975 and 1994. The counts of pups between El Niño events increased at 8.8% between 1976 and 1982 and at 8.2% between 1983 and 1994.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The current rate of net production is greater than the observed growth rate because fishery mortality takes a large fraction of the net production. Net productivity was, therefore, calculated for 1980- 1994 as the realized rate of population growth (increase in pup counts from year ***i*** to year ***i+l,*** divided by pup count in year ***i)*** plus the harvest rate (fishery mortality in year ***i*** divided by population size in year ***i).*** For California sea lions, the total fishery mortalities estimated from NMFS, California Dept. of Fish and Game, and Columbia River Area observer programs were 1,967, 1,967, 1,967,4,344, 2,476,2,364,4,417, 2,847,3,753,2,315,2,753, 1,915, 3,351,2,073 for 1980 to 1993, respectively (Miller et al. 1983; Hanan et al. 1988; Hanan and Diamond 1989; Perkins et al. 1992, 1994; Brown and Jeffries 1993; Julian 1993, 1994; Barlow et al. 1994). The total mortality estimate for 1994 (through the third quarter) was 113 (Julian, pers. comm. Jan. 1995).

Between 1980 and 1994 the net productivity rate averaged 11.7% (Figure 2). A regression shows a slight increase in net production rates, but the regression is strongly influenced by the El Niño years (1983 and 1992) and the net production rate for 1994. Maximum net productivity rates cannot be estimated from available data.

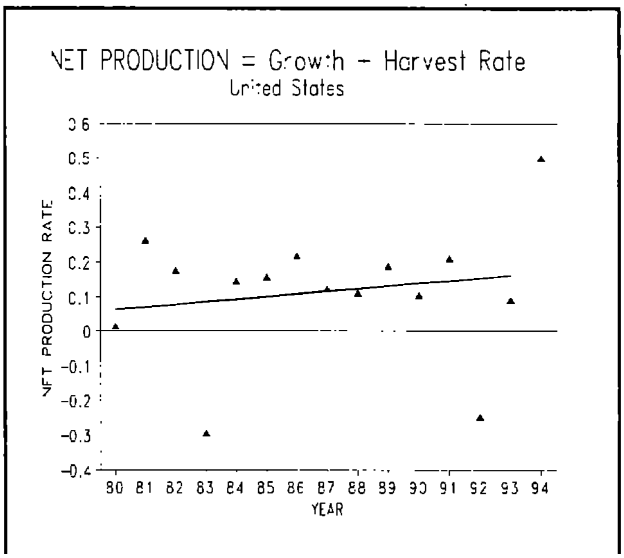

Figure 2. Net productivity rates and regression line estimated from pup counts with corrections for incidental harvest in commercial fisheries.

POTENTIAL BIOLOGICAL REMOVAL

The Potential Biological Removal (PBR) for the United States stock of California sea lions is 5,052. This PBR value was derived from a minimum population estimate of 84,195, a default R_{max}, value of 12%, and a recovery factor of 1.0 (unknown status, increasing significantly).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

California sea lions are killed incidentally in set and drift gillnet fisheries (Hanan et al. 1993; Barlow et al. 1994). Through the first three quarters of 1994, the estimated mortality in the California gillnet fishery was 113 California sea lions. In 1993, the estimated mortality in the California gillnet fishery was 2,093. The combined estimated mortality for California and the Columbia River gillnet fisheries in 1992 was 3,351 (Table 1; Brown and Jeffries 1993, Barlow et al. 1994). Between 1983 and 1989, mortality estimates have ranged between 1,908 and 4,417 California sea lions. Logbook data indicate that mortality of California sea lions occurs also in the following non-gillnet fisheries: (1) California, Oregon, and Washington salmon troll fisheries; (2) Oregon and Washington non-salmon troll fisheries; (3) California herring purse seine fishery; (4) California anchovy?;, mackerel, and tuna purse seine fishery; and (5) California sardine purse seine fishery.

During 1993, in California there were 134 vessels in the set gillnet fishery (J. Cordaro, Southwest Region, NMFS, pers. comm.) for angel shark, California halibut, white seabass, white croaker, and other species. The number of vessels are expected to decrease in 1994 because the Marine Resources Protection Act (passed by the state of California) prohibits gillnet fishing within three nautical miles of the mainland in southern California. During 1993, in California there were 149 vessels in the drift-gillnet fishery (J. Cordaro, Southwest Region, NMFS, pers. comm.) for shark and swordfish. During 1992, in the Columbia River there were 750 vessels permitted to fish with gillnets for salmon, but a significantly lower number of vessels actually fished (Brown and Jeffries 1993). Similar drift gillnet fisheries for swordfish and sharks exist along the entire Pacific coast of Baja California, Mexico and may probably take animals from the same 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 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.

Fishery Mortality Rates

The total number of California sea lions killed in U.S. gillnet fisheries averaged 2,446 from 1991 to 1993. This total fishery mortality rate is not less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. However, preliminary mortality estimates for the first three quarters of 1994 (Table 1) indicate that a large reduction in the mortality rate has taken place and that it may be less than 10% of the calculated PBR for 1994. This determination cannot be made for individual fisheries until the implementing regulations for Section 118 of the Marine Mammal Protection Act (MMPA) have been reviewed by the public and finalized.

Table I. Estimates of incidental mortality for California sea lions in gillnet fisheries and estimates of fishing effort for each fishery (Julian 1993, 1994, pers. comm. Jan. 1995, Brown and Jeffries 1993).

			Estimate		Est. Mortality rate		
Year	Region	Fishery	Kill	S.E.	Kill/ drift	Kill/ day	S.E.
1994[1]	CA TOTAL	Set net	109[1]	N.A.[2]		0.003	N.A.
	California	Drift	4[1]	N.A.		0.070	N.A.
1993	Southern CA[3]	Set net	354	53.3		0.114	0.017
	Ventura, CA[4]		937	90.2		0.443	0.043
	Channel Is.,		614	216.1		2.000	0.704
	Central CA[5]		80	23.5		0.295	0.087
	CA TOTAL		1984	241.3		0.342	0.041
	California	Drift	89	34.3		0.002	0.006
1992	Southern CA	Set net	1164	131.0		0.397	0.448
	Ventura, CA		1242	265.2		0.677	0.145
	Channel Is.,		1164	131.0		0.397	0.045
	Central CA		51	16.1		0.233	0.073
	CA TOTAL		3255	848.9		0.595	0.155
	California	Drift	68	23.0		0.002	0.005
	Columbia R.[6]	Drift	28		0.004		

[1]Through the third quarter
[2]Not Available
[3]South of 33° 50'N (excluding Channel Islands)
[4]North of 33° 50'N to 34° 30'N (excluding Channel Islands)

Other Mortality

California sea lions that were injured by entanglement in man-made debris have been observed at rookeries and haulouts (Stewart and Yochem 1987, Oliver 1991). The proportion of those entangled ranged from 0.08% to 0.35% of those present on land, with the majority (52%) of those being entangled with monofilament gillnet material. A marine mammal rehabilitation center found that 73% of the marine mammals it rescued were California sea lions entangled, and subsequently injured, by monofilament gillnetting (P. Howorth pers. comm.). The occurrence of California sea lions injured by monofilament gillnetting indicates that some are escaping from gillnets after being caught by them. The rate of escape from gillnets, as well as the mortality rate of these injured animals, is unknown.

Live strandings and dead beach-cast California sea lions have also been observed with gunshot wounds in California (Lowry and Folk 1987, Deiter 1991, Barocchi et al. 1993, T. Goff pers. comm.). There are currently no estimates of the number of California sea lions being killed or injured by guns.

STATUS OF STOCK

The last analysis of the dynamics of the California sea lion population in the United States concluded that there was no evidence of a density dependent signal in the series of counts collected between 1983 and 1990, and that it was not possible to determine the status of this stock relative to OSP (Lowry et al. 1992). They are not listed as “endangered” or “threatened” under the Endangered Species Act or as “depleted” under the MMPA. They would not be listed as a “strategic” stock under the MMPA because human-caused mortality is now less than the PBR. The population has been growing recently at 8.2% per year, and the fishery mortality is declining.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Harbor seals are widely distributed in the North Atlantic and North Pacific. Two subspecies exist in the Pacific: *P. v. stejnegeri* in the western North Pacific. near Japan, and *P. v. richardsi* in the eastern North Pacific, The latter subspecies inhabits near-shore coastal and estuarine areas from Baja California, Mexico, to the Pribilof Islands in Alaska. These seals do not make extensive pelagic migrations, but do travel 300-500 km on occasion to find food or suitable breeding areas (Herder 1986: D. Hanan unpublished data). In California: harbor seal haulout sites are widely distributed on mainland and offshore islands, including intertidal sandbars, rocky shores and beaches. Because harbor seal movement is usually limited to less than 500km from their pupping sites, because strong habitat gradients exist along the U.S. west coast. and because coastal gillnet fisheries along the west coast are largely confined to California, the harbor seals of California will be treated as a separate stock in this report. Other Marine Mammal Protection Act (MMPA) stock assessment reports cover the three other stocks that are recognized along the U.S. west coast: 1) Oregon/Washington outer coastal waters, 2) Washington inland waters. and 3) 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 precocious, and pups can enter the water almost immediately after birth. Population size is therefore estimated by counting the number of seals ashore during the peak haul-out period (the May/June molt) and by multiplying this count by the inverse of the estimated faction of seals on land. Boveng (1988) reviewed studies estimating the proportion of seals hauled out to those in the water and concluded that a correction factor for harbor seals in California is likely to be between 1.4 and 2.0. Huber et al.(1993) estimate a mean correction factor of 1.61 (CV=O.O62) for harbor seals in Oregon and Washington. Hanan and Beeson (1994) reported 21.462 seals counted on the mainland coast and islands of California during May and June, 1994. Using that count and the correction factor 1.61 gives a best population estimate (1.61 times the count) of 34:554 harbor seals.

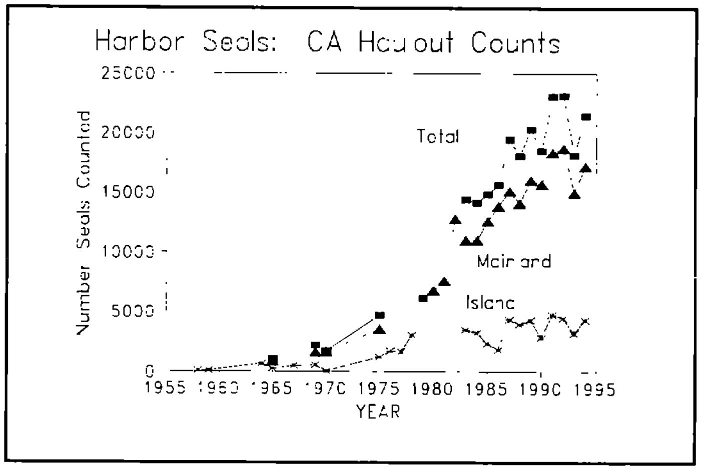

Figure 1. Habor seal counts in California.

Minimum Population Estimate

The minimum population size is taken as the lower 20th percentile of a log-normal population estimate based on the corrected abundance estimate and the CV of the correction factor or approximately 32,798.

Current Population Trend

Harbor seal counts have continued to increase each year except during El Niño events of 1983 and 1993 (Fig. 1). The rate of increase appears, however, to be slowing (Fig. 2).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A realized rate of increase was calculated for the 1982-1994 period by linear regression of the natural logarithm of total count versus year. The slope this regression line was 0.041 (s.e.=0.009) which gives an annualized growth rate estimate of 4.1%. The current rate of net production is greater than this observed growth rate because fishery mortality takes a large fraction of the net production. Net productivity was therefore calculated for 1980-1993 as the realized rate of population growth (increase in pup counts from year ***i*** to year ***i+l,*** divided by pup count in year ***i)*** plus the harvest rate (fishery mortality in year ***i*** divided by population size in year ***i)***. For harbor seals, the total fishery mortalities estimated from NMFS and California Dept. of Fish and Game (CDF&G) observer programs were 834, 1,138, 2,044, 2,118,963, 1,115,746, 890, 559, 1,136, and 480 for 1983 to 1993, respectively (Miller et al. 1983; Hanan et al. 1988; Hanan and Diamond 1989; Perkins et al. 1992, 1994; Julian 1993, 1994; Julian 1993, 1994).

Between 1983 and 1993, the net productivity rate for the California stock averaged 9.7% (Figure 2). A regression shows a decrease in net production rates, but the regression is strongly influenced by the El Niño years. Maximum net productivity rates cannot be estimated because measurements were not made when the stock size was very small.

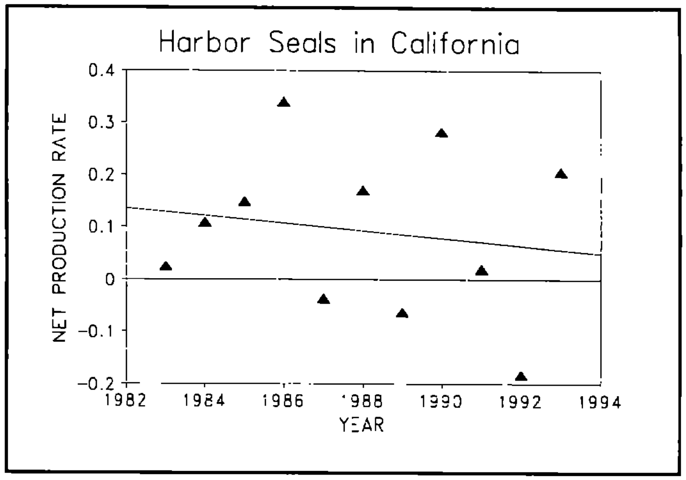

Figure 2. Net productivity rates and regression line estimated from haulout counts, with corrections for incidental harvest in commercial fisheries.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (32,798) times one half the default maximum net productivity rate for pinnipeds (l/2 of 12%) times a recovery factor of 1 .O (for a stock of unknown status that is growing), resulting in a PBR of 1,968.

ANNUAL HUMAN-CAUSED MORTALITY

Historical Takes

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

Fishery Information

In California, harbor seals are killed incidentally in several gillnet fisheries (Hanan and Diamond 1989). Set gillnets are used by approximately 134 vessels (J. Cordaro, Southwest Region, NMFS, pers. comm.) to catch halibut, flounder, angel shark, yellowtail, white seabass, and white croaker in California coastal waters, and marine mammal mortality has been noted in all these fisheries (Barlow et al. 1994). As a result of area closures, fishing effort has decreased from approximately 40,000 sets per year in the mid-1980s to 16,000 in 1993 (Barlow et al. 1994) and decreased again in 1994 because of a new ban on fishing within 3 nmi of shore in southern California. Based on a California Department of Fish and Game (CDFG) observer program, it was estimated that between 800 and 2,000 harbor seals were killed annually during the 1980-88 period (Hanan and Diamond 1989, Hanan et al. 1988, Konno pers. corn.). A National Marine Fisheries Service (NMFS) observation program has monitored 5-16% of all sets in the halibut and angel shark fisheries from 1990-93. Harbor seal mortality in these fisheries was estimated as 1,085, 717, 865, 571, 1,136, and 480, respectively for 1988-93 (Perkins et al. 1992, 1994; Julian 1993, 1994). The 1990-93 mortality rates for these vessels were 0.52 total marine mammals and 0.12 harbor seals per fishing day (Barlow et al. 1994).

Drift gillnets are used by approximately 149 vessels (J. Cordaro, Southwest Region, NMFS, pers. comm.) to catch swordfish, thresher shark, and mako shark in California offshore waters (Hanan et al. 1993). Fishing effort has decreased from approximately 10,000 sets per year in the mid-1980s to 6,600 in 1993 (Hanan et al. 1993; Barlow et al. 1994). CDFG observers monitored <1 % of sets from 1980-86, and NMFS observers monitored 4- 13% of all sets in this fishery from 1990-93. Only 2 harbor seals have been observed taken by this fishery during this time period (Perkins et al. 1992, 1994; Julian 1993, 1994; Hanan et al. 1993). The 1990-93 mortality rates for these vessels were 0.10 total marine mammals and 0.0005 harbor seals per fishing day (Barlow et al. 1994). Given current levels of fishing effort, this would result in approximately 3 harbor seal deaths per year.

Fishery Mortality Rates

Annual gillnet mortality may have been as high as 5-10% of the California harbor seal population. A kill this large would have strong influences on population growth rates and would depress them appreciably below the growth rate that would be observed in the absence of fishery mortality. Most of the kill was in the southern half of the State (Hanan et al. 1988; Hanan and Diamond 1989) and most of the mainland seals are in the northern half of California (Hanan 1993). This differential kill rate by geographic areas has not been investigated but may be an important factor in harbor seal dynamics in California.

The average rate of incidental fishery mortality for this stock over the last 3 years was 729 animals per year, which is greater than 10% of the calculated PBR. Therefore, fishery mortality cannot be considered insignificant and approaching zero mortality and serious injury rate. This determination cannot be made for individual fisheries until the implementing regulations for Section 118 of the MMPA have been reviewed by the public and finalized.

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 1993). They are not listed as "endangered" or "threatened" under the Endangered Species Act nor as "depleted" under the MMPA. Because their annual mortality rate is less than the calculated PBR for this stock, they would not be considered a "strategic" stock under the MMPA. The population appears to be growing and the fishery mortality is declining.

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HARBOR SEAL *(Phoca vitulina richardsi):*
Oregon & Washington Coastal Waters Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Harbor seals inhabit coastal and estuarine waters off Baja California north to California, Oregon, Washington, and Prince William Sound, 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. Along the west coast of the continental U.S., 3 separate stocks have been defined based on harbor seal biology, in addition to management implications (Boveng 1988): (1) inland waters of Washington (Hood Canal, Puget Sound, and Strait of Juan de Fuca out to Cape Flattery). (2) outer coast of Oregon and Washington. and (3) California. These stock definitions are based on differences in mean pupping date (Temte 1986), movement patterns (Jeffries 1985, Brown 1988), and preliminary genetic analyses (Huber et al. 1994). This report considers only the second of these stocks.

POPULATION SIZE

Aerial surveys of harbor seals in Oregon and Washington were conducted during the pupping season in 1991 and 1992, when both the total number of seals (including pups) and number of pups were counted. A correction factor for the proportion of the population that was in the water during surveys was determined from radiomarked animals that were surveyed simultaneously during count surveys. Population estimates based on the total number of seals were considered more accurate than estimates based on pup counts because pup counts had a greater variance (Huber et al. in prep.). Coefficients of variation were determined for multiple surveys and found to be <0.15 in all cases. The total count for the Oregon and Washington coastal waters stock was 18,596 (CV=O.O2) in 1992, resulting in an estimated population size of 29,939 (CV=O.O66; 95% CI 26,320 - 34.056) animals using a mean correction factor of 1.61 (CV=O.O62) (Huber et al. 1993).

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock is calculated from equation I from the PBR Guidelines (this volume): N_{MIN} = N/exp(0,842*[ln(l-[CV(N)]^{2})]$^{1/2}$). Using the population estimate (N) of 29,939 and its associated CV of 0.066, N_{MIN} for this stock is 28,322.

Current Population Trend

Historical levels of harbor seal abundance are unknown, but the population apparently decreased during the 1940s and 1950s due to mortality from bounty hunting; approximately 17.133 harbor seals were killed in Washington State by bounty hunters between 1943 and 1960 (Newby 1973). More than 3,800 harbor seals were killed in Oregon between 1925 and 1972 by a state-hired seal hunter and bounty hunters (Pearson 1969). The population remained relatively low during the 1960.5, but counts have increased from 6,389 in 1977 to 18,596 in 1992 (Huber et al. in prep.).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The Oregon and Washington coastal waters stock of harbor seals increased at an annual rate of 11% from 1977-82, and then at 5.5% from 1983- 1992 (Huber et al. in prep.). However: until additional estimates of net productivity are available, it is recommended that the default pinniped maximum theoretical net productivity rate (R_{MAX}) of 12% (PBR Guidelines, this volume) be employed for this stock of harbor seals.

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA): the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = N_{MIN} **x** $0.5R_{MAX}$ **x** F_R The recovery factor (F_R for this stock is 1.O, the value for unknown stocks that are increasing with no evidence of changes in the level of incidental mortality. Thus, for the Oregon and Washington coastal waters stock of harbor seals, PBR = (28,322 x 0.06 x 1 .O), or 1,699 animals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Observers under the direction of the Oregon and Washington Departments of Fish and Wildlife (ODFW & WDFW) recorded 9 harbor seal mortalities incidental to the Washington and Oregon Lower Columbia River drift gillnet fishery in 1991, resulting in an extrapolated estimated total kill of 233 seals (CV=O.37) (Brown and Jeffries 1993). The observed effort was 2,582 drifts with an observer coverage of 4.7%. During 1992, ODFW & WDFW observers recorded 15 harbor seal mortalities incidental to the Washington and Oregon Lower Columbia River drift gillnet fishery, resulting in an extrapolated estimated total kill of 192 seals (CV=O.32) (Brown and Jeffries 1993). The observed effort was 1,545 drifts with an observer coverage of 27.2%. The average estimated annual kill for this fishery for 1991 and 1992 is therefore 213 ([233+192]/2) animals per year. Also during 1992, ODFW & WDFW observers recorded 1 harbor seal mortality incidental to the Washington Grays Harbor salmonid set and drift gillnet fishery, resulting in an extrapolated estimated total kill of 10 seals (CV=1 .O). The observed effort was 307 drifts with an observer coverage of 4.2%. NMFS observers recorded 39 harbor seal mortalities incidental to the Washington marine set gillnet fishery during 1989-1992, which resulting in an extrapolated annual mean kill of 10 animals per year. The mean estimated annual kill based on the above 3 fisheries is 233 (2l3+ 10+l0) seals per year.

The total fishery mortality and serious injury for this stock (233) is not less than 10% of the calculated PBR (170) and, therefore, cannot be considered to be insignificant and approaching a zero mortality and serious injury rate.

STATUS OF STOCK

The level of human-caused mortality and serious injury (233) does not exceed the PBR (1,699), thus the Oregon and Washington coastal waters stock of harbor seals is not classified as a strategic stock.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Harbor seals inhabit coastal and estuarine waters off Baja California north to California, Oregon, Washington, and Prince William Sound, 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. Along the west coast of the continental U.S.. 3 separate stocks have been defined based on harbor seal biology, in addition to management implications (Boveng 1988): (1) inland waters of Washington (Hood Canal? Puget Sound, and Strait of Juan de Fuca out to Cape Flattery), (2) outer coast of Oregon and Washington, and (3) California. These stock definitions are based on differences in mean pupping date (Temte 1986), movement patterns (Jeffries 1985, Brown 1988), and preliminary genetic analyses (Huber et al. 1994). This report considers only the first of these.

POPULATION SIZE

Aerial surveys of harbor seals in Washington and Oregon were conducted during the pupping season in 1991 and 1992, when both the total number of seals (including pups) and number of pups were counted. A correction factor for the proportion of the population that was in the water during surveys was determined from radiomarked animals that were surveyed simultaneously during count surveys. Population estimates based on the total number of seals were considered more accurate than estimates based on pup counts because pup counts had a greater variance (Huber et al. in prep.). Coefficients of variation were determined for multiple surveys and found to be <0.08 in all cases. The total count for the Washington inland waters stock was 8,592 (CV = 0.03) in 1992, resulting in an estimated population size of 13:833 (CV=O.O69; 95% Cl 12,095 - 15,820) animals using a mean correction factor of 1.61 (CV=O.O62) (Huber et al. 1993).

Minimum Population Estimate

The minimum population estimate (N_{MIN} for this stock is calculated from equation 1 from the PBR Guidelines Report (this volume): $N_{MIN} = N/\exp(0{,}842*[\ln(l-[CV(N)]^2)]^{1/2})$. Using the population estimate (N) of 13,833 and its associated CV of 0.069, N_{MIN} for this stock is 13:053.

Current Population Trend

Historical levels of harbor seal abundance are unknown, but the population apparently decreased during the 1940s and 1950s due to mortality from bounty hunting; 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 most recently, counts have increased steadily from 4,824 in 1983 to 8,592 in 1992 (Huber et al. in prep.).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

From 1983 to 1992, the Washington inland waters stock of harbor seals increased at an annual rate of 6.1% (Huber et al. in prep.). However, until additional estimates of net productivity are available, it is recommended that the default pinniped maximum theoretical net productivity rate (R_{MAX}) of 12% (PBR Guidelines: this volume) be employed for this stock of harbor seals.

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = $N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 1 .0, the value for unknown stocks that are increasing with no evidence of changes in the level of incidental mortality. Thus, for the Washington inland waters stock of harbor seals, PBR = (I 3,053 x 0.06 x 1.0), or 783 animals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

NMFS observers recorded harbor seal mortality incidental to the Washington marine set gillnet fishery during 1989-1992. Following are the number of observed kills and the extrapolated total kill for each year: 1989, 5 extrapolated to 21 (Kajimura in prep.); 1990, 4 extrapolated to IO (Gearin et al. in press); 1991, 8 extrapolated to 13 (Gearin et al. 1992); and 1992. 10 extrapolated to I3 (Gearin et al. 1993). The observed effort and percentage of observer coverage were as follows: 1989 - 361 net days, 27% coverage; 1990 - 264 net days, 47% coverage; 1991 - 238 net days, 62% coverage; 1992 - 264 net days, 80% coverage. The mean estimated annual kill for this fishery during 1989-92 is 14 seals per year. An observer program was assigned to the sockeye gill net fishery in 1994, primarily to estimate the incidental kill of Marbled Mm-relets, not harbor seals. However, results from this new observer program estimated an extrapolated kill of 15 harbor seals (Pierce et al. 1995). Additional incidental take of harbor seals likely occurs in other fisheries that have not been observed.

The estimated motility rate incidental to commercial fisheries recently monitored is 29 (14 + 15) animals per year. At present, mortality levels less than 78 animals per year (i.e., 10% of PBR) are considered insignificant.

STATUS OF STOCK

The level of human-caused mortality and serious injury (29) does not exceed the PBR (783), thus the Washington Inland waters stock of harbor seal is not classified as a strategic stock.

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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 lsands and in the Gulf of Alaska: and females feed further south, south of 45°N (Stewart and Huber 1993 ; Le Boeuf et al. 1993). Adults return to land between March and August to molt, with males returning later than females. Adults return to their feeding areas again between their spring/summer molting and their winter breeding seasons.

Populations of northern elephant seals in the U.S. and Mexico were all originally derived from a few tens or a few hundreds of individuals surviving in Mexico after being nearly hunted to extinction (Stewart et al. 1994). Given the very recent derivation of most rookeries: no genetic differentiation would be expected. Although movement and genetic exchange continues between rookeries, most elephant seals return to their natal rookeries when they start breeding (Huber et al. 1991). Because in situ recruitment is much greater than immigration for large rookeries: they can be considered demographically distinct. Similarly, the California breeding population is now demographically rather isolated from the Baja California population. No international agreements exist for the joint management of this species by the U.S. and Mexico. The U.S. breeding population is considered here to be a separate stock.

POPULATION SIZE

All age classes of elephant seal are never ashore at the same time to allow a complete population count. 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, and using it erroniously assumes that a population is not growing. Boveng (1988) and Barlow et al.(1993) argue that a multiplier of 3.5 is more appropriate for a rapidly growing population such as the California stock of elephant seals. Based on the estimated 21,000 pups born in California (Barlow et al. 1993; Stewart eet al. 1994) and this 3.5 multiplier, the California stock was approximately 73.500 in 1991. Pup counts since 1991 have not been published yet, but unpublished NMFS data indicate that populations have continued to increase on California's Channel Islands (Figure I).

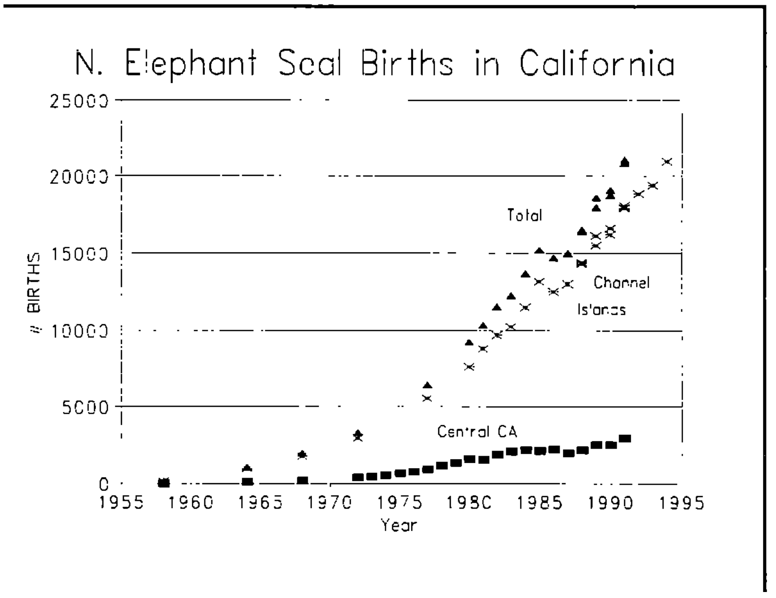

Figure 1. Elephant seal births in California Multiple independent estimates are presented for the Channel Islands 1988-91.

Minimum Population Estimate

The minimum population size for northern elephant seals can be estimated very conservatively as 42,000, twice the observed pup count (to account for the pups and their mothers). More sophisticated methods of estimating minimum population size would be available if a variance were associated with the multiplier used to estimate population size.

Current Population Trend

Based on trends in pup counts from 1965 to 1991, northern elephant seal populations were continuing to grow in California but appeared to be stable or slowly decreasing in Mexico (Stewart et al. 1994). More recent data (NMFS, unpublished) indicate that the Channel Islands rookeries (which account for more than 85% of the births in California) have continued to grow from 1991 to 1994 (Figure I

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Although growth rates as high as 16% per year have been documented for elephant seal rookeries in the U.S. from 1959 to 1981 (Cooper and Stewart 1983), much of this growth was supported by immigration from Mexico. The highest growth rate measured for the whole U.S./Mexico population was 8.3% between 1965 and 1977 (Cooper and Stewart 1983). A continuous growth rate of 8.3% is consistent with an increase from approximately 100 animals in 1900 to the current population size. The "maximum estimated net productivity rate" as defined in the Marine Mammal Protection Act (MMPA) would therefore be 8.3%. In California: the net productivity rate appears to have declined in recent years (perhaps with a decline in the relative contribution from immigration); however, current net productivity is still near 8% per year [Figure 2: net production rate was calculated as the realized rate of population growth (increase in pup abundance from year ***i*** to year ***i+I,*** divided by pup abundance in year *i)* plus the harvest rate (fishery mortality in year ***i*** divided by population size in year *i)].*

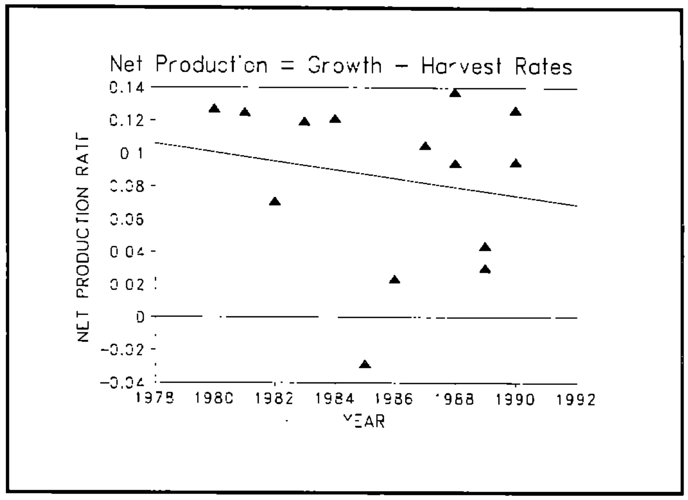

Figure 2. Net productivity rates estimated from pup counts with corrections for incidental harvest in commercial fisheries. Mortality for 1980- 1987 is assumed to be 300, the average of 1988-90 values.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (42,000) times one half the observed maximum net growth rate for this stock (l/2 of 8.3%) times a recovery factor of 1 .0 (for a species of unknown status that is increasing) resulting in a PBR of 1,743.

ANNUAL HUMAN-CAUSED MORTALITY

Fisheries Information

Set gillnets are used by approximately 134 vessels (J. Cordaro, Southwest Region, NMFS, pers. comm.) to catch halibut, flounder, angel shark, yellowtail, white seabass, and white croaker in California coastal waters, and marine mammal mortality has been noted in all these fisheries (Barlow et al. 1994). As a result of area closures: fishing effort has decreased from approximately 40,000 sets per year in the mid- 1980s to 16,000 in 1993 (Barlow et al. 1994) and is expected to decrease again in 1994 because of a new ban on fishing within 3 nmi of shore in southern California. An observation program has monitored 5-16% of all sets in the halibut and angel shark fisheries from 1990-93. Northern elephant seal mortality in these fisheries was estimated as 19.5, 188, 182, 26, 51, and 71, respectively for 1988-93 (Perkins et al. 1992, 1994; Julian 1993, 1994). The 1990-93 mortality rates for these vessels were 0.52 total marine mammals and 0.014 elephant seals per fishing day (Barlow et al. 1994).

Drift gillnets are used by approximately 149 vessels (J. Cordaro, Southwest Region, NMFS, pers. comm.) to catch swordfish, thresher shark, and mako shark in California offshore waters (Hanan et al. 1993). Fishing effort has decreased from approximately 10,000 sets per year in the mid-1980s to 6,600 in 1993 (Barlow et al. 1994). An observation program has monitored 4-13% of all sets in this fishery from 1990-93. Northern elephant seal mortality was estimated as 120, 11.5, 101, 110, 114, and 103, respectively for 1988-93 (Perkins et al. 1992, 1994; Julian 1993, 1994). The 1990-93 mortality rates for these vessels were 0.10 total marine mammals and 0.021 elephant seals per fishing day (Barlow et al. 1994).

Although all of the above mortalities occurred in U.S. waters? some may be of seals from Mexico's breeding population that are migrating through U.S. waters. Similar drift gillnet fisheries for swordfish and sharks exist along the entire Pacific coast of Baja California, Mexico and may probably take animals from the same 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 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. 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).

Fishery Mortality Rates

The average rate of incidental fishery mortality for this stock over the last 3 years was 166 animals per year, which is 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 determination cannot be made for individual fisheries until the implementing regulations for Section 118 of the MMPA have been reviewed by the public and finalized.

STATUS OF STOCK

A review of elephant seal dynamics through 1991 concluded that their status could not be determined with certainty: but that they might be within their Optimal Sustainable Population (OSP) range (Barlow et al. 1993). They are not listed as “endangered” or “threatened” under the Endangered Species Act nor as “depleted” under the MMPA. Because their annual mortality rate is much less than the calculated PBR for this stock, they would not be considered a “strategic” stock under the MMPA. The population is continuing to grow rapidly and fishery mortality is relatively constant.

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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 Point Conception, California (and possibly as far north as the Farrallon Islands), to the Revillagigedo Islands. Mexico (Fleischer 1987). The capture of two adult males at Guadalupe Island in 1928 established the species' return (Townsend 1931); however, they were not seen again until 1954 (Hubbs 1956). At the present time Guadalupe fur seals pup and breed only at Guadalupe Island, Mexico, but individuals have been sighted in the Channel Islands and central California (Stewart et al. 1987, Gallo 1994) and in the Gulf of California (Gallo 1994: 0. Maravilla, pers. comm. 1994). The population is considered to be a single stock because they pup and breed only at Guadalupe Island, Mexico.

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 Size

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 (I 984). 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 I).

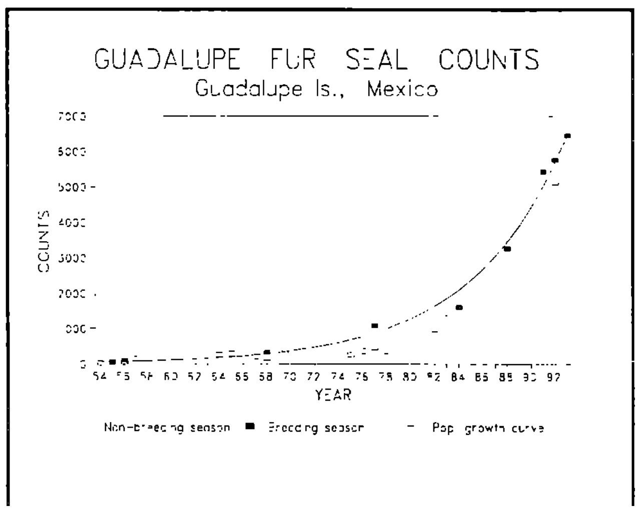

Figure 1. Counts of Guadalupe fur seals at Guadalupe Island, Mexico and the estimated population growth curve derived from counts made during the breeding season.

CURRENT AND MAXIMUM 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 the Guadalupe fur seal is 104. This PBR value was derived from a minimum population estimate of 3,028, an R_{max} value of 13.7%, and a recovery factor of 0.5 (for a threatened species). The vast majority of this PBR would apply towards incidental mortality in Mexico.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY RATE

Fishery Information

In the United States there have been no reports of gillnet mortalities or injuries for Guadalupe fur seals (Lennert et al. 1991, Perkins et al. 1992, Julian et al. 1993, 1994, Barlow et al. 1994). No information is available for human-cause mortalities or injuries in Mexico.

Drift and set giltnet fisheries may cause incidental mortality of Guadalupe fur seals in Mexico and the United States. In the United States, during 1993 there were 134 vessels in the set-gillnet fishery for halibut and angel shark and 149 vessels in the drift-gillnet fishery for shark and swordfish. The number of set net vessels is expected to decline in 1994 because the Marine Resources Protection Act of 1990 (passed by the state of California) limits fishing within 3 miles of the coast in southern California. Similar drift gillnet fisheries for swordfish and sharks exist along the entire Pacific coast of Baja California, Mexico and may probably take animals from the same 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 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. The number of set gillnets used in Mexico is unknown.

Fishery Mortality Rates

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. This determination cannot be made for individual fisheries until the implementing regulations for Section 118 of the Marine Mammal Protection Act (MMPA) have been reviewed by the public and finalized.

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 population is growing at approximately 13.7% per year.

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NORTHERN FUR SEAL *(Callorhinus m-sinus):* 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. During the breeding season, approximately 74% of the worldwide population is found on the Pribilof Islands in the southern Bering Sea, with the remaining animals spread throughout the North Pacific Ocean (Lander and Kajimura 1982). Of the seals in U.S. waters outside of the Pribilofs, approximately 1% of the population is found on Bogoslof Island in the southern Bering Sea and San Miguel Island off southern California (NMFS 1993). Fur seals may temporarily haul-out on land at other sites in Alaska, British Columbia. and on islets along the coast of the continental United States, but generally outside of the breeding season (Fiscus 1983).

Adults usually occur onshore during a 5 month period, principally during the breeding-season (May-October), then migrate south and spend the next 7 months at sea. Adult females and pups from the Pribilof Islands migrate through the Aleutian Islands into the North Pacific Ocean, often to the Oregon and California offshore waters. 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, thus the distinction between the North Pacific Stock and the San Miguel stock is based principally on geographic separation during the breeding season.

POPULATION SIZE

The population estimate for the San Miguel Island stock of fur seals is calculated as the estimated number of pups at rookeries multiplied by an expansion factor. Based on research conducted on the eastern North Pacific stock of fur seals, a life table analysis was performed to estimate the number of yearlings, 2 yr olds, 3 yr olds, and animals at least 4 yrs old (Lander 1981). The resulting population estimate was equal to the pup count multiplied by approximately 4.475. The expansion factors are based on a sex and age distribution estimated after the harvest of juvenile males was terminated; currently, CVs are unavailable. A more appropriate expansion factor for the San Miguel stock is 4.0, based on the increased mortality and possible emigration of adults associated with the El Niño Southern Oscillation event in 1982-l983 (DeLong, pers. comm.). The 1994 pup count of 2,634 (NMFS, unpubl. data) was the highest reported at San Miguel since the colony was discovered in 1968. Based on this count and the expansion factor, the most recent population estimate of this stock is 10,536 (2,634 x 4.0) fur seals.

Minimum Population Estimate

The survey technique utilized for estimating the abundance of northern fur seals within the San Miguel 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 N_{MIN}, for this stock can not be estimated using equation 1 from the PBR Guidelines (this volume). Rather, N_{MIN} is estimated as twice the maximum number of pups born in 1994 or 5268 (2,634 x 2) animals. This approach was recommended by the Pacific Scientific Review Group.

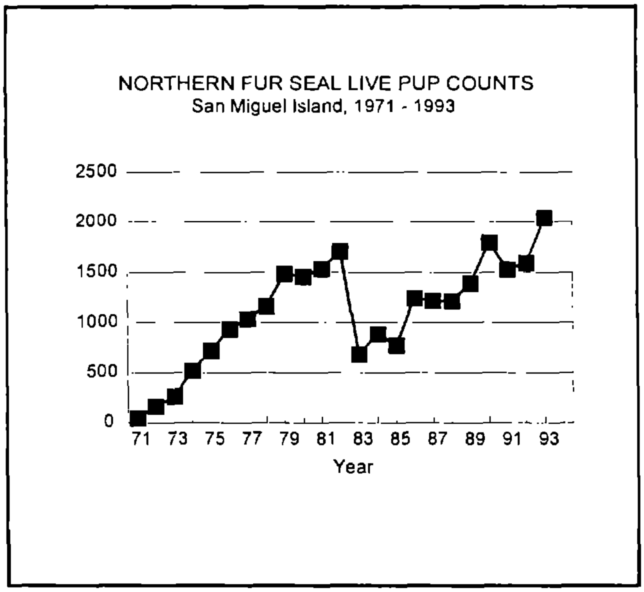

Figure 1.

Current Population Trend

The population of fur seals on San Miguel has increased steadily since the early 1970s, except during the El Niño Southern Oscillation event in 1982-1983. Specifically, pup counts increased about 24% annually from 1972 through 1982, an increase due, in part, to immigration of females from the Bering Sea and the western North Pacific Ocean (DeLong 1982). In 1983, counts decreased dramatically by 63% (DeLong and Antonelis 1991) and have since steadily increased; yet, counts remained below the 1982 level (pre-El Niño) until 1990 (Fig. I).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The northern fur seal population increased steadily during 1912-1940 when the commercial harvest on the Pribilof Islands excluded pregnant females. During this period, the rate of population growth was 8.6% (SE=1.47%) per year (York pers. comm.), the maximum recorded for this species.

POTENTIAL BIOLOGICAL REMOVAL

Under the I994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = N_{MIN} **x** $0.5R_{MAX}$ **x** F_R. The recovery factor (F_R) for this stock is 1 .O, the value for stocks of unknown status that are increasing with no evidence of change in the level of incidental mortality (PBR Guidelines, this volume). Thus, for the San Miguel stock of northern fur seals, PBR = (5,268 x 0.043 x 1.0) or 227 animals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Mortality of northern fur seals incidental to the California gillnet fisheries has not been reported in the last 5 years. 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. High-seas gillnetting in the central North Pacific has been discontinued. The estimated mortality rate incidental to commercial fisheries recently monitored is zero. At present, mortality levels less than 23 animals per year (i.e., 10% of PBR) are considered insignificant and approaching a zero mortality and serious injury rate.

Other Mortality

Other than occasional reports of fur seals being found dead from gunshot wounds, no other human-caused mortality is known for this stock.

STATUS OF STOCK

The estimated annual level of total human-caused mortality and serious injury (0) does not exceed the PBR (227), thus the San Miguel stock of the northern fur seal is not classified as a strategic stock. The population status of this stock relative to OSP is unknown, unlike the Eastern Pacific 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) in six main reproductive populations at French Frigate Shoals, Laysan Island, Lisianski Island, Pearl and Hermes Reef, Midway Atoll, and Kure Atoll. The Midway population has not contributed significantly to pup production since the 1950s. Additional populations, with limited reproduction and maintained by immigration, are found at Necker Island and Nihoa Island, and a small number of seals are distributed throughout the main Hawaiian Islands. Study of this species has focused on their abundance and behavior on land during the reproductive season (spring and early summer). Their pelagic distribution and behavior (and any seasonal or temporal variation therein) are largely unknown.

In the last two centuries, this species has experienced two major declines which: presumably, have severely reduced its genetic variation. The tendency for genetic drift may have been (and continue to be) relatively large, due to the small size of the different island/atoll populations. However, l0- 15% of these seals migrate among the populations (Johnson and Kridler 1983, NMFS unpubl. data) and, at least to some degree, this movement should counter the development of separate genetic stocks. Genetic variation among the different island populations is currently under investigation but. at present, we have no evidence that separate genetic stocks have developed.

Demographically, the different island populations have exhibited considerable independence. For example, abundance at French Frigate Shoals grew rapidly during the 1950s to the 198Os, while other populations declined rapidly. However, the variation in past population trends may be partially explained by changes in the level of human disturbance (Gerrodette and Gilmartin 1990). Current demographic variability among the island populations probably reflects a combination of different recent histories and varying environmental conditions. While management activities and research focus on problems of single island/atoll populations, this species is managed as, and considered to be, a single stock.

POPULATION SIZE

Total abundance of the Hawaiian monk seal was estimated to be 1580 (SE=l47) in 1992 (Ragen, 1993). Mean beach counts are used as the primary index of abundance, and between 1992 and 1993, the total of mean beach counts at the main reproductive populations (excluding Midway) declined by 11%. If the decline in mean beach counts indicates a similar decline in total number of seals, then the best estimate of total abundance for 1993 would be 1406 (SE=131; assuming constant coefficient of variation).

Minimum Population Size

Using 1406 as the most current estimate of abundance, 131/1406 = 0.093 as the coefficient of variation, and the formula provided in the Report of the PBR (Potential Biological Removal) Workshop, June 24-27, 1994, the best estimate of N_{min} is 1300.

Current Population Trend

Between 1958 and 1993. mean beach counts at the main reproductive populations declined by 60% (Fig. 1). From 1985 to 1993, counts declined at 5% per year.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Assuming that mean beach counts are a reliable index of total abundance, the current net productivity rate for this species is -0.05 yr^{-1} (i.e., the species is declining at 5% per year). Much of this decrease reflects an extensive loss of immature seals at French Frigate Shoals, the largest population. In addition, populations at Laysan and Lisianski

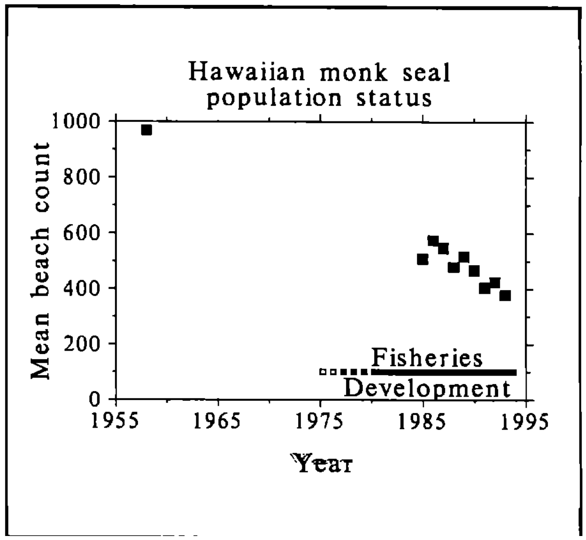

Figure 2. Total of mean beach counts of Hawaiian monk seals (excluding pups) at five of the six main reproductive populations, 1958-1993.

Islands continue to decline slowly.

Contrary to the decline at the above sites, the population at Kure Atoll has grown at ca. 3% since 1981 (due largely to decreased human disturbance and introduced females): and the population at Pearl and Hermes Reef has grown at approximately 6% since 1975. This 6% growth rate is the best indicator of the maximum net productivity rate (R,,) for this species.

POTENTIAL BIOLOGICAL REMOVAL

Using the values of N_{min} and R_{max} given above (1300 and 0.06 yr^{-1}, respectively) and a recovery factor (F_R) of 0.1 (the Hawaiian monk seal was designated as both endangered and depleted in 1976) the potential biological removal (PBR) for this species is 1300 * (0.06 * (0.5)) * 0. 1 = 3.9. However, the Endangered Species Act takes precedence in the management of this species and, under the Act, allowable take is zero.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Human-related mortality has caused 2 major declines of the Hawaiian monk seal, and may continue to be an important factor impeding its recovery. In the 1800s this species was decimated by sealers, crews of wrecked vessels, and guano and feather hunters (Dill and Bryan 1912, Wetmore 1935, Clapp and Woodward 1972). Several populations may have been driven extinct; for example, no seals were seen at Midway Atoll during a l4-month period in 1888-89, and only a single seal was seen during three months of observations at Laysan Island in 1912-l3 (Bailey 1952). A survey in 1958 indicated at least partial recovery of the species in the first half of this century (Rice 1960). However, subsequent surveys documented a second major decline beginning in 1958 (or earlier), during which several populations (Kure Atoll, Midway Atoll, and Pearl and Hermes Reef) decreased by 80-100%. This second decline has not been explained at Pearl and Hermes Reef, or Lisianski and Laysan Islands. However, trends at Kure Atoll, Midway Atoll, and French Frigate Shoals appear to have been determined by the pattern of human disturbance which, among other effects, caused pregnant females to abandon prime pupping habitat and nursing females to abandon their pups (Kenyon 1972: Gerrodette and Gilmartin 1990). The result was a decrease in pup survival, which led to poor reproductive recruitment, low productivity, and population decline. Since 1979, disturbance from human activities on land has been limited primarily to Kure and Midway Atolls. The U.S. Coast Guard LORAN station at Kure Atoll was closed in 1992 and vacated in 1993. The U.S. Naval Air Facility at Midway was closed in 1993, and will be vacated following clean-up and restoration activities. Thereafter, human disturbance on land should not impede the recovery of this species. Disturbance at sea, however, may impede recovery.

Fishery Information

Since the late 197Os, development and expansion of fisheries in the NWHI has lead to interactions detrimental to monk seals. The interactions fall into four categories: operations/gear conflict: entanglement in fisheries debris, seal consumption of potentially toxic discard, and competition for prey. Since 1982, a total of five fishery-related monk seal deaths have been recorded, including three from entanglement in fisheries debris (Henderson 1990) one from entanglement in the bridle rope of lobster trap (NMFS, unpubl. data), and one from entanglement in an illegally set gill net off the western shore of Oahu (NMFS, Unpubl. data). In addition, 12 seals have been observed with embedded fish hooks and 23 seals have been observed with uncharacteristic wounds attributed to interactions, Importantly, the majority of these deaths and injuries have been observed incidentally during other research activities; study of monk seal/fisheries interactions has not been adequate to reliably estimate the rate of fisheries-related injury or mortality for this species.

The Hawaiian monk seal interacts with four fisheries. The NWHI lobster fishery began in the late 1970s. developed rapidly in the 1980s and then declined in the late 1980s and early 1990s. The fishery had to be dosed in 1993 due to low spawning stock biomass, and was limited to nine weeks in 1994. From 1983 to 1991, catch per unit effort declined by 80% (Polovina 1993). The number of vessels in the fishery increased from four in 1983 to 16 in 1985-86, and then declined to 12 in 1992 (Dollar and Landgraf 1992, Dollar 1993). Both effort and landings have been concentrated at Gardner Pinnacles, Mare Reef. Necker Island, and St. Rogatien Bank (Clarke and Todoki 1988. Polovina and Moffitt 1989). Seasonal and area differences in fisheries interactions, and total incidental mortality, have not been evaluated. As just noted, one mortality has been documented; in 1986, a monk seal drowned after becoming entangled in the bridle rope of an actively fishing lobster trap near Necker Island. However, indirect mortality due to competition for prey may be a more serious problem than direct interactions. The recent trend in the seal population at French Frigate Shoals indicates that this population is severely food-limited. Monk seals eat lobsters and forage at all the sites where lobster fishing has been concentrated. Competition probably occurs, but the extent of this competition is not known because the relative importance of lobsters in the monk seal diet has not been determined, Thus, the degree to which the lobster fishery has contributed to the high mortality of immature seals at French Frigate Shoals is uncertain.

The NWHI bottomfish fishery occurred at low levels (< 50 t per year) until 1977, steadily increased to 460 t in 1987, and then dropped to ca. I40 to 190 t per year from 1988 to 1992 (Pooley 1993, Kawamoto 1993). The number of vessels rose from 19 in 1984 to 28 in 1987, and then varied from IO to 17 in 1988 through 1992 (Kawamoto 1993). Nitta and Henderson (3993) reported an interaction rate of one event per 34.4 hours of fishing (based on observer data), but they do not provide a confidence interval for their estimate. Documented interactions include seals damaging and removing hooked catch, seals being hooked in the process, and seals consuming discarded fish, which may contain high levels of ciguatoxin or other biotoxins. Of the 12 cases where seals have been observed with embedded hooks, only two cases were known to involve a bottomfish hook. Consumption of discarded fish may be a more serious problem for interacting seals. In particular, the seals eat discarded kahala (Seriola dumerili), which is not kept by fishery participants because it is considered to accumulate high levels of ciguatoxin and other biotoxins. The subsequent effects on the seals have not been assessed. No monk seal mortalities have been documented by participants or observers in the bottomfish fishery. The ecological effects of this fishery on monk seals (i.e., competition for prey) are unknown and unstudied.

The third fishery with which monk seals interact is the pelagic longline fishery. This fishery targets swordfish and tunas, primarily, and does not compete with Hawaiian monk seals for prey. The fishery began in the 1940s and operated at a relatively low level (< 5000 t per year) until the mid 1980s. In 1987. 37 vessels participated in this fishery, but by 1992, the number had grown to 166 (Dollar 1993). Entry is currently limited to a maximum of 167 vessels. While much of the fishery operated outside of the NWHl Exclusive Economic Zone, the rapid expansion raised concerns about the potential for interactions with protected species, including the monk seal. Evidence of interactions began to accumulate in 1990, including five hooked seals and 13 unusual seal wounds thought to have resulted from interactions. After some interim management measures, a permanent Protected Species Zone was established in October 1991, This zone extends 50 nautical miles around the NWHI and the corridors between the islands. However, monk seals are still observed with evidence of interactions. In 1994, for example, a parturient female at French Frigate Shoals was observed with a hook in her mouth; the hook was not removed or recovered. but appeared to be from the longline fishery. The rate of such interactions and their eventual outcome have not been quantitatively assessed.

Finally, monk seals have interacted with recreational fisheries in the main Hawaiian Islands and at Kure Atoll. In four of the 12 known hookings, the hook was from recreational fishing. As Kure Atoll was vacated by the U.S. Coast Guard in 1993, such interactions should no longer occur at this site. All (three) documented interactions within the main Hawaiian Islands have been near Kauai; one hooking occurred in the recreational fishery for ulua (Caranx spp.), and the fishery was undetermined in the two other cases. These interactions may become more prevalent with the translocation of seals from populations in the **NWHI** to the main Islands. However, twenty-one adult males were translocated in July/August 1994. and as of February 1995, no interactions have been confirmed. In addition. the translocated males have virtually no reproductive value to the species, and interactions should not pose a significant threat to the species.

Fishery Mortality Rate

The total fishery mortality and serious injury for this stock is uncertain and cannot be estimated without more quantitative assessment. However? as seals are still observed with serious injuries (such as the parturient fernal mentioned in the previous section), the total fishery mortality and serious injury for this stock is greated than 1) zero allowable take under the Endangered Species Act and 2) 10% of the calculated PBR (3.9 * 0. IO = 0.39). Therefore, total fishery mortality and serious injury can not be considered to be insignificant and approaching a rate of zero. In addition, fishery interactions with this species have not been adequately studied and, therefore, the information above represents only the minimum level of interactions. not the true level. Without further study, the true level of interaction cannot be estimated. Finally, the most serious interactions may be indirect (i.e., involving competition for prey with the lobster fishery or consumption of discard from the bottomfish fishery) and, to date, the extent or consequences of such indirect interactions have not been evaluated.

Other Mortality

Since 1982,29 Hawaiian monk seals have died in captivity (NMFS, unpubl. data). Twenty of these seals were collected for rehabilitation, four were being held in permanent captivity, three were subjects of field research, one was being translocated from Laysan Island to Johnston Atoll, and one was being held for translocation to the main Hawaiian Islands.

Seals have also died after encounters with marine debris from sources other than fisheries. In 1986, a weaned pup died at East Island, French Frigate Shoals, after becoming entangled in wire left when the U.S. Coast Guard abandoned the island 3 decades earlier. In 1991, a seal died after becoming trapped behind a decaying seawall on Tern Island, French Frigate Shoals.

The only documented case of illegal killing of an Hawaiian monk seal occurred when a resident of Kauai killed an adult female.

Other sources of mortality which may be impeding the recovery of this population include mobbing (attacks on a female my multiple males), sharks, poisoning by ciguatoxin or other biotoxins, and disease/parasitism. Mobbing appears to be a major impediment to recovery at Laysan and Lisianski Islands. It has also been documented at French Frigate Shoals: Kure Atoll (although not recently), and Necker Island. The primary cause of mobbing is thought to be an imbalance in the adult sex ratio, with males outnumbering females. Mobbed seals include adult females and immature seals of both sexes. These imbalances are more likely to occur when populations are reduced (Starfield et al. in press). To the extent that human activity has reduced monk seal populations, such activity may have contributed to the mobbing problem.

The incidence of shark wounds increased in the late 1980s and early 1990s at French Frigate Shoals. However, sharks have been ruled out as the primary cause of the recent decline observed at French Frigate Shoals (Ragen 1993). Poisoning by ciguatoxin or related toxins is suspected as the primary cause of the Laysan die-off in 1978, and may have contributed to the high mortality ofjuvenile seals translocated to Midway Atoll in 1992 and 1993. In the NWHI. the danger of ciguatera poisoning is considered to be greatest at Midway Atoll (Hokama, University of Hawaii, pers. comm.), where nearshore construction and the reshaping of Sand Island may contribute to the probability of dinoflagellate blooms. While virtually all wild monk seals carry parasites after they begin to forage, the role of parasitism in monk seal mortality is unknown. The role of disease is also uncertain, although Banish and Gilmartin (1992) did not find any evidence that infectious disease is impeding the recovery of this species.

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 assumed to be well below its OSP and, since 1985, has been declining at 5% per year. Therefore, this species is characterized as a strategic stock.

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HARBOR PORPOISE *(Phocoena phocoena):* Central California 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 mix freely 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. 1990). A phylogeographic analysis of genetic data from northeast Pacific harbor porpoise did not show complete concordance between DNA sequence types and geographic location (Rose1 1992). However, an AMOVA analysis of the same data with additional samples found significant genetic differences for 4 of the 6 pair-wise comparisons between the four areas investigated: California. Washington, British Columbia, and Alaska (Rose1 et al, in press). These results demonstrate that harbor porpoise along the west coast of North America are not pan-mictic or migratory, and movement is sufficiently restricted that genetic differences have evolved.

In their assessment of harbor porpoise, Barlow and Hanan (in press) recommend that the animals inhabiting central California (defined to be from Point Conception to the Russian River) be treated as a separate stock. The justifications given 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. In addition, recent genetic studies have confirmed that movement on the west coast is limited (Rose1 et al, in press); therefore, harbor porpoise in central California are considered a separate stock. Other Pacific coast Marine Mammal Protection Act (MMPA) stock assessment reports for harbor porpoise include: 1) a northern California stock 2) an Oregon/Washington coastal stock, 3) a Washington inland-waters stock. and 4) an Alaska stock

POPULATION SIZE

Barlow and Forney (1994) reviewed previous estimates of harbor porpoise abundance in central California and presented a new estimate of 4,120 (CV=O.22) based on a series of aerial surveys from 1988 to 1993. This recent estimate is not significantly different from the previous estimate of 3,274 (CV=O.31) but is more precise (owing to the greater number of kilometers surveyed). Both of these estimates only include the region between the coast and the 50-fathom (91m) isobath. Barlow (1988) found that the vast majority of harbor porpoise in California were within this 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). The above abundance estimates are likely to underestimate the total abundance of harbor porpoise by a non-trivial amount.

Minimum Population Estimate

The minimum population estimate for harbor porpoise in central California is taken as the lower 20th percentile of the log-normal distribution of abundance estimated from the 1988-93 aerial surveys (Barlow and Forney 1994) or 3,431.

Current Population Trend

An analysis of a 1986-93 time series of aerial surveys was conducted to examine trends in harbor porpoise abundance in central California (Forney et al. 1991; Forney, in press). After controlling for the effects

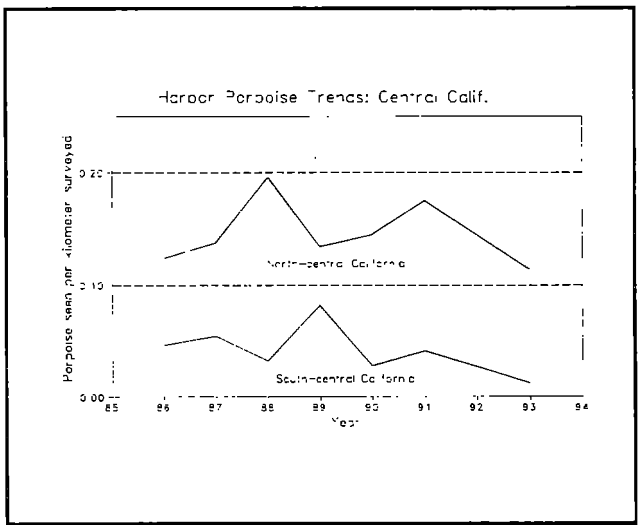

Figure 1: Changes in harbor porpoise abundance from aerial surveys.

of sea state, cloud cover: and area on sighting rates, Forney (in press) found a statistically significant decline in harbor porpoise abundance in central California ($p < 0.1$) (Fig. 1). The decline is most evident in the southern part of central California, between Point Conception and Monterey Bay. She did not find any compensating increase in porpoise abundance in northern California. The decline is somewhat surprising given that fishery mortality has been declining during this same time period (Table 1).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Based on what are argued to be biological limits of the species (ie. 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). [Woodley and Read (199 1) 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 weak.] This maximum theoretical rate may not be achievable for any real population. Population growth rates have not actually been measured for any harbor porpoise population. We therefore conclude that the current and maximum net productivity rates are unknown for the central California population of harbor porpoise.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (3,431) times one half the default maximum net growth rate for cetaceans (l/2 of 4%) times a recovery factor of 0.5 (for a species of unknown status), resulting in a PBR of 34.

ANNUAL HUMAN-CAUSED MORTALITY

Fishery Information

The incidental capture of harbor porpoise is largely limited to set gillnet fisheries in central California (coastal setnets are not allowed in not-them California, and harbor porpoise do not occur in southern California). Set gillnets are used by approximately 134 vessels (J. Cordaro, Southwest Region, NMFS, pers. comm.) to catch halibut, flounder. angel shark, yellowtail, white seabass, and white croaker in California coastal waters (Barlow et al. 1994). Harbor porpoise have been caught in nets set for halibut, flounder, white croaker, and (historically) white seabass (Barlow and Forney 1994). Due in part to area closures, fishing effort in central California has decreased from approximately 10,000 sets per year in the mid-1980s (Hanan et al. 1986) to approximately 400 sets per year in 1993 (calculated from 270 days of effort times 1.6 sets per day, Julian 1994). Harbor porpoise mortality in halibut gillnets has been estimated for the years 1969 through 1993 (Table I) based on direct observation of a subset of gillnet hauls from 1983 to 1993 and an extrapolation to the number of gillnet sets from 1969 to 1982. An increase is seen during this time period to a maximum annual catch of 200-300 porpoise in the late 1970s and early 1980s. The decrease in annual mortality since the mid- 1980s was primarily the result of decreased fishing effort (Perkins et al. 1994). The average 1992 and 1993 mortality rates for these vessels were 0.58 total marine mammals and 0.11 harbor porpoise per fishing day (Julian 1993, 1994). The death of one harbor porpoise was observed during the retrieval of 200 white croaker gillnets in central California in the 1980s which gives a mortality rate of 0.005 porpoise per net (Barlow and Hanan, in press). Total harbor porpoise mortality has not been estimated for the white croaker fishery.

Table I. Estimated annual mortality in central California gillnet fisheries (Barlow and Forney 1994).

Fishing Year	Number Killed
1969/70	28
1970/71	21
1971/72	46
1972/73	62
1973/74	19
1974/75	39
1975/76	77
1976/77	96
1977/78	74
1978/79	124
1979/80	179
1980/81	226
1981/82	283
1982/83	222
1983/84	303
1984/85	226
1985/86	226
1986/87	197
1987/88	34
1988/89	91
1989	92
1990	84
1991	38
1992	44

Fishery Mortality Rates

The average gillnet mortality for the last 3 years (31 porpoise per year) is greater than 10% of the calculated PBR; therefore, the fishery mortality cannot be considered insignificant and approaching zero mortality and serious injury rate. This determination cannot be made for individual fisheries until the implementing regulations for Section 118 of the MMPA have been reviewed by the public and finalized.

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 (in press) calculate the status of harbor porpoise relative to historic carrying capacity (K) using a technique called back-projection. They calculate that the central California population could have been reduced to between 30% and 97% of K by incidental fishing mortality, depending on the choice of input parameters. They conclude that there is no practical way to reduce the range of this estimate. New information does not change this conclusion, and the status of harbor porpoise relative to their Optimum Sustainable Population (OSP) levels in central California must be treated as unknown. The average mortality rate over the last 3 years (3 1) is slightly less than the calculated PBR (34) for central California harbor porpoise; therefore, the central California harbor porpoise population is not "strategic" under the MMPA. The Pacific Scientific Review Group (established by the MMPA) recommended that this stock be considered strategic because it is declining and may be listed as threatened under the Endangered Species Act unless the decline is stopped. Because fishery mortality has declined over the last 10 years and because the decline in the population is likely to be natural, the NMFS does not believe that a strategic status is -justified at this time. Research will continue to monitor the population size and to investigate the possible causes of the decline.

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HARBOR PORPOISE *(Phocoena phocoena):* Northern California 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 mix freely 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. 1990). A phylogeographic analysis of genetic data from northeast Pacific harbor porpoise did not show complete concordance between DNA sequence types and geographic location (Rose1 1992). However, an AMOVA analysis of the same data with additional samples found significant genetic differences for 4 of the 6 pair-wise comparisons between the four areas investigated: California, Washington, British Columbia, and Alaska (Rose1 et al, in press). These results demonstrate that harbor porpoise along the west coast of North America are not pan-mictic or migratory, and movement is sufficiently restricted that genetic differences have evolved.

In their assessment of harbor porpoise. Barlow and Hanan (in press) recommend that the animals inhabiting central California (defined to be from Point Conception to the Russian River) be treated as a separate stock. The justifications given 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. In addition, recent genetic studies have confirmed that movement on the west coast is limited (Rose1 et al. in press); therefore, harbor porpoise in central California are considered a separate stock. Lacking further biological evidence, the Northern California stock was separated from the Oregon/Washington coastal stock based on an application of a precautionary principle: dividing stocks into units that are as small as practicable. This report addresses the harbor porpoise stock in northern California. north of the Russian River. Other Pacific coast Marine Mammal Protection Act (MMPA) stock assessment reports for harbor porpoise include: I) a central California stock 2) an Oregon/Washington coastal stock, 3) a Washington inland-waters stock, and 4) an Alaska stock.

POPULATION SIZE

Barlow and Forney (1994) reviewed previous estimates of harbor porpoise abundance in northern California and presented a new estimate of 9,250 (CV=O.23) based on a series of aerial surveys from 1988 to 1993. This estimate only includes the region between the coast and the 50-fathom (91m) isobath. Barlow (1988) found that the vast majority of harbor porpoise in California were within this depth range; however, Green et al. (1992) found that 24% of harbor porpoise seen during aerial surveys of Oregon and Washington were between the 1OOm and 200m isobaths (55 to 109 fathoms). The above abundance estimates are likely to underestimate the total abundance of harbor porpoise by a non-trivial amount.

Minimum Population Estimate

The minimum population estimate for harbor porpoise in northern California is taken as the lower 20th percentile of the log-normal distribution of abundance estimated from the 1988-93 aerial surveys (Barlow and Forney **1994)** or 7,640.

Current Population Trend

Forney (in press) examines trends in relative harbor porpoise abundance in Northern California based on aerial surveys from 1989-93. No significant trends were evident over this time period.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Based on what are argued to be biological limits of the species (ie. 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). [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 weak.] This maximum theoretical rate may not be achievable for any real population. Population growth rates have not actually been measured for any harbor porpoise population. We therefore conclude that the current and maximum net productivity rates are unknown for the northern California stock of harbor porpoise.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (7,640) times one half the default maximum net growth rate for cetaceans (1/2 of 4%) times a recovery factor of 0.5 (for a species of unknown status), resulting in a PBR of 76.

ANNUAL HUMAN-CAUSED MORTALITY

Fishery Information

The incidental capture of harbor porpoise in California is largely limited to set gillnet fisheries in central California. Coastal setnets are not allowed in not-them California (to protect salmon resources there).

Fishery Mortality Rates

Because there is no known fishery mortality in northern California, the fishery mortality can be considered insignificant and approaching zero mortality and serious injury rate.

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. 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 there is no known human-caused mortality or serious injury, this would not be considered a “strategic” stock under the MMPA.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

In the eastern North Pacific Ocean, harbor porpoises are found coastally from the Bering Strait, Alaska, to central California, occasionally frequenting bays, the mouths of large rivers and at times ascending freshwater streams (Leatherwood and Reeves 1983). Aerial survey data from coastal Oregon and Washington, collected during all seasons, suggests that harbor porpoise distribution varies by depth with 79% occurring at depths less than 50 fathoms, 18% between 50- 100, fathoms and 3% at depths greater than the 100 fathom isobath (Green et al. 1992). Unlike the results summarized by Gaskin (1984) for harbor porpoises in the North Atlantic Ocean, no reliable data on seasonal changes in distribution or abundance are available to make inferences about harbor porpoise movements in the North Pacific. Harbor porpoises are known to occur year around in the inland trans-boundary area of Washington and British Columbia, Canada (Osborne et al. 1988) and along the Oregon/Washington coast (Barlow 1988, et al. 1988, Green et al. 1992).

Using the 1990-91 aerial survey data of Calambokidis et al. (1993b) for water depths < 50 fathoms, Osmek et al. (in press) found significant differences in harbor porpoise mean densities ($z=5.9$, $p<0.01$) between the waters of coastal Oregon/Washington And inland Washington/southern British Columbia, Canada (i.e., Strait of Juan de Fuca/San Juan Islands).

Stock discreteness was analyzed using mitochondrial DNA from samples collected along the west coast (Rose1 1992) and is summarized in Osmek et al. (1994). Two distinct mitochondrial DNA 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 intrinsic mixing rate exists for harbor porpoises along the west coast. No comparisons of genetic differences were made between harbor porpoises of coastal verses inland Washington because the sample size from inland Washington was too small. An AMOVA analysis of the same data with additional samples found significant genetic differences for 4 of the 6 pair-wise comparisons between the four areas investigated: California, Washington, British Columbia, and Alaska (Rose1 et al., in press). These results demonstrate that harbor porpoise along the west coast of North America are not pan-mictic or migratory. and movement is sufficiently restricted that genetic differences have evolved.

Differences in organochlorine pollutant residue (OPR) ratios and concentrations by geographic area indicate that there were increasing CDDE concentrations from north to south for coastal Washington and Oregon (Calambokidis and Barlow 1991, Osmek et al. 1994). Calambokidis and Barlow (199 1) found, through discriminant analysis of OPR ratios, that the state from which the harbor porpoise was collected from could be accurately predicted for 86% of the samples. These observed differences in OPR ratios are suitable for illustrating that harbor porpoise movements on the west coast may be limited, though no stock boundaries are apparent.

Although differences in density exist between coastal Oregon/Washington and inland Washington, a specific stock-boundary line cannot be identified based upon biological differences in Oregon and Washington. Two stocks, 1) Oregon/Washington coast and 2) inland Washington (boundary at Cape Flattery), however, are being designated based primarily, but not entirely, for conservation reasons because harbor porpoise movements and rates of intermixing within the northeast Pacific are restricted and a significant decline in harbor porpoise sightings has occurred within southern Puget Sound since the 1940's. In the future, biological evidence for delineating stocks may come from the analysis of environmental pollutants in tissues, from seasonal movements of individual harbor porpoises or new genetic analytical methods.

POPULATION SIZE

Aerial surveys of the Washington coast, and parts of the southwest Strait of Juan de Fuca, were conducted during summer 1990 (Calambokidis et al. 1991) by flying a saw-tooth design at an altitude of 183 m (600 feet), and speeds of 185 km/hr (100 knots), from shore out to the 50 fathom isobath. During 1991 (Calambokidis et al. 1992) surveys, using the same 1990 methods, were flown over the marine waters of coastal Oregon and coastal/inland Washington. Because the 1990-91 surveys both covered coastal Washington and portions of the western Strait of Juan de Fuca, these data were pooled and used to calculate abundance estimates (Calambokidis et al. 1993b) following the methods described by Buckland et al. (1993). The program DISTANCE (Laake et al. 1993) was used to conduct the analyses. Only effort and sightings made during excellent sighting conditions were used. Effort was used only during Beaufort Wind Scale levels of Force 2 or less and cloud cover of less than 25%. A single estimate of f(0) and of group size was calculated using data from all regions in both years. The correction factor [l/g(0)] of 3.1 and its associated variance (g(o)=O.324, var=0.003) was used to adjust the 1990-91 harbor porpoise sighting data for groups missed by aerial observers (Calambokidis et al. 1993a). The best corrected estimate of abundance for harbor porpoises in coastal Oregon and Washington waters is 26,175 (CV=O.206). This estimate includes animals along the US/Canadian boundary waters and a portion of the southern coastal waters of British Columbia along the Strait of Juan de Fuca.

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock is calculated from equation 1 from the PBR Guidelines (this volume): $N_{MIN} = N/\exp(0.842*[\ln(1+[CV(N)]^2)]^{1/2})$. Using the population estimate (N) of 26,175 and its associated CV of 0.206, N_{MIN} for the Oregon/Washington coastal stock of harbor porpoise is 22,049.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently not available for harbor porpoises. Therefore, until additional data become available? it is recommended that the cetacean maximum theoretical net productivity rate (R_{MAX}) of 4% be employed for harbor porpoises.

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate. and a recovery factor: PBR = N_{MIN} x $0.5R_{MAX}$ x F_R. The recovery factor (F_R) for this stock is 0.5, the value for a cetacean stock with an unknown population status (PBR Guidelines, this volume). Thus. for Oregon/Washington coastal stock of harbor porpoise, PBR = (22,049 x 0.02 x 0.5) or 220 animals (Table 1).

TABLE 1. Corrected abundance estimates (I 990-9 1) and PBRs for harbor porpoises of Oregon and Washington marine waters (<50 fathoms for the Oregon/Washington coast stock)(Osmek et al. in press). The Rmax and Fr values used in the PBR calculations are 0.04 and 0.5, respectively.

Stock (and combined stocks)	Area in nm^2 (% of total)	N	CV(N)	N_{MIN} (% of total)	PBR	Mean takes/year
Oregon/Washington coast	**4,669 (65)**	**26,175**	**0.206**	**22,049 (89)**	**220**	**9**
Inland Washington	2,148 (30)	3,352	0.270	2,680 (11)	27	16

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Within the EEZ boundaries of coastal Oregon and Washington, human-caused (fishery) mortalities are presently known to occur only in northern Washington.

The tribal set gillnet fishery for chinook salmon along the coast of northwest Washington is closely monitored by NMFS observers, thus total estimates of harbor porpoise incidental takes are reliable. NMFS observer program results for 1988-90 (Gearin et al. 1992), 1991 (Gearin et al. 1993), 1992 (Gearin et al. 1994), and 1993 (Osmek et al. in press) are given in Table 2. Incidental take estimates for 1989-93 were derived using catch per unit effort (CPUE) information stratified by sub-area (Gearin et al. 1994) because harbor porpoise mortality varied greatly by location. All but one of the total harbor porpoise incidentally caught in this fishery since 1988 (n=156) were taken along the northern Washington outer coast. Similar fishing gear is used throughout this coastal/inland Washington fisher); (i.e., 7-8 inch (18-20 cm) multi-strand stretched mesh, 100 fathoms (200 m) maximum length, 40-90 meshes (4-9 m) deep). Gearin et al. (1994) reported that 48% of the harbor porpoises (n-males =55 and n-females = 45) collected and necropsied from this fishery during 1988-90 were reproductively immature and < two years in age. The impact of removing 9 animals per year (1990-93 average) with these characteristics from Oregon and Washington waters is unknown.

TABLE 2. NMFS observer program results for the NW Washington set gillnet fishery (northern coastal Washington: Area 4/4A). An incidental take estimate for 1988 would be invalid (*=not estimated) because observer coverage was minimal and not representative of the overall fishery. Several harbor porpoises were known to be incidentally taken in this fishery in 1994 but final results are unavailable.

Descriptioni Year	1988	1989	1990	1991	1992	1993	1990-93 Mean
Total net days fished	1384	483	91	131	4	0	57
Percent net days observed	5.5	42.6	74.7	71	75	0	73
Number of discrete vessels	4	2	2	2	1	0	1
Observed animals taken	22	14	13	13	0	0	7
Not observed but recovered	48	3	0	1	2	0	1
Reported but not recovered	32	5	0	1	0	0	0
Observed, recovered and repot-ted	102	22	13	15	2	0	8
Total estimated incidental takes	*	33	16	19	0	0	9

The total fishery mortality and serious injury for this stock (14) is currently less than 1O% of the calculated PBR (22) and, therefore, can be considered an insignificant rate.

STATUS OF STOCK

The level of human-caused mortality and serious injury (9) does not exceed the PBR (220). thus the Oregon/Washington coast stock of harbor porpoise is not classified as strategic. The status of this stock relative to OSP and population trends are unknown.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

In the eastern North Pacific Ocean: harbor porpoises are found coastally from the Bering Strait, Alaska, to central California, occasionally frequenting bays, the mouths of large rivers and at times ascending freshwater streams (Leatherwood and Reeves 1983). Aerial survey data from coastal Oregon and Washington, collected during all seasons, suggests that harbor porpoise distribution varies by depth with 79% occurring at depths less than 50 fathoms, 18% between 50- 100, fathoms and 3% at depths greater than the 100 fathom isobath (Green et al. 1992). Unlike the results summarized by Gaskin (1984) for harbor porpoises in the North Atlantic Ocean, no reliable data on seasonal changes in distribution or abundance are available to make inferences about harbor porpoise movements in the North Pacific, Harbor porpoises are known to occur year around in the inland trans-boundary area of Washington and British Columbia, Canada (Osborne et al. 1988) and along the 0regon/Washington coast (Barlow 1988, et al. 1988, Green et al. 1992).

Using the 1990-91 aerial survey data of Calambokidis et al. (1993b) for water depths < 50 fathoms, Osmek et al. (in press) found significant differences in harbor porpoise mean densities (z=5.9, p<O.Ol) between the waters of coastal Oregon/Washington and inland Washington/southem British Columbia, Canada (i.e., Strait of Juan de Fuca/San Juan Islands).

Stock discreteness was analyzed using mitochondrial DNA from samples collected along the west coast (Rose1 1992) and is summarized in Osmek et al. (1994). Two distinct mitochondrial DNA 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 intrinsic mixing rate exists for harbor porpoises along the west coast. No comparisons of genetic differences were made between harbor porpoises of coastal verses inland Washington because the sample size from inland Washington was too small. An AMOVA analysis of the same data with additional samples found significant genetic differences for 4 of the 6 pair-wise comparisons between the four areas investigated: California, Washington, British Columbia, and Alaska (Rose1 et al., in press). These results demonstrate that harbor porpoise along the west coast of North America are not pan-mictic or migratory, and movement is sufficiently restricted that genetic differences have evolved.

Differences in organochlorine pollutant residue (OPR) ratios and concentrations by geographic area indicate that there were increasing CDDE concentrations from north to south for coastal Washington and Oregon (Calambokidis and Barlow 199l, Osmek et al. 1994). Calambokidis and Barlow (1991) found, through discriminant analysis of OPR ratios, that the state from which the harbor porpoise was collected from could be accurately predicted for 86% of the samples. These observed differences in OPR ratios are suitable for illustrating that harbor porpoise movements on the west coast may be limited, though no stock boundaries are apparent.

Although differences in density exist between coastal Oregon/Washington and inland Washington, a specific stock-boundary line cannot be identified based upon biological differences in Oregon and Washington. Two stocks, 1) Oregon/Washington coast and 2) inland Washington (boundary at Cape Flattery), however, are being designated based primarily, but not entirely, for conservation reasons because harbor porpoise movements and rates of intermixing within the northeast Pacific are restricted and a significant decline in harbor porpoise sightings has occurred within southern Puget Sound since the 1940’s. In the future, biological evidence for delineating stocks may come from the analysis of environmental pollutants in tissues, from seasonal movements of individual harbor porpoises or new genetic analytical methods.

POPULATION SIZE

Aerial surveys of the Washington coast, and parts of the southwest Strait of Juan de Fuca, were conducted during summer 1990 (Calambokidis et al. 1991) by flying a saw-tooth design at an altitude of 183 m (600 feet), and speeds of 185 km/hr (100 knots), from shore out to the 50 fathom isobath. During 1991 (Calambokidis et al. 1992) surveys, using the same 1990 methods, were flown over the marine waters of coastal Oregon and coastal/inland Washington. Survey track-lines, within inland Washington, were flown from shore to shore covering all depth contours. Because the 1990-91 surveys both covered coastal Washington and portions of the western Strait of Juan de Fuca, these data were pooled and used to calculate abundance estimates (Calambokidis et al. 3993b) following the methods described by Buckland et al. (1993). The program DISTANCE (Laake et al. 1993) was used to conduct the analyses. Only effort and sightings made during excellent sighting conditions were used. Effort was used only during Beaufort Wind Scale levels of Force 2 or less and cloud cover of less than 25%. A single estimate of f(0) and of group size was calculated using data from all regions in both years. The correction factor [l/g(O)] of 3.1 and its associated variance (g(o)=O.324, var=0.003) was used to adjust the 1990-91 harbor porpoise sighting data for groups missed by aerial observers (Calambokidis et al. 1993a). The best corrected estimate of abundance for harbor porpoises of inland Washington waters is 3,352 (CV=O.270). This estimate includes animals along the northern Strait of Juan de Fuca (Canadian waters) and the US/Canadian boundary waters of the San Juan Islands and the adjacent waters of southern British Columbia.

Minimum Population Estimate

The minimum population estimate (N_{MIN} for this stock is calculated from equation I from the PBR Guidelines (this volume): $N_{MIN} = N/\exp(0.842*[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 3,352 and its associated CV of 0.270, N_{MIN} for the inland Washington stock of harbor porpoise is 2.680.

Current Population Trend

There are no reliable data on population trends of harbor porpoises for most waters of Oregon, Washington or British Columbia. In southern Puget Sound, however, harbor porpoises are now rarely observed, a sharp contrast to 1942 when harbor porpoises were considered common there (Scheffer and Slipp 1948). Although quantitative data for this area are lacking, marine mammal survey effort (Everitt et al. 1980). stranding records since the early 1970's (Osmek et al. In prep.) and the results of harbor porpoise surveys of 1991 (Calambokidis et al. 1992) and 1994 (Osmek et al. in prep.) indicate that harbor porpoise abundance has declined in southern Puget Sound. Reasons for the decline are unknown, but it may be related to fishery interactions. pollutants, vessel traffic and other activities that may affect harbor porpoise occurrence and distribution in this area (Osmek et al. in prep.). Research to identifying trends in harbor porpoise abundance is also needed for the other areas within inland Washington.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is not currently available for harbor porpoises. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate (R_{MAX} of 4% be employed for harbor porpoises.

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA): the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = $N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.5, the value for a cetacean stock with an unknown population status (PBR Guidelines, this volume). Thus, for inland Washington stock of harbor porpoise, PBR = (2,680 x 0.02 x 0.5) or 27 animals (Table 1).

TABLE 1. Corrected abundance estimates (1990-91) and PBRs for harbor porpoises of Oregon and Washington marine waters (<50 fathoms for the Oregon/Washington coast stock)(Osmek et al. in press). The Rmax and Fr values used in the PBR calculations are 0.04 and 0.5, respectively.

Stock (and combined stocks)	Area in nm^2 (% of total)	N	CV(N)	Nmin (% of total)	PBR	Mean takes/year
Oregon/Washington coast	4,669 (65)	26,175	0.206	22,049 (89)	220	9
Inland Washington	**2,148 (30)**	**3,352**	**0.270**	**2,680 (11)**	**27**	**16**

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

During 1993 and 1994, the NMFS, in cooperation with the Washington Department of Fish and Wildlife and the Tribes, conducted observer programs to monitor incidental takes of marine mammals in commercial drift-gillnet and purse seine fisheries within inland Washington waters. No mortalities were observed except during the 1994 sockeye-salmon gillnet fishery (August-September) near the San Juan Islands (Area 7/7A) where one harbor porpoise mortality was observed and one was entangled and released alive. Using the one observed harbor porpoise mortality and over 400 observed vessel trips in Area 7/7A, an incidental take estimate of 15 harbor porpoises per year was calculated for this sockeye salmon fishery (Joe Scordino, pers. comm. NW Region, NMFS, 24 February 1995). The coefficient of variation and confidence interval are not yet available for this take estimate. Over 1000 vessels are licensed by the state to fish gillnets within inland Washington waters: and about 500 to 600 actually fish each year. The gillnets used in this sockeye salmon fishery are made of 5-inch (I 3 cm) stretched-mesh monofilament: with a maximum net length of 300 fathoms (600 m) that is fished 150-250 meshes (10- 16 m) deep.

During 1991, a single harbor porpoise was observed taken within the tribal set gillnet fishery for chinook salmon in the western Strait of Juan de Fuca (Area 4B). Similar fishing gear is used throughout this coastal/inland Washington fishery (i.e., 7-8 inch (18-20 cm) multi-strand stretch mesh: 100 fathoms (200 m) maximum length, 40-90 meshes (4-9 m) deep).

The total fishery mortality and serious injury for this stock, 16 (15+ I), exceeds 10% of the calculated PBR (2.7) and, therefore, can be considered a significant rate.

A conservative approach seems appropriate when managing the inland Washington harbor porpoise stock because: 1) the estimated take level constitutes significant mortality and is close to exceeding the PBR (i.e., one additional observed mortality or serious injury in the sockeye drift gillnet fishery would increase the estimated annual take level above the PBR): 2) this is a trans-boundary stock with a minimum population estimate and a PBR that is based on some portion of the harbor porpoises that occupy British Columbia waters but were within the 1991 aerial survey area (see “Population Estimates”, Calambokidis et al. 1993b). and 3) the take rate is based on limited data.

STATUS OF STOCK

The level of human-caused mortality and serious injury (16) does not exceed the PBR (27) thus the inland Washington harbor porpoise stock is not classified as strategic. Because the level of incidental take is based on limited observations, it is recommended that the status of this stock be reviewed during 1996. Data are insufficient to make an OSP determination for this stock.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Dall's porpoise are endemic to temperate waters of the North Pacific Ocean. Off the U.S. west coast, they are commonly seen in shelf, slope and offshore waters (Morejohn 1979; Dohl et al. 1980, 1983; Green et al. 1992, 1993; Carretta and Forney 1993; Mangels and Gerrodette 1994; Barlow 1995). Sighting patterns from recent aerial and shipboard surveys conducted in California, Oregon and Washington at different times (Green et al. 1992, 1993; Mangels and Gerrodette 1994; Forney et al. 1995; Barlow 1995) suggest that north-south movement between these states occurs as oceanographic conditions change, both on seasonal and inter-annual time scales. The southern end of this population's range is not well-documented, but they are commonly seen off Southern California in winter, and during cold-water periods they probably range into Mexican waters off northern Baja California. The stock structure of eastern North Pacific Dall's porpoise is not known but based on patterns of stock differentiation in the western North Pacific, where they have been more intensively studied, it is expected that separate stocks will emerge when data become available (Perrin and Brownell 1994). Although Dali's porpoise are not restricted to U.S. territorial 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, Dali'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.

POPULATION SIZE

Separate surveys have been conducted during different years off California and Oregon/Washington (Green et al. 1992, 1993; Mangels and Gerrodette 1994; Barlow l995), but because animals are likely to have moved from one region to another between surveys, the different estimates cannot be added to produce a total estimate. Forney (1994) reviews recent abundance estimates for Dall's porpoise along the U.S. west coast and concludes that the best estimate of overall population size in California, Oregon and Washington is the estimate of 78,422 Dall's porpoise (C.V. = 0.35) obtained from the ship survey conducted off California during summer/fall 1991 (Barlow 1995).

Minimum Population Estimate

The log-normal 20th percentile of the above abundance estimate is 58,902 Dall's porpoise.

Current Population Trend

No information is available regarding trends in abundance of Dall's porpoise in California, Oregon and Washington.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Based on this stock's unknown status and growth rate, the recovery factor (F,) is 0.5, and $1/2R_{max}$, is the default value of 0.02. Multiplying these two values times the minimum population estimate of 58,902 yields a potential biological removal (PBR) of 589 Dali's porpoise per year.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Dali's porpoise are incidentally killed in drift gillnets, which have been used to catch swordfish, thresher shark, and mako shark in offshore California, Oregon and Washington waters (Hanan et al. 1993), with approximately 149 vessels currently active (J. Cordaro, Southwest Region, NMFS, pers. comm.). Fishing effort has decreased from approximately 10,000 sets per year in the mid-1980s to 6600 in 1993 (Barlow et al. 1994). Based on less than 1% observer coverage of fishing effort between 1980 and 1985, no Dali's porpoise were reported killed (Diamond et al.

1987). Between July 1990 and December 1993, with approximately 4-13% observer coverage of California drift gillnet fisheries, observed mortality of Dall's porpoise was one in 1990, two in 1991, one in 1992, and nine in 1993, resulting in annual mortality estimates of 23 (s.e. 22) for July-December 1990, 17 (s.e. 13) for 1991, 8 (s.e. 7) for 1992, and 82 (s.e. 36) for 1993 (Lennert et al. 1994; Perkins et al. 1992; Julian 1993, 1994). The corresponding average rates of Dali's porpoise kill per fishing day are 0.006, 0.004. 0.002, and 0.012 for 1990, 1991 1992 and 1993, respectively. Preliminary mortality data for 1994 indicate that two Dall's porpoise were observed killed (NMFS, unpublished data). The average estimated annual mortality for Dali's porpoise in this fishery for the three complete years of monitoring, 1991-93, is 36 animals.

Similar drift gillnet fisheries for swordfish and sharks exist along the entire Pacific coast of Baja California. Mexico and may take some Dall's porpoise from the same population during cold-water periods. 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 1990-93 (0. 15 marine mammals per set), but species-specific information is not available for the Mexican fisheries.

Based on logbook data or low levels of observer coverage, additional mortality of Dall's porpoise is known to occur in the following three fisheries (NMFS. unpublished data): (1) the California/Oregon Washington groundfish trawl fisheries, for which approximately 585 permits have been issued, (2) the California salmon troll fishery, which had about 1,100 active permit holders in 1994, and (3) the Washington Puget Sound salmon set and drift gillnet fishery, which has approximately 3900 participants and is active from about May to September. Due to the uncertainties in these data sources, however, no estimate of overall mortality can be made for these fisheries.

An experimental gillnet fishery for thresher shark off Oregon and Washington in 1986-89 also reported mortality of Dall's porpoise; however, this fishery was discontinued after 1989 due to the high rates of marine mammal and turtle bycatch (Stick and Hreha, 1989).

Fishery Mortality Rate

The total fishery mortality and serious injury for this stock durin g 1991-93 (36 animals per year) is less than 10% of the calculated PBR and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate. This determination cannot be made for individual fisheries until the implementing regulations for Section 118 of the MMPA have been reviewed by the public and finalized.

STATUS OF STOCK

The status of Dall's porpoise in California, Oregon and Washington relative to OSP is not known, and there are insufficient data to evaluate potential trends in abundance. They are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. Because the average annual human-caused mortality is estimated to be less than the PBR, they are not classified as a "strategic" stock under the MMPA.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Pacific white-sided dolphins are endemic to temperate waters of the North Pacific Ocean: and are common both on the high seas and along the continental margins. Off the U.S. west coast, Pacific white-sided dolphins have been seen primarily in shelf and slope waters (Dohl et al. 1980, 1983; Green et al. 1992, 1993; Carretta and Forney 1993; Mangels and Gerrodette 1994: Barlow 1995). Sighting patterns from recent aerial and shipboard surveys conducted in California, Oregon and Washington at different times of the year (Green et al. 1992, 1993; 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).

Stock structure throughout the North Pacific is poorly understood, but based on morphological evidence? hvo 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 33ºN, (Southern California to Alaska), and southern specimens were obtained from about 36ºN southward along the coasts of California and Baja California. Samples of both forms have been collected in the Southern California Bight, but it is unclear whether this indicates sympatry in this region or whether they may occur there at different times (seasonally or interannually). Recent preliminary genetic analyses have confirmed the distinctness of animals found off Baja California from animals occurring in U.S. waters (NMFS, unpublished data). Based on these genetic data, the current boundary between the two forms appears to be south of U.S. waters. but there is evidence that this boundary is dynamic, as both forms have occurred in U.S. waters in the past (Walker et al. 1986).

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

Forney (1994) reviews recent abundance estimates for Pacific white-sided dolphins along the U.S. west coast and concludes that the best estimate of overall population size in California, Oregon and Washington is the estimate obtained from aerial surveys conducted off California during winter/spring of 1991 and 1992 (Forney et al. 1995). Because of the observed seasonal shifts in distribution, this estimate of 121,693 animals (C.V. = 0.48) is expected to include animals which may be found off Oregon and Washington in the summer/fall.

Minimum Population Estimate

The log-normal 20th percentile of the above abundance estimate is 82,939 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).

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

Based on this stock's unknown status and growth rate, the recovery factor (F,) is 0.5, and $1/2R_{max}$ is the default value of 0.02. Multiplying these two values times the minimum population estimate of 82,939 yields a potential biological removal (PBR) of 829 Pacific white-sided dolphins per year.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Pacific white-sided dolphins are incidentally killed in California drift gillnet fisheries, which have been used to catch swordfish, thresher shark, and mako shark in offshore California, Oregon and Washington waters (Hanan et al. 1993), with approximately 149 vessels currently active (J. Cordaro, Southwest Region, NMFS, pers. comm.). Fishing effort has decreased from approximately 10,000 sets per year in the mid-1980s to 6600 in 1993 (Barlow et al. 1994). Based on less than 1% observer coverage of fishing effort between 1980 and 1985, Diamond et al. (1987) report a single take of this species, which can be extrapolated to yield a rough estimate of total mortality of 110 animals, or approximately 18 per year. Between July 1990 and December 1993, with approximately 4- 13% observer coverage of California drift gillnet fisheries, observed mortality of Pacific white-sided dolphins was three in 1990, five in 1991. three in 1992, and two in 1993, resulting in annual mortality estimates of 68 (s.e. 38) for 1990, 42 (s.e. 30) for 1991, 23 (s.e. 16) for 1992, and 18 (s.e. 12) for 1993 (Lennert et al. 1994; Perkins et al. 1992; Julian 1993, 1994). The corresponding rates of Pacific white-sided dolphin kill per fishing day are 0.0 17,0.009, 0.005, and 0.003 for 1990, 1991 1992 and 1993, respectively. Preliminary mortality data for 1994 indicate that three Pacific white-sided dolphins were observed killed (NMFS, unpublished data). The average estimated annual mortality for Pacific white-sided dolphins in this fishery for the three complete years of monitoring, 1991-93, is 28 animals.

Similar drift gillnet fisheries for swordfish and sharks exist along the entire Pacific coast of Baja California, Mexico and probably take the southern form of this species. 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 1990-93 (0.15 marine mammals per set), but species-specific information is not available for the Mexican fisheries.

An experimental gillnet fishery for thresher shark off Oregon and Washington in 1986-89 also reported mortality of Pacific white-sided dolphins; however, this fishery was discontinued after 1989 due to the high rates of marine mammal and turtle bycatch (Stick and Hreha, 1989).

Fishery Mortality Rate

The total fishery mortality and serious injury for this stock during 1991-93 (28 animals per year) is less than 10% of the calculated PBR and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate. This determination cannot be made for individual fisheries until the implementing regulations for Section 118 of the MMPA have been reviewed by the public and finalized.

Other removals

Additional removals of Pacific white-sided dolphins from the wild have occurred in live-capture fisheries off California. Brownell et al. (in press) 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. They are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. They are not classified as a "strategic" stock under the MMPA, because the average annual human-caused mortality is estimated to be less than the PBR.

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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 (Green et al. 1992, 1993; Forney et al. 1995; Barlow 1995): animals found off California during the colder water months are thought to shift northward into Oregon and Washington as water temperatures increase in late spring and summer (Green et al. 1992). The southern end of this population's range is not well-documented, but on a recent joint U.S./Mexican ship survey: Risso's dolphins were sighted off northern Baja California, and a conspicuous 500 nmi gap was present between these animals and Risso's dolphins sighted south of Baja California and in the Gulf of California (Mangels and Gerrodette 1994). Thus this population appears distinct from animals found in the eastern tropical Pacific and the Gulf of California. Although Risso's dolphins are not restricted to U.S. waters. cooperative management agreements with Mexico exist only for the tuna purse seine fishery and not for other fisheries which may take this species (e.g. gillnet fisheries). For the Marine Mammal Protection Act (MMPA) stock assessment reports, Risso's dolphins within the Pacific U.S. Exclusive Economic Zone are divided into two discrete, non-contiguous areas: I) waters off California, Oregon and Washington (this report), and 2) Hawaiian waters.

POPULATION SIZE

Forney (1994) reviews recent abundance estimates for Risso's dolphins along the U.S. west coast and concludes that the best estimate of overall population size in California, Oregon and Washington is the estimate obtained from aerial surveys conducted off California during winter/spring of 1991 and 1992 (Forney et al. 1995). Because of the observed seasonal shifts in distribution, this estimate of 32,376 animals (C.V. = 0.46) is expected to include animals which may be found off Oregon and Washington in the summer/fall.

Minimum Population Estimate

The log-normal 20th percentile of the above abundance estimate is 22:388 Risso's dolphins.

Current Population Trend

Although sighting records of Risso's dolphins appear to have increased during the last two decades in some areas off the U.S. West coast (Green et al. 1992, 1993; Shane 1994), sampling effort has also increased, and there are no statistical estimates of historical abundance on which to base a quantitative comparison. Thus, it is possible that Risso's dolphin abundance off the U.S. West coast has increased, but no definitive statement regarding trends in abundance of Risso's dolphins off California, Oregon and Washington can be made.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No information on current or maximum net productivity rates is available for Risso's dolphins in California.

POTENTIAL BIOLOGICAL REMOVAL

Based on this stock's unknown status and growth rate, the recovery factor (F,) is 0.5, and $1/2R_{max}$ is the default value of 0.02. Multiplying these two values times the minimum population estimate of 22,388 yields a potential biological removal (PBR) of 224 Risso's dolphins per year.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Risso's dolphins are incidentally killed in drift gillnets, which have been used to catch swordfish, thresher shark, and mako shark in offshore California, Oregon and Washington waters (Hanan et al. 1993). with approximately 149 vessels currently active (J. Cordaro, Southwest Region: NMFS, pers. comm.). Fishing effort has decreased from approximately 10,000 sets per year in the mid-1980s to 6600 in 1993 (Barlow et al. 1994). Between July 1990 and December 1993. with approximately 4- 13% observer coverage of California drift gillnet fisheries, observed mortality of Risso's dolphins was zero in 1990, five in 1991, five in 1992, and four in 1993, resulting in annual mortality estimates of zero for 1990, 42 (s.e. 24) for 1991, 38 (s.e. 18) for 1992, and 36 (s.e. 27) for 1993 (Lennert et al. 1994; Perkins et al. 1992; Julian 1993, 1994). The corresponding average rates of Risso's dolphin kill per fishing day are 0, 0.009, 0.008, and 0.005 for 1990, 1991, 1992 and 1993, respectively. Preliminary mortality data for 1994 indicate that one Risso's dolphin was observed killed (NMFS, unpublished data). The average estimated annual mortality for Risso's dolphins in this fishery for the three complete years of monitoring, 1991-93, is 39 animals.

Similar drift gillnet fisheries for swordfish and sharks exist along the entire Pacific coast of Baja California. Mexico and may probably take animals from the same 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 1990-93 (0.15 marine mammals per set), but species-specific information is not available for the Mexican fisheries.

Additional mortality of unknown extent has been documented for Risso's dolphins in the squid purse seine fishery off Southern California (Heyning et al. 1994), which currently includes approximately 145 vessels (NMFS, unpublished data). This mortality probably represents 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.

An experimental gillnet fishery for thresher shark off Oregon and Washington in 1986-89 also reported mortality of Risso's dolphins; however, this fishery was discontinued after 1989 due to the high rates of marine mammal and turtle bycatch (Stick and Hreha, 1989).

Fishery Mortality Rate

The total fishery mortality and serious injury for this stock during 1991-93 (39 animals per year) is greater than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. This determination cannot be made for individual fisheries until the implementing regulations for Section 118 of the MMPA have been reviewed by the public and finalized.

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. 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 is estimated to be less than the PBR, so they are not classified as a "strategic" stock under the MMPA.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bottlenose dolphins are distributed world-wide in tropical and warm-temperate waters. In many regions, including California, separate coastal and offshore populations are known (Walker 1981; Ross and Cockcroft 1990; Van Waerebeek et al. 1990). California coastal bottlenose dolphins are found within about one kilometer of shore (Hansen 1990; NMFS unpublished data) primarily from Point Conception south into Mexican waters, at least as far as Ensenada. 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 (Defran et al. 1986; Hansen 1990), and monthly counts based on surveys between the U.S./Mexican border and Point Conception are variable (NMFS, unpublished data), indicating that animals are probably moving into and out of this area. Although coastal bottlenose dolphins are not restricted to U.S. waters, cooperative management agreements with Mexico exist only for the tuna purse seine fishery and not for other fisheries which may take this species (e.g. gillnet fisheries). Therefore, the management stock includes only animals found within U.S. waters. For the Marine Mammal Protection Act (MMPA) stock assessment reports, bottlenose dolphins within the Pacific U.S. Exclusive Economic Zone are divided into three stocks: 1) California coastal stock (this report), 2) California. Oregon and Washington offshore stock, and 3) Hawaiian stock.

POPULATION SIZE

Forney (1994) reviews recent abundance estimates for coastal bottlenose dolphins in Californian waters, and concludes that the best abundance estimate is the combined count of 245 animals obtained on October 25,1991 based on aerial surveys in Southern California (Pt. Conception to the U.S./Mexican border; NMFS, unpublished data) and a shipboard photo-identification survey in Monterey Bay (Maldini 1992). This count is probably an underestimate of the total population size? because submerged animals may be missed on aerial surveys, and because north of Point Conception, regions other than Monterey Bay were not surveyed. Furthermore, oceanographic events appear to influence the distribution of animals along the coasts of California and Baja California, 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). Therefore, the number of animals which use the California coastline over a longer time period is likely to be greater than the count at any given time. However, without recent quantitative data on the extent of such movement, the maximum observed number of coastal bottlenose dolphins (245) currently represents the best estimate of population size.

Minimum Population Estimate

The minimum population estimate for coastal bottlenose dolphins in California is the count of 245 animals from the above October 1991 surveys.

Current Population Trend

No trend in abundance of coastal bottlenose dolphins is apparent based on the available data.

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

Based on this stock's unknown status and growth rate, the recovery factor (F,) is 0.5, and $1/2R_{max}$ is the default value of 0.02. Multiplying these two values times the minimum population estimate of 245 yields a potential biological removal (PBR) of 2.5 animals per year.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Due to the strictly coastal habits of this bottlenose dolphin population, it is susceptible to fishery-related mortality in coastal set net fisheries. Set gillnets are used by approximately 134 vessels (J. Cordaro, Southwest Region, NMFS, pers. comm.) to catch halibut, flounder, angel shark? yellowtail, white seabass. and white croaker in California coastal waters. As a result of area closures, fishing effort has decreased from approximately 40,000 sets per year in the mid-1980s to 16,000 sets in 1993 (Barlow et al. 1994). Although effort data for 1994 are still incomplete, effort appears to have decreased as a result of new ban on fishing within 3 nmi of shore in Southern California. Between July 1990 and December 1993, with approximately 5- 15% of California set gillnet fisheries observed, no coastal bottlenose dolphins were recorded killed (Lennert et al. 1994; Perkins et al. 1992; Julian 1993, 1994). Preliminary mortality data for 1994 indicate that no bottlenose dolphins were observed killed (NMFS, unpublished data). Although this does not prove that no animals were taken (because observer coverage was not 100%) it does indicate that mortality (if it occurred) was probably only a few individuals per year. Heyning et al. (1994) report that four bottlenose dolphins stranded with evidence of fishery interactions between 1975 and 1990, but the stock identity of these animals and the responsible fishery are not known. Beginning in 1994, California set gillnet fisheries are no longer expected to overlap with the range of coastal bottlenose dolphins? because they have been banned from nearshore areas. However, coastal gillnet fisheries exist in Mexico and probably take animals from this population, but no details are available for these fisheries.

Other removals

Seven coastal bottlenose dolphins were collected during the late 1950s in the vicinity of San Diego morris 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.

Pollutant levels, especially DDT residues, found in Southern California coastal bottlenose dolphins have been found to be 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).

Fishery Mortality Rate

The total fishery mortality and serious injury for this stock can be considered to be insignificant and approaching zero? because no recent fishery takes have been reported. However, the observed take of a single animal would result in a mortality rate exceeding 10% of the PBR, and therefore this evaluation is tenuous.

STATUS OF STOCK

The status of coastal bottlenose dolphins in California relative to OSP is not known, and there is no evidence of a trend in abundance. They are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. Because no recent fishery takes have been documented, coastal bottlenose dolphins are not classified as a "strategic" stock under the MMPA.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bottlenose dolphins are distributed world-wide in tropical and warm-temperate waters. In many regions, including California, separate coastal and offshore populations are known (Walker 1981; Ross and Cockcroft 1990; Van Waerebeek et al. 1990). On surveys conducted off California: offshore bottlenose dolphins have been found in the Southern California Bight and in offshore waters as far north as about 4l°N (Hill and Barlow 1992; Carretta and Fomey 1993; Mangels and Gerrodette 1994). 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 199l-92 (Forney et al. 1995) and shipboard surveys conducted in summer/fall 1991 (Barlow 1995), no seasonality in distribution is apparent. Although offshore bottlenose dolphins are not restricted to U.S. waters, cooperative management agreements with Mexico exist only for the tuna purse seine fishery and not for other fisheries which may take this species (e.g. gillnet fisheries). Therefore, the management stock includes only animals found within U.S. waters. For the Marine Mammal Protection Act (MMPA) stock assessment reports, bottlenose dolphins within the Pacific U.S. Exclusive Economic Zone are divided into three stocks: I) California coastal stock (this report), 2) California, Oregon and Washington offshore stock. and 3) Hawaiian stock.

POPULATION SIZE

Formey (I 994) reviews recent abundance estimates for offshore bottlenose dolphins in Californian waters, and concludes that the best abundance estimate is a weighted average of estimates obtained from the 199l-92 aerial surveys (Forney et al. 1995) and the 1991 shipboard surveys (Barlow 1995). This estimate is 2:382 (C.V. = 0.36) offshore bottlenose dolphins.

Minimum Population Estimate

The minimum population estimate for offshore bottlenose dolphins in California (defined as the log-normal 20th percentile of the above abundance estimate) is 1,775 animals.

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

Based on this stock's unknown status and growth rate. the recovery factor (F,) is 0.5, and $1/2R_{max}$ is the default value of 0.02. Multiplying these two values times the minimum population estimate of 1,775 yields a potential biological removal (PBR) of 18 animals per year.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Offshore bottlenose dolphins are incidentally killed in drift gillnet fisheries, which have been used to catch swordfish, thresher shark, and mako shark in offshore California: Oregon and Washington waters (Hanan et al. 1993), with approximately 149 vessels currently active (J. Cordaro, Southwest Region. NMFS, pers. comm.). Fishing effort has decreased from approximately 10,000 sets per year in the mid- 1980s to 6600 in 1993 (Barlow et al. 1994). Based on less than 1% observer coverage of fishing effort between 1980 and 1985, no bottlenose dolphins were reported killed (Diamond et al. 1987). Between July 1990 and December 1993, with approximately 4-13% of California drift gillnet fisheries observed, three offshore bottlenose dolphins were recorded killed in driftnets in 1992, resulting in annual mortality estimates of zero for 1990, 1991 and 1993, and 23 (s.e. 21) for 1992 (Lennert et al. 1994; Perkins et al. 1992;

Julian 1993, 1994). Corresponding average rates of kill per fishing day are zero in 1990, 1991 and 1993, and 0.005 in 1992. Preliminary mortality data for 1994 indicate that no bottlenose dolphins were observed killed (NMFS, unpublished data). The average estimated annual mortality for offshore bottlenose dolphins in this fishery for the three complete years of monitoring, 1991-93, is 7.7 animals.

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, 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 1990-93 (0. I5 marine mammals per set), but species-specific information is not available for the Mexican fisheries.

Based on logbook data for 1990-92, one additional mortality of an offshore bottlenose dolphin was documented in the California anchovy, mackerel and tuna purse seine fishery, which includes approximately 150 vessels (NMFS, unpublished data). Thus the minimum mortality for this period is 0.33 animals per year; however, due to the uncertainties in this data source, no estimate of total mortality can be made for this fisheries.

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? which currently includes approximately 145 vessels (NMFS, unpublished data). 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.

Fishery Mortality Rate

The total fishery mortality and serious injury for this stock during 1991-93 (7.7 animals per year) is greater than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. This determination cannot be made for individual fisheries until the implementing regulations for Section 118 of the MMPA have been reviewed by the public and finalized.

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. They are not listed as “threatened” or “endangered” under the Endangered Species Act nor as “depleted” under the MMPA. Because the average annual human-caused mortality is estimated to be less than the PBR, they are not classified as a “strategic” stock under the MMPA.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Striped dolphins are distributed world-wide in tropical and warm-temperate pelagic waters. On recent shipboard surveys extending about 300 nmi offshore of California, they were sighted within about 100-300 nmi from the coast (Barlow 1995; Mangels and Gerrodette 1994). 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 summedfall 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.

POPULATION SIZE

Barlow (1995) estimates a population size of 19,008 (C.V. = 0.41) for striped dolphins off California, based on the 1991 summer/fall ship survey extending 300 nmi offshore.

Minimum Population Estimate

The minimum population estimate for striped dolphins in California (defined as the log-normal 20th percentile of the above abundance estimate) is 13,639 animals.

Current Population Trend

Prior to the 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.

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

Based on this stock's unknown status and growth rate, the recovery factor (F,) is 0.5, and $1/2R_{max}$ is the default value of 0.02. Multiplying these two values times the minimum population estimate of 13,639 yields a potential biological removal (PBR) of 136 animals per year.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Striped dolphins are susceptible to mortality in drift gillnets, which have been used to catch swordfish, thresher shark. and mako shark in offshore California, Oregon and Washington waters (Hanan et al. 1993), with approximately 149 vessels currently active (J. Cordaro, Southwest Region, NMFS, pers. comm.). Fishing effort has decreased from approximately 10,000 sets per year in the mid- 1980s to 6600 in 1993 (Barlow et al. 1994). Striped dolphin mortality in this fishery is likely to be rare, because the majority of fishing effort has occurred within about 150nm of the coastline

(NMFS, unpublished data), whereas striped dolphins primarily are found farther offshore (Barlow 1995). No takes of striped dolphins were documented by observers in this gillnet fishery from 1980-85 (based on less than 1% observer coverage; Diamond et al. 1987), or from July 1990 to December 1993. when 4- 13% of all sets were monitored (Lennert et al. 1994; Perkins et al. 1992; Julian 1993, 1994). Preliminary mortality data for 1994 indicate that one striped dolphin was observed killed (NMFS, unpublished data). Thus some mortality of striped dolphins does occur in this fishery, but levels appear to be low, on the order of a few animals per year.

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 fishey, 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 1990-93 (0. 15 marine mammals per set), but species-specific information is nor available for the Mexican fisheries.

Fishery Mortality Rate

The total fishery mortality and serious injury for this stock can be considered to be insignificant and approaching zero. because no striped dolphins were observed killed in 199l-93. The observed take of a single animal in 1994 is not expected to change this conclusion, because the average annual mortality estimate will remain below 10% of the total PBR.

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. They are not listed as “threatened” or “endangered” under the Endangered Species Act nor as “depleted” under the MMPA. Because of the low levels of observed human-caused mortality, they are not classified as a “strategic” stock as defined by the MMPA.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Short-beaked common dolphins are the most abundant cetacean off California, and are widely distributed between the coast and at least 300 nmi distance from shore. The abundance of this species off California has been shown to change on both seasonal and inter-annual time scales (Dohl et al. 1986; Barlow 1995; Forney et al. 1995). Historically, they were reported primarily south of Pt. Conception (Dohl et al. 1986), but on recent (199l/93) summer/fall surveys, they were commonly sighted as far north as 42°N (Barlow 1995; Mangels and Gerrodette 1994). Four strandings of common dolphins have been reported in Oregon and Washington since 1942 (B. Norberg, pers. comm.). Of these, three were not identified to the species level, and one animal, which stranded in 1983, was identified as a short-beaked common dolphin (J. Hodder, pers. comm.). Winter/spring surveys in 1991-92 did not result in any sightings of common dolphins north of Point Conception (Carretta and Forney 1993) suggesting seasonal north-south movements of this species. Their distribution is continuous southward into Mexican waters to about 13°N (Perrin et al. 1985; Wade and Gerrodette 1994; 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 (Pen-in 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 (Heynin g and Perrin 1994; Rose1 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.

POPULATION SIZE

Aerial line transect surveys conducted in winter/spring of 1991-92 resulted only in a combined abundance estimate of 305.694 (C.V. = 0.34) animals for short-beaked and long-beaked common dolphins, because species-level identification was not possible from the air (Forney et al. 3995). Based on sighting locations, the majority of these were probably short-beaked common dolphins. Currently: the best abundance estimate is 225,821 (C.V. = 0.28) short-beaked common dolphins, based on a summedfall 1991 shipboard line transect survey (Barlow 1995).

Minimum Population Estimate

The log-normal 20th percentile of the above abundance estimate is 179. 185 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). Although the recent 199l-92 surveys did not reveal any seasonal differences (Barlow 1995; Formey et al. 1995). both surveys resulted in overall abundance estimates (for both types of common dolphins combined) which were considerably greater than historical estimates (Dohl et al. 1986). This suggests a long-term increase in common dolphin abundance during this period of gradual warning of the waters off California (Roemmich 1992). The majority of this increase reflects an increase in the abundance of short-beaked common dolphins. Heyning and Perrin (1994) have detected changes in the proportion of short-beaked to long-beaked common dolphins stranding along the California coast, with the short-beaked common dolphin stranding more frequently prior to the 1982-83 El Niño (which increased water temperatures off California)? and the long-beaked common dolphin more commonly observed for several years afterwards. Thus, it appears that both relative and absolute 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

Based on this stock's unknown status, the recovery factor (F,) is 0.5. Multiplying this times the default annual growth rate ($1/2R_{max}$) of 0.02 and the minimum abundance estimate of 179, 185 yields a potential biological removal (PBR) of 1,792 short-beaked common dolphins per year.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Short-beaked common dolphins are killed incidentally in drift gillnets, which have been used to catch swordfish, thresher shark. and mako shark in offshore California, Oregon and Washington waters (Hanan et al. 1993), with approximately 149 vessels currently active (J. Cordaro, Southwest Region, NMFS, pers. comm.). Fishing effort has decreased from approximately 10,000 sets per year in the mid- 1980s to 6600 in 1993 (Barlow et al. 1994). Between July 1990 and December 1993, with approximately 4-15% of California drift and set gillnet fisheries observed, 128 common dolphins were recorded killed in driftnets, without distinction between short-beaked and long-beaked types. Total mortality estimates for both types of common dolphins are 203 (se. 82) for July-December 1990; 373 (s.e. 73) for 1991; 356 (s.e. 66) for 1992, and 253 (s.e. 69) for 1993 (Lennert et al. 1994; Perkins et al. 1992; Julian 1993? 1994). Corresponding average rates of kill per fishing day are 0.05,0.08,0.08, and 0.03, for 1990, 1991 1992 and 1993, respectively. Preliminary mortality data for 1994 indicate that 1O short-beaked common dolphins and 17 unidentified common dolphins were observed killed. Based on the locations of the takes for 1990-93 (Figure 1). it is likely that most of the killed animals were short-beaked common dolphins. This is supported by the recent examination of some of the biological samples, which resulted in the identification of 36 short-beaked and two long-beaked common dolphins (NMFS, unpublished data). Assuming there is no bias in the likelihood of being able to identify the two species, the proportion of short-beaked common dolphins in the total number identified (36/38 = 0.947) can be used to prorate the total common dolphin mortality. yielding total estimates of 192, 353, 337, and 240 short-beaked common dolphins for this fishery in 1990, 1991, 1992 and 1993, respectively. The average estimated annual mortality for short-beaked common dolphins in this fishery for the three complete years of monitoring, 1991-93, is 3 IO animals.

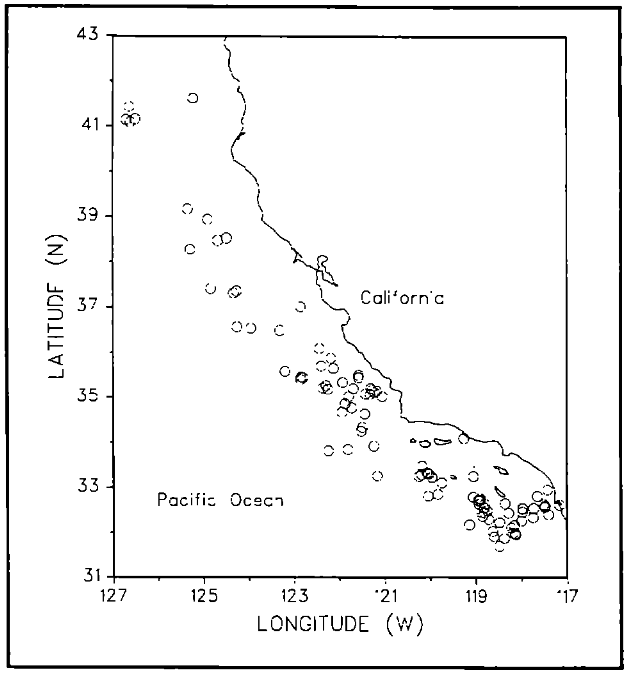

Figure 1. Locations of all observed common dolphin takes in California set and drift gillnet fisheries, 1990-93.

Additional common dolphin mortality has been reported for set gillnets, which are used by approximately I34 vessels (J. Cordaro, Southwest Region, NMFS, pers. comm.) to catch halibut, flounder, angel shark, yellowtail, white seabass, and white croaker in California coastal waters. As a result of area closures, fishing effort has decreased from approximately 40,000 sets per year in the mid-1980s to 16,000 sets in 1993 (Barlow et al. 1994), and is expected to continue to decrease because of a 1994 ban on fishing within 3 nmi of shore in Southern California. An observation program has monitored 5-15% of all sets in halibut and angel shark fisheries from 1990-1993, yielding no common dolphins observed killed in 1990, 1991 and 1993, and 2 observed killed in 1992. Total estimated annual common dolphin mortality for this fishery is zero for 1990, 1991 and 1993, and I7 (s.e. 11) for 1992. Corresponding average rates of common dolphin kill per fishing day are zero in 1990, 1991 and 1993: and 0.004 in 1992. The average estimated annual mortality for common dolphins (type not specified) in this fishery for the three complete years of monitoring, 1991-93, is six animals.

Similar drift and set gillnet fisheries exist along the entire Pacific coast of Baja California, Mexico and probably take short-beaked common dolphins from the same 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 1990-93 (0.15 marine mammals per set), but species-specific information is not available for the Mexican fisheries.

Fishery Mortality Rate

The total fishery mortality and serious injury for short-beaked common dolphins during 1991-93 (3 10-316 animals per year, depending on species composition of the set net kill) is greater than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. This determination cannot be made for individual fisheries until the implementing regulations for Section 118 of the MMPA have been reviewed by the public and finalized.

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 1990 and 1994, annual mortality of northern common dolphins (potentially including both short-beaked and long-beaked common dolphins) ranged between 81 and 1,773 animals. with an average of 564 (Hall and Boyer 1992; Hall and Lennert 1993, 1994, 1995; Lennert and Hall 1994). 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 over the last decade probably reflects a distributional shift (Anganuzzi et al. 1993; Barlow 1995, Forney et al. 1995), rather than an overall population increase due to growth. They are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. The average total estimated mortality for this species is lower than the PBR, so they are not a "strategic" stock under the MMPA.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Long-beaked common dolphins have only recently been recognized as a distinct species (Heyning and Perrin 1994; Rose1 et al. 1994). Along the U.S. west coast, their distribution overlaps with that of the short-beaked common dolphin: and much historical information has not distinguished between these two species. Long-beaked common dolphins are commonly found within about 50 nmi of the coast, from Baja California (including the Gulf of California) northward to about central California (Figure 1). Stranding data and sighting records indicate that the relative abundance of this species off California changes both seasonally and inter-annually, with highest densities observed during warm-water events (Heyning and Perrin 1994). Although long-beaked common dolphins are not restricted to U.S. waters, cooperative management agreements with Mexico exist only for the tuna purse seine fishery and not for other fisheries which may take this species (e.g. gillnet fisheries). Under the Marine Mammal Protection Act (MMPA): long-beaked ("Baja neritic") common dolphins involved in eastern tropical Pacific tuna fisheries are managed separately as part of the 'northern common dolphin' stock (Perrin et al. 1985), and these animals are not included in the assessment reports. For the MMPA stock assessment reports, there is a single Pacific management stock including only animals found within the U.S. Exclusive Economic Zone of California.

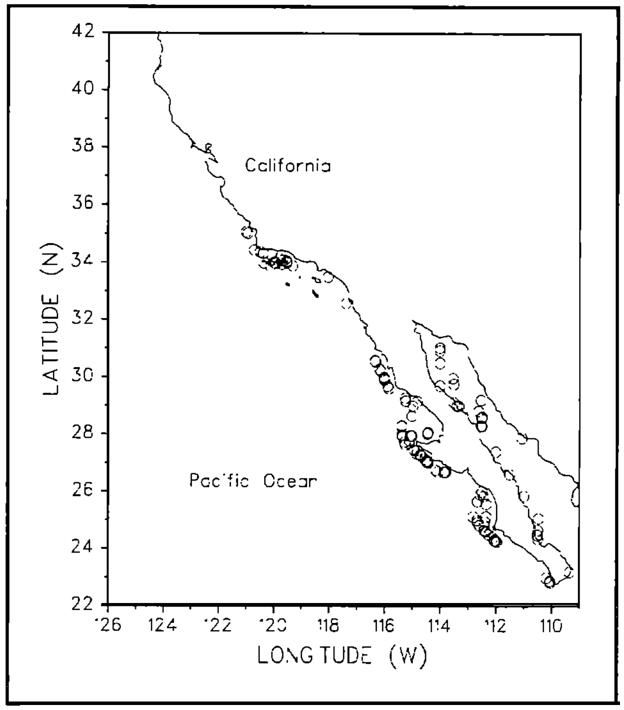

Figure 1. Long-beaked common dolphin sightings based on 199l-93 shipboard surveys within 300 nmi of the California and Baja California coastline (Hill and Barlow 1992; Mangels and Gerrodette 1994).

POPULATION SIZE

Aerial line transect surveys conducted in winter and spring of 1991 and 1992 resulted only in a combined abundance estimate of 305.694 (C.V. = 0.34) long-beaked and short-beaked common dolphins, because species-level identification was not possible from the air (Forney et al. 1995). Based on sighting locations, the majority of these animals were probably short-beaked common dolphins. Barlow (1995) presents a population estimate of 9,472 (C.V. = 0.68) long-beaked common dolphins based on a summer/fall 1991 shipboard line transect survey. This is currently the best available population estimate.

Minimum Population Estimate

The log-normal 20th percentile of the above abundance estimate is 5,636 long-beaked common dolphins.

Current Population Trend

Due to the historical lack of distinction between the two species of common dolphins? it is difficult to establish trends in abundance for this species. In the past, common dolphins have been shown to increase in abundance off California during the warm-water months (Dohl et al. 1986). Although the recent 1991-92 surveys did not reveal any seasonal differences (Barlow 1995; Forney et al. 1995), both surveys resulted in overall abundance estimates (for both types of common dolphins combined) which were considerably greater than historical estimates (Dohl et al. 1986). This suggests a long-term increase in common dolphin abundance during this period of gradual warming of the waters off California (Roemmich 1992), but it is unclear how much of this increase reflects an increase in the abundance of the long-beaked common dolphin. Heyning and Pen-in (1994) have detected changes in the proportion of short-beaked to long-beaked common dolphins stranding along the California coast, with the short-beaked common dolphin stranding more frequently prior to the 1982-83 El Niño (which increased water temperatures off California), and the long-beaked common dolphin more commonly observed for several years afterwards. Thus, it appears that both relative and absolute abundance of these species off California may change with varying oceanographic conditions.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Based on this stock's unknown status, the recovery factor (F,) is 0.5. Multiplying this times the default annual growth rate ($1/2R_{max}$) of 0.02 and the minimum abundance estimate of 5,636 yields a potential biological removal (PBR) of 56 long-beaked common dolphins per year.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Long-beaked common dolphins are killed incidentally in drift gillnets, which have been used to catch swordfish, thresher shark, and mako shark in offshore California, Oregon and Washington waters (Hanan et al. 1993), with approximately 149 vessels currently active (J. Cordaro, Southwest Region, NMFS, pers. comm.). Fishing effort has decreased from approximately 10,000 sets per year in the mid-1980s to **6600** in 1993 (Barlow et al. 1994). Between July 1990 and December 1993, with approximately 4-15% of California drift and set gillnet fisheries observed, 128 common dolphins were recorded killed in driftnets, without distinction between short-beaked and long-beaked types. Total mortality estimates for both types of common dolphins are 203 (s.e. 82) for July-December 1990; 373 (s.e. 73) for 1991; 356 (s.e. 66) for 1992, and 253 (s.e. 69) for 1993 (Lennert et al. 1994; Perkins et al. 1992; Julian 1993, 1994). Corresponding average rates of kill per fishing day are 0.05, 0.08, 0.08, and 0.03, for 1990, 1991 1992 and 1993, respectively. Preliminary mortality data for 1994 indicate that 17 unidentified common dolphins were observed killed. Based on the locations of the takes for 1990-93 (Figure 1), it is likely that most of the killed animals were short-beaked common dolphins. This is supported by the recent examination of some of the biological samples, which resulted in the identification of 36 short-beaked and two long-beaked common dolphins (S. NMFS, unpublished data). Assuming there is no bias in the likelihood of being able to identify the two species, the proportion of long-beaked common dolphins in the total number identified (2/38 = 0.053) can be used to prorate the overall common dolphin mortality, yielding estimates of 1 1, 20, 19, and 13 long-beaked common dolphins for 1990, 1991, 1992 and 1993, respectively. The average estimated annual mortality for long-beaked common dolphins in this fishery for the three complete years of monitoring, 1991-93, is 17 animals.

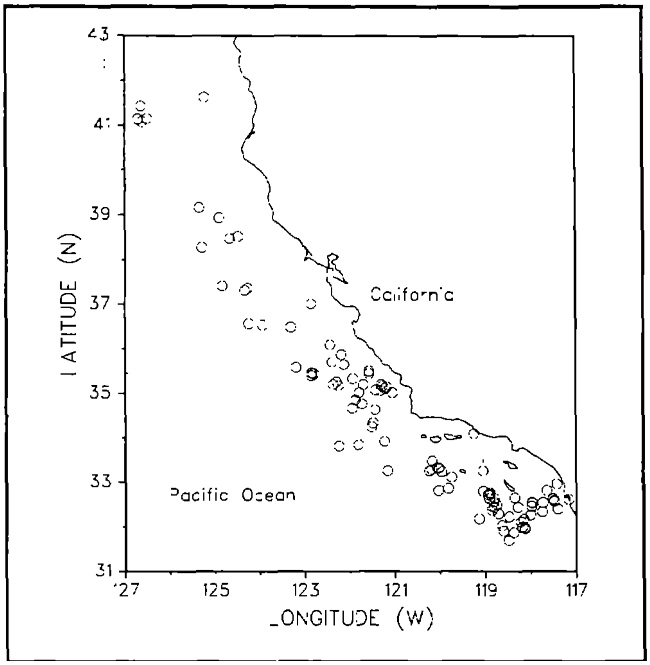

figure 2. Locations of all observed common dolphin takes in California set and drift gillnet fisheries, 1990-93.

Additional common dolphin mortality has been reported for set gillnets, which are used by approximately 134 vessels (J. Cordaro, Southwest Region, NMFS, pers. comm.) to catch halibut, flounder, angel shark, yellowtail, white seabass, and white croaker in California coastal waters. As a result of area closures, fishing effort has decreased from approximately 40,000 sets per year in the mid-1980s to 16,000 sets in 1993 (Barlow et al. 1994), and is expected to continue to decrease because of a 1994 ban on fishing within 3 nmi of shore in Southern California. An observation program has monitored 5-15% of all sets in halibut and angel shark fisheries from 1990-1993. yielding no common dolphins observed killed in 1990, 1991 and 1993, and 2 observed killed in 1992. Total estimated annual common dolphin mortality for this fishery is zero for 1990, 1991 and 1993, and 17 (s.e. 11) for 1992. Corresponding average rates of common dolphin kill per fishing day are zero in 1990, 1991 and 1993, and 0.004 in 1992. The average estimated annual mortality for common dolphins (type not specified) in this fishery for the three complete years of monitoring, 1991-93, is six animals.

Similar drift gillnet fisheries for swordfish and sharks exist along the entire Pacific coast of Baja California, Mexico and may take long-beaked common dolphins from the same 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 1990-93 (0. 15 marine mammals per set), but species-specific information is not available for the Mexican fisheries.

Fishery Mortality Rate

The average total fishery mortality and serious injury for long-beaked common dolphins in 1991-93 (17-23 animals per year, depending on species composition of the set net kill) is greater than l0% of the PBR. and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. This determination cannot be made for individual fisheries until the implementing regulations for Section 118 of the MMPA have been reviewed by the public and finalized. Furthermore, given the uncertainties in estimating long-beaked common dolphin mortality based on overall common dolphin mortality, a re-evaluation should take place when additional species-specific data and analyses of biological samples become 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 during the last decade (Joseph 1994). Between 1990 and 1994, annual mortality of northern common dolphins (potentially including both long-beaked and short-beaked common dolphins) ranged between 81 and 1,773 animals, with an average of 564 (Hall and Boyer 1992; Hall and Lennert 1993, 1994, 1995; Lennert and Hall 1994). Although it is likely that the long-beaked common dolphins included in the 'northern common dolphin' stock are part of the same population as those found off California, they are managed separately under a section of the MMPA written specifically for the management of dolphins involved in eastern tropical Pacific tuna fisheries.

STATUS OF STOCK

The status of long-beaked common dolphins in California waters relative to OSP is not known, and there are insufficient data to evaluate potential trends in abundance of this species of common dolphin. They are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. Because the total estimated mortality for this species is lower than the PBR, they would not be classified as a "strategic" stock under the MMPA.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Northern right whale dolphins are endemic to temperate waters of the North Pacific Ocean. Off the U.S. west coast, they have been seen primarily in slope and offshore waters. with seasonal movements into the Southern California Bight (Leather-wood 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). 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., in press). 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.

POPULATlON SIZE

Forney (1994) reviews recent abundance estimates for northern right whale dolphins along the U.S. west coast and concludes that the best estimate of overall population size in California. Oregon and Washington is the estimate obtained from aerial surveys conducted off California during winter and spring of 1991 and 1992 (Forney et al. 1995). Because of the observed seasonal shifts in distribution, this estimate of 21.332 animals (C.V. = 0.43) is expected to include animals which may be found off Oregon and Washington in the summer/fall.

Minimum Population Estimate

The log-normal 20th percentile of the above abundance estimate is 15,080 northern right whale dolphins.

Current Population Trend

No information is available regarding trends in abundance of northern right whale dolphins in California: Oregon and Washington.

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 BlOLOGICAL REMOVAL

Based on this stock's unknown status and growth rate. the recovery factor (F,) is 0.5, and $1/2R_{max}$ is the default value of 0.02. Multiplying these two values times the minimum population estimate of 15,080 yields a potential biological removal (PBR) of 151 northern right whale dolphins per year.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Northern right whale dolphins are incidentally killed in California drift gillnets, which have been used to catch swordfish, thresher shark, and mako shark in offshore California: Oregon and Washington waters (Hanan et al. 1993): with approximately 149 vessels currently active (J. Cordaro, Southwest Region, NMFS, pers. comm.). Fishing effort has decreased from approximately 10,000 sets per year in the mid- 1980s to 6600 in 1993 (Barlow et al. 1994). Based on less than 1% observer coverage of fishing effort between 1980 and 1985, Diamond et al. (1987) report a single take of this species, which can be extrapolated to yield a rough estimate of total mortality of 110 animals? or roughly 18 per year.

Between July 1990 and December 1993, with approximately 4-13% observer coverage of California drift gillnet fisheries, observed mortality of northern right whale dolphins was zero in 1990, seven in 1991, two in 1992, and seven in 1993, resulting in annual mortality estimates of zero for 1990, 59 (s.e. 28) for 1991, 15 (se. 10) for 1992, and 63 (se. 25) for 1993 (Lennert et al. 1994: Perkins et al. 1992; Julian 1993, 1994). Corresponding average rates of northern right whale dolphin kilt per fishing day are 0, 0.013, 0.003, and 0.010 for 1990, 1991 1992 and 1993, respectively. Preliminary mortality data for 1994 indicate that seven northern right whale dolphins were observed killed (NMFS, unpublished data). The average estimated annual mortality for northern right whale dolphins in this fishery for the three complete years of monitoring, 1991-93, is 46 animals.

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 during cold-water periods. 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 1990-93 (0.15 marine mammals per set), but species-specific information is not available for the Mexican fisheries.

An experimental gillnet fishery for thresher shark off Oregon and Washington in 1986-89 also reported mortality of northern right whale dolphins; however, this fishery was discontinued after 1989 due to the high rates of marine mammal and turtle bycatch (Stick and Hreha: 1989).

Fishery **Mortality Rate**

The total fishery mortality and serious injury for northern right whale dolphins during 1991-93 (46 animals per year) is greater than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. This determination cannot be made for individual fisheries until the implementing regulations for Section 118 of the MMPA have been reviewed by the public and finalized.

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. 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 is estimated to be less than the PBR. and therefore they are not classified as a “strategic” stock under the MMPA.

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KILLER WHALE *(Orcinus orca)*: California/Oregon/Washington Pacific Coast 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 abundance 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; Forney et al. 1995). Seasonal and year-round occurrence has been noted for killer whales throughout Alaska (Braham and Dahlheim 1982, Dahlheim in prep) and in the intracoastal waterways of British Columbia and Washington State, where pods have been labeled as 'resident' and 'transient' (Bigg et al. 1990) based on aspects of morphology, ecology, genetics and behavior (Ford and Fisher 1982; Baird and Stacey 1988; Baird et al. 1992). Although some resident pods have been sighted off the outer Washington coast as far south as Grays Harbor (Bigg et al. 1990), most sightings of killer whales in Washington have occurred in inland waterways.

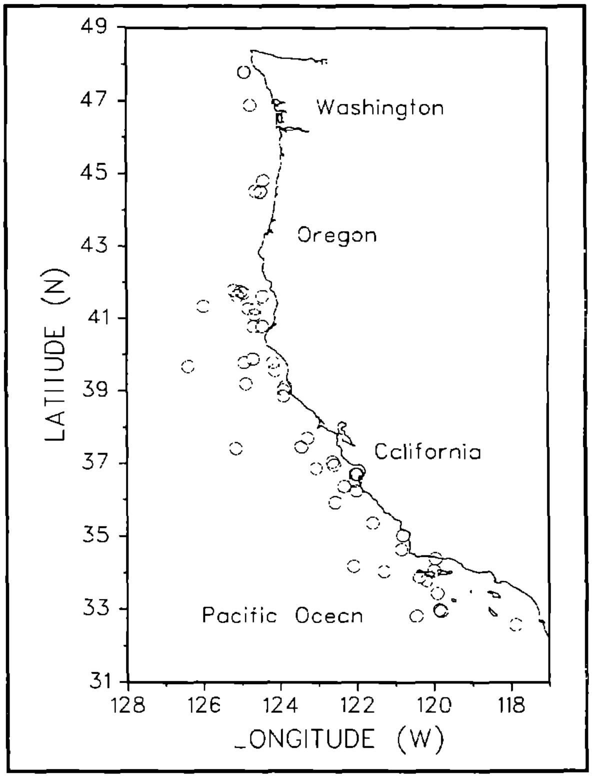

Figure 1. Killer whale sightings based on aerial and shipboard surveys off the Pacific coast of California, Oregon and Washington, 1975- 1994 (see text for data sources).

Off California. Oregon and the Pacific coast of Washington, killer whale sightings have been relatively infrequent and dispersed (Figure 1; data from Dohl et al. 1980, 1983; Green et al. 1992; Hill and Barlow 1992; Carretta and Forney 1993; Mangels and Gerrodette 1994; NMFS, unpublished data). Although movement between Alaska and California recently was documented for three identifiable killer whales photographed together in both regions (Black et al. 1993, Goley and Straley 1994), it is not known what proportion of animals found off California, Oregon and the outer Washington coast may exhibit similar long-range movements, or whether any resident pods exist in these areas. Until additional information on movements and population structure is available, killer whales within the U.S. Exclusive Economic Zone of offshore Washington waters (south of Cape Flattery), and in Oregon and California should be managed as a separate stock from the resident and transient populations which have been studied in the inland waterways of Washington and British Columbia and in Alaska. This designation also roughly corresponds to the operating area of drift gillnet fisheries, which are most likely to take killer whales incidentally. Thus, for the Marine Mammal Protection Act (MMPA) stock assessment reports, killer whales within the Pacific U.S. EEZ are divided into four stocks: 1) a California, Oregon and Washington stock (this report),2) a transient stock in Alaska and Washington inland waters, 3) a resident stock in Alaska and Washington inland water: and 4) a Hawaiian stock.

POPULATION SIZE

Killer whales generally have been sighted too infrequently off the Pacific coast of California, Oregon and Washington to produce reliable abundance estimates. For California, Forney (1994) reviews available data and concludes that the abundance estimate of 307 (C.V. = 1.2) obtained by Barlow (1995) based on a 1991 summer/fall ship survey extending 300 nmi off the California coast is likely to be the most accurate, although the variance in this estimate is high. No abundance estimates have been made for offshore Oregon and Washington waters. Thus, the California value represents the only available population estimate for this stock, although it does not include any killer whales that may have been off Oregon or Washington at the time of that survey.

Minimum Population Estimate

The log-normal 20th percentile of the above abundance estimate is 139 killer whales.

Current Population Trend

No information is available regarding trends in abundance of killer whales off California, Oregon and the outer coast of Washington.

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

Based on this stock's unknown status and growth rate, the recovery factor (F,) is 0.5, and $1/2R_{max}$ is the default value of 0.02. Multiplying these two values times the minimum population estimate of 139 yields a potential biological removal (PBR) of 1.4 animals per year.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Killer whales are susceptible to mortality in drift gillnets, which are used by approximately 149 vessels (J. Cordaro, Southwest Region, NMFS, pers. comm.) to catch swordfish, thresher shark, and mako shark in California offshore waters (Hanan et al. 1993). Fishing effort has decreased from approximately 10.000 sets per year in the mid-1980s to 6600 in 1993 (Barlow et al. 1994). No takes of killer whales have been documented by fishery observers in U.S. west coast gillnet fisheries for 1980-85 (<1% observer coverage; Diamond et al. 1987), and from July 1990 to December 1994 (4- 15% observer coverage; Lennert et al. 1994; Perkins et al. 1992; Julian 1993, 1994; NMFS, unpublished data). Although this does not prove that mortality is zero (because observer coverage was not l00%), it does indicate that mortality is probably infrequent. Heyning et al. (1994) report one stranding of a killer whale with net marks in Southern California in 1985, but it is not known which gillnet fishery may have been responsible.

Another potential source of killer whale mortality are set gillnets, which are used by approximately 134 vessels (J. Cordaro, Southwest Region, NMFS, pers. comm.) to catch halibut, flounder, angel shark, yellowtail, white seabass, and white croaker in California coastal waters. As a result of area closures, fishing effort has decreased from approximately 40,000 sets per year in the mid-1980s to 16,000 sets in 1993 (Barlow et al. 1994): and is expected to continue to decrease because of a 1994 ban on fishing within 3 nmi of shore in Southern California. An observation program has monitored 5-15% of all sets in this fishery since July 1990.

Similar set and 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 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 1990-93 (0.15 marine mammals per set), but species-specific information is not available for the Mexican fisheries.

Fishery Mortality Rate

No fishery mortality or serious injury has been reported for this stock of killer whales since 1985, and, therefore, fishery mortality and serious injury can be considered to be insignificant and approaching zero.

Other mortality

California coastal whaling operations killed five killer whales between 1962 and 1967 (Rice 1974). An additional killer whale was taken by whalers in British Columbian waters (Hoyt 198 1), but it is unknown whether this animal may have belonged to a stock ranging south along the Pacific coast of Califonia/Oregon/Washington.

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. They are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. Because mortality in fisheries is infrequent, and no human-caused takes have been observed in the 3990-93 observer program, killer whales off California are not classified as a "strategic" stock under the MMPA.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Short-finned pilot whales were once commonly seen off Southern California, with an apparently resident population around Santa Catalina Island, as well as seasonal migrants (Dohl et al. 1980). After a strong El Niño event in 1982-83, short-finned pilot whales virtually disappeared from this region. and despite increased survey effort along the entire U.S. west coast, few sightings were made from 1984- 1992 (Jones and Szczepaniak 1992; Hill and Barlow 1992; Carretta and Forney 1993; Shane 1994; Green et al. 1992, 1993). In 1993, six sightings of short-finned pilot whales were again made off California (Mangels and Gerrodette 1994; NMFS, unpublished data), and mortality in drift gillnets increased (Julian 1994). Figure 1 summarizes the sighting history of short-finned pilot whales off the U.S. west coast (sightings from Dohl et al. 1980, 1983; Carretta and Forney 1993; Mangels and Gerrodette 1994; NMFS. unpublished data). No sightings have been documented for Oregon or Washington, but four strandings of short-finned pilot whales have occurred in Washington (B. Norberg, pers. comm.). Although the full geographic range of the California/Oregon/Washington population is not known, it may be continuous with animals found off Baja California, and is 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.

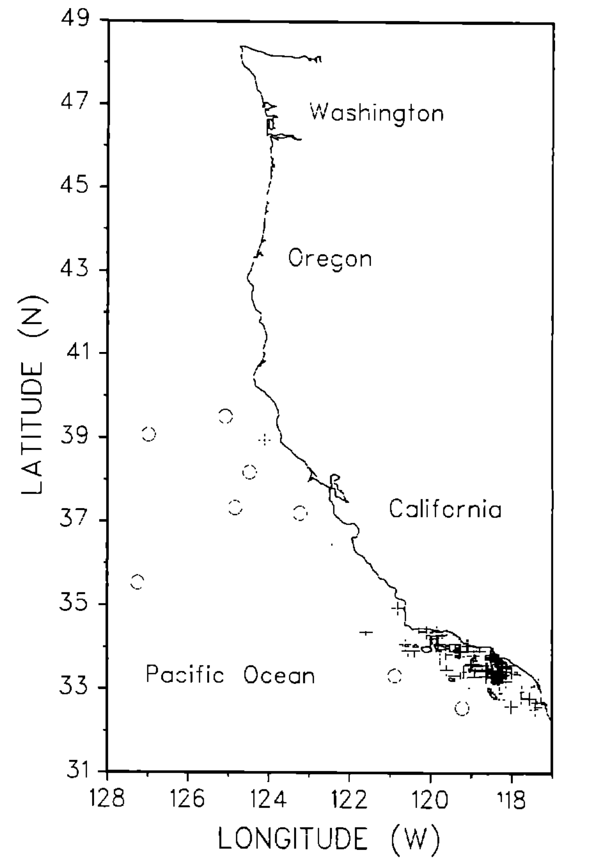

Figure I. Short-finned pilot whale sightings made during aerial and shipboard surveys conducted off California in 1975-83 (+) and off California, Oregon and Washington in 1989-93 (0) (See text for data sources).

POPULATION SIZE

No estimates of population size are currently available for short-finned pilot whales off the U.S. west coast. because the 1991-92 aerial and shipboard surveys resulted in only one sighting of this species while in transit to the survey area. However, a population estimate is expected to become available in the near future, when ship survey data for 1993 (Mangels and Gerrodette 1994) have been analyzed.

Minimum Population Estimate

No minimum population estimate is available for short-finned pilot whales in California. The largest documented group size was 25 animals seen off central California in 1991 (Jones and Szczepaniak 1992). However, this is not a meaningful minimum population estimate, as recent levels of mortality appear to exceed this value (Julian 1994).

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 (NMFS, unpublished data; Julian 1994). However, this cannot be considered a true growth in the population, because it merely reflects large-scale, long-term movements of this species in response to changing oceanographic conditions. It is not known where the animals went after the 82-83 El Niño, nor where the recently observed animals came from. Until the range of this population and the movements of animals in relation to environmental conditions are better documented, no inferences can be drawn regarding trends in abundance of short-finned pilot whales off California, Oregon and Washington.

CURRENT AND MAXlMUM 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

Based on this stock's unknown status and growth rate, the recovery factor (F,) is 0.5, and $1/2R_{max}$ is the default value of 0.02. However, because no minimum abundance estimate is available, no potential biological removal (PBR) can be calculated.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Short-finned pilot whales are incidentally killed in California drift gillnet fisheries. Drift gillnets are used by approximately 149 vessels (J. Cordaro, Southwest Region, NMFS, pers. comm.) to catch swordfish, thresher shark, and mako shark in California offshore waters (Hanan et al. 1993). Fishing effort has decreased from approximately 10,000 sets per year in the mid-1980s to 6600 in 1993 (Barlow et al. 1994). Based on less than 1% coverage of fishing effort between 1980 and 1985, Diamond et al. (1987) report two takes of this species in 1980. However, given the observed changes in distribution of short-finned pilot whales after 1983, it is not plausible to extrapolate to an overall mortality estimate for the period. Between July 1990 and December 1993, with approximately 4-13% observer coverage of California drift gillnet fisheries, observed short-finned pilot whale mortality was one in 1990, zero in 1991, one in 1992, and 11 in 1993 (Lennert et al. 1994: Perkins et al. 1992; Julian 1993, 1994). resulting in total annual mortality estimates of 23 (s.e. 22) in 1990, zero in 1991, 8 (se. 7) in 1992, and 100 (s.e. 43) in 1993. The corresponding average rates of short-finned pilot whale kill per fishing day are 0.006, 0,0.002, and 0.015 for 1990, 1991, 1992 and 1993, respectively. Preliminary mortality data for 1994 indicate that no short-finned pilot whales were observed killed (NMFS, unpublished data). The average estimated annual mortality for short-finned pilot whales in this fishery for the three complete years of monitoring, 199l-93, is 36 animals.

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, 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 1990-93 (0.15 marine mammals per set). but species-specific information is not available for the Mexican fisheries.

Historically, short-finned pilot whales were also killed in squid purse seine operations off Southern California (Miller et al. 1983; Heyning et al. 1994): although the extent of such mortality is unknown. This fishery currently includes approximately 145 vessels (NMFS, unpublished data). No recent mortality has been reported, presumably because short-finned pilot whales have not returned to the areas of squid purse seine fishing activity. Furthermore, past mortality in this fishery 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.

Fishery Mortality Rate

The total fishery mortality and serious injury for 199l-93 (36 animals per year) cannot be considered to be insignificant and approaching zero, because the population size of this stock of short-finned pilot whales is unknown.

Determinations cannot be made for individual fisheries until the implementing regulations for Section 118 of the MMPA have been reviewed by the public and finalized.

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 and changed their distribution since the 1982-83 El NiNo, but the nature of these changes is not adequately understood. Shot-t-finned pilot whales are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. Because there is documented fishery mortality of this species, but no PBR can be calculated due to the lack of abundance estimates. short-finned pilot whales off California are a "strategic" stock under the MMPA.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Baird's beaked whales are distributed throughout deep waters and along the continental slopes of the North Pacific Ocean. 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 from late spring to early fall (Figure 1; data from Dohl et al. 1980, 1983; Green et al. 1992, unpublished data; Hill and Barlow 1992; Mangels and Gerrodette 1994; NMFS, unpublished data). 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 hvo discrete, non-contiguous areas: 1) waters off California, Oregon and Washington (this report), and 2) Alaskan waters.

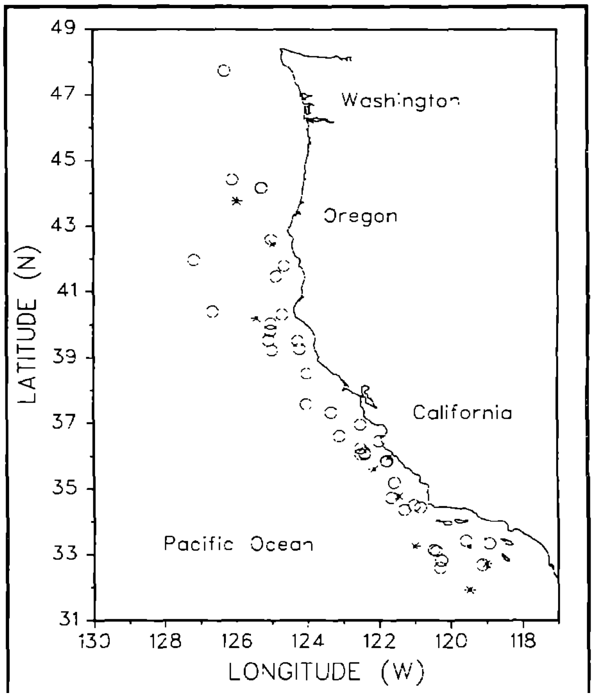

Figure 1. Baird's beaked whale sightings based on aerial and shipboard surveys off California, Oregon and Washington, 1975- 1994. Key: O = May-October; * = November-April. (See text for data sources.)

POPULATION SIZE

Although Baird'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 generally been too rare to produce reliable population estimates. Forney (1994) reviews all available data and concludes that the best population estimate currently available is 38 animals (C.V. = 1.03): based on a 1991 ship survey along the California coast (Barlow 1995). However, in addition to being imprecise, this estimate is biased downward by an unknown amount because of the large proportion of time this species spends submerged, and because the ship survey covered only California waters, and thus could not observe animals off Oregon/Washington. Studies of the proportion of time this species spends diving will be needed to obtain more accurate abundance estimates for Baird's beaked whales in the future.

Minimum Population Estimate

Based on the above abundance estimate and C.V., the minimum population estimate (defined as the log-normal 20th percentile of the abundance estimate) for Baird's beaked whales in California, Oregon, and Washington is 19 animals. As with the best population estimate above, this value is an underestimate, but the degree of inaccuracy is unknown.

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

Based on this stock's unknown status and growth rate, the recovery factor (F,) is 0.5, and $1/2R_{max}$ is the default value of 0.02. Multiplying these two values times the minimum population estimate of 19 yields a potential biological removal (PBR) of 0.2 animals per year.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Baird's beaked whales are susceptible to mortality in drift gillnets, which are used by approximately 149 vessels (J. Cordaro, Southwest Region, NMFS, pers. comm.) to catch swordfish, thresher shark, and mako shark in California offshore waters (Hanan et al. 1993). Fishing effort has decreased from approximately 10,000 sets per year in the mid-1980s to 6600 in 1993 (Barlow et al. 1994). No takes of Baird's beaked whales were documented by fishery observers in U.S. west coast gillnet fisheries for 1980-85 (<1 % observer coverage; Diamond et al. 1987), and from July 1990 to December 1993 (4-l5% observer coverage; Lennert et al. 1994; Perkins et al. 1992; Julian 1993, 1994). However, six unidentified beaked whales and three unidentified cetaceans were reported entangled in drift gillnets off California since 1980, and one or more of these could have represented this species. Preliminary mortality data for 1994 indicate that two Baird's beaked whales and three unidentified beaked whales were observed killed (NMFS: unpublished data). Although the average estimated annual mortality for Baird's beaked whales in this fishery for 1991-93 is zero, the addition of data for 1994 will result in an overall average annual mortality that substantially exceeds the PBR for this species.

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, 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 1990-93 (0.15 marine mammals per set): but species-specific information is not available for the Mexican fisheries.

Fishery Mortality Rate

Although no takes were reported for this species in 1990-93, **two** Baird's beaked whales were reported taken in 1994, exceeding the calculated PBR of 0.2 (or 1 animal every 5 years). Therefore, total fishery mortality and serious injury cannot be considered to be insignificant and approaching zero. This determination cannot be made for individual fisheries until the implementing regulations for Section 118 of the MMPA have been reviewed by the public and finalized.

Other mortality

California coastal whaling operations killed 1.5 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).

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. They are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. Although no mortality of this species was documented for 1990-93 and the total mortality estimates for 1994 are not yet available, the two animals observed killed in 1994 will result in an estimate of average annual mortality that exceeds the PBR, and therefore Baird's beaked whales are classified as a "strategic" stock under the MMPA.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Mesoplodont beaked whales are distributed throughout deep waters and along the continental slopes of the North Pacific Ocean. At least 5 species in this genus have been recorded off the U.S. west coast, but due to the rarity of records and the difficulty in identifying these animals in the field, virtually no species-specific information is available (Mead 1989). The five species known to occur in this region are: Blainville's beaked whale *(M. densirostris),* Hector's beaked whale, (M *hectori),* 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 five 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 (i.e. genetic tests) to obtain species-specific abundance and mortality 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.

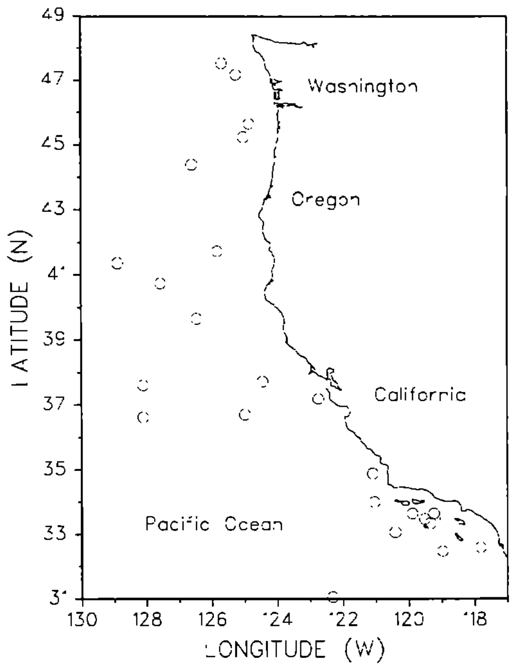

Figure 1. Sightings of mesoplodont beaked whales off California, Oregon and Washington based on aerial and shipboard surveys, 1975-1993 (data from Dohl et al. 1980, 1983; Green et al. 1992, unpublished data; Hill and Barlow 1992; Carretta and Forney 1993; Mangels and Gerrodette 1994; NMFS, unpublished data).

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. Forney (1994) reviews all available data and concludes that the best population estimate currently available is 250 animals (C.V. = 0.83), based on a 1991 ship survey along the California coast (Barlow 1995). However, in addition to being imprecise, this estimate is biased downward by an unknown amount because of the large proportion of time mesoplodont beaked whales spend submerged: and because the ship survey 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).* Studies of the proportion of time spent diving by these species will be needed to obtain more accurate abundance estimates in the future.

Minimum Population Estimate

Based on the above abundance estimate and C.V., 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 136 animals. As with the best population estimate, this value is an underestimate, but the degree of inaccuracy is unknown.

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

Based on this stock's unknown status and growth rate, the recovery factor (F,) is 0.5, and $1/2R_{max}$ is the default value of 0.02. Multiplying these two values times the minimum population estimate of 136 yields a potential biological removal (PBR) of 1.4 mesoplodont beaked whales per year.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Mesoplodont beaked whales are incidentally killed in California drift gillnets, which are used by approximately 149 vessels (J. Cordaro, Southwest Region, NMFS, pers. comm.) to catch swordfish, thresher shark, and mako shark in California offshore waters (Hanan et al. 1993). Fishing effort has decreased from approximately 10,000 sets per year in the mid-1980s to 6600 in 1993 (Barlow et al. 1994). Based on less than 1% observer coverage of fishing effort between 1980 and 1985, Diamond et al. (1987) report a single take of a cow/calf pair, which corresponds to a kill-per-net-pull of 0.005 animals and extrapolates to a total mortality of 220 animals, or roughly 37 per year. Between July 1990 and December 1993, with approximately 4- 13% of California drift gillnet fisheries observed, four mesoplodont beaked whales were recorded killed in driftnets (Lennert et al. 1994; Perkins et al. 1992; Julian 1993, 1994). Additionally, three unidentified beaked whales and three unidentified cetaceans, which may have been mesoplodont beaked whales, were reported. Based only on the identified takes, these authors report total annual mortality estimates for mesoplodont beaked whales as 23 (s.e. 22) for July-December 1990; zero in 1991 and 1993, and 23 (s.e. 12) for 1992. The corresponding average rates of mesoplodont beaked whale kill per fishing day are 0.006, 0, 0.005, and 0 for 1990, 1991, 1992 and 1993, respectively. Preliminary mortality data for 1994 indicate that three unidentified beaked whales, which may have been mesoplodont beaked whales, were observed killed (NMFS, unpublished data). The average annual estimated mortality of whales identified to the genus *Mesoplodon* for the three complete years of monitoring, 1991-93, is 7.7 animals.

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, 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 1990-93 (0.15 marine mammals per set), but species-specific information is not available for the Mexican fisheries.

Fishery Mortality Rate

The total fishery mortality and serious injury for mesoplodont beaked whales during 199l-93 (7.7 animals per year) is greater than the calculated PBR and: therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. This determination cannot be made for individual fisheries until the implementing regulations for Section 118 of the MMPA have been reviewed by the public and finalized.

STATUS OF STOCK

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. None of the five species is listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. The estimated fishery mortality for mesoplodont beaked whales exceeds the PBR, and therefore this group of species is classified as a "strategic" stock as defined by the MMPA.

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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). Although sightings of this species off the U.S. west coast have been infrequent (Figure 1; data from Dohl et al. 1980, 1983; Green et al. 1992, unpublished data; Hill and Barlow 1992; Carretta and Forney 1993; Mangels and Gerrodette 1994; NMFS, unpublished data), they are nonetheless the most commonly encountered beaked whale in this region. 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.

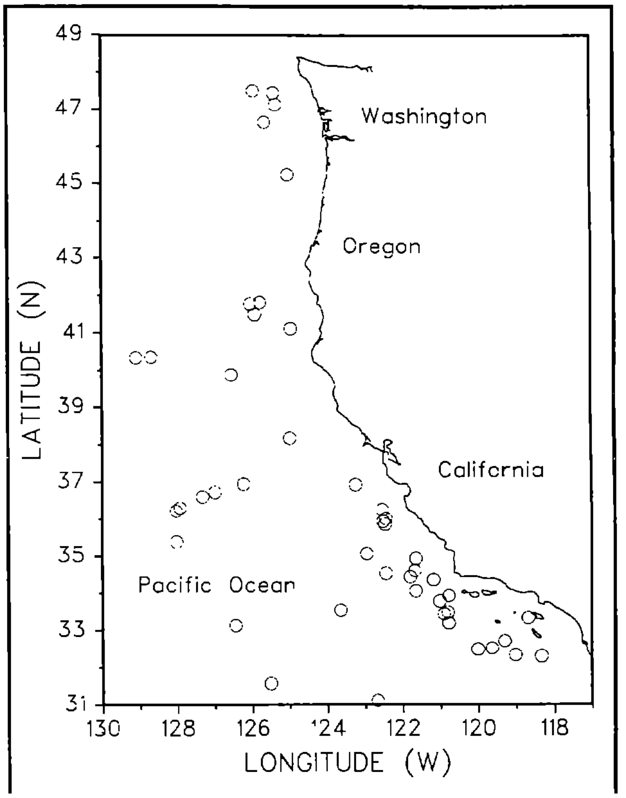

Figure 1. Cuvier's beaked whale sightings based on aertal and shipboard surveys off California, Oregon and Washington, 1975-93. (See text for data sources.)

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 generally been too rare to produce reliable population estimates. Forney (1994) reviews all available data and concludes that the best population estimate currently available is 1,621 animals (C.V. = 0.82) based on a 1991 ship survey along the California coast (Barlow 1995). However, in addition to being imprecise, this estimate is biased downward by an unknown amount because of the large proportion of time this species spends submerged, and because the ship survey 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 Meroplodon sp. or Cuvier's beaked whales *(Ziphius cavirostris).* Studies of the proportion of tune Cuvier's beaked whales spend diving will be needed to obtain more accurate abundance estimates for this species in the future.

Minimum Population Estimate

Based on the above abundance estimate and C.V., 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 886 animals. As with the best population estimate above, this value is an underestimate, but the degree of inaccuracy is unknown.

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

Based on this stock's unknown status and growth rate, the recovery factor (F,) is 0.5, and $1/2R_{max}$ is the default value of 0.02. Multiplying these two values times the minimum population estimate of 886 yields a potential biological removal (PBR) of 8.9 animals per year.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Cuvier's beaked whales are incidentally killed in California drift gillnet fisheries, which are used by approximately 149 vessels (J. Cordaro, Southwest Region, NMFS, pers. comm.) to catch swordfish? thresher shark, and mako shark in California offshore waters (Hanan et al. 1993). Fishing effort has decreased from approximately 10,000 sets per year in the mid-1980s to 6600 in 1993 (Barlow et al. 1994). Between July 1990 and December 1993, with approximately 4-13% of California drift gillnet fisheries observed, nine Cuvier's beaked whales were recorded killed in driftnets (Lennert et al. 1994; Perkins et al. 1992; Julian 1993. 1994). Additionally, three unidentified beaked whales and three unidentified cetaceans, which may have been Cuvier's beaked whales, were reported. Based only on the identified takes, these authors report total annual mortality estimates for Cuvier's beaked whales as zero in 1990 and 1991, 45 (s.e. 17) in 1992, and 27 (s.e. 15) for 1993. Corresponding mortality rates are 0, 0, 0.010, and 0.004 Cuvier's beaked whales per fishing day for 1990, 1991, 1992 and 1993, respectively. Preliminary mortality data for 1994 indicate that six Cuvier's beaked whales and three unidentified beaked whales were observed killed (NMFS, unpublished data). The average annual estimated mortality of Cuvier's beaked whales for the three complete years of monitoring, 1991-93, is 24 animals.

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. 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 1990-93 (0.15 marine mammals per set), but species-specific information is not available for the Mexican fisheries.

Fishery Mortality Rate

The total fishery mortality and serious injury for Cuvier's beaked whales during 199l-93 (24 animals per year) is greater than the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. This determination cannot be made for individual fisheries until the implementing regulations for Section 118 of the MMPA have been reviewed by the public and finalized.

STATUS OF STOCK

The status of Cuvier's beaked whales in California, Oregon and Washington water's relative to OSP is not known, and there are insufficient data to evaluate trends in abundance. They are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. The estimated fishery mortality of this species exceeds the PBR, and therefore Cuvier's beaked whales off California, Oregon and Washington are classified as a "strategic" stock as defined by the MMPA.

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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 (Caldwell and Caldwell 1989; Ross 1984). Along the U.S. west coast, sightings of this species and of animals identified only as *Kogia* sp. have been very rare (Figure 1: data from Dohl et al. 1980, 1983; Green et al. 1992, unpublished data; Hill and Barlow 1992; Mangels and Gerrodette 1994, NMFS, unpublished data). However, this is probably a reflection of their pelagic distribution, small body size and cryptic behavior, rather than an indication of true rareness. Strandings of pygmy sperm whales in this region are known from California, Oregon and Washington (Roest 1970; Caldwell and Caldwell 1989; ODFG, unpublished data; NMFS, unpublished data). 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.

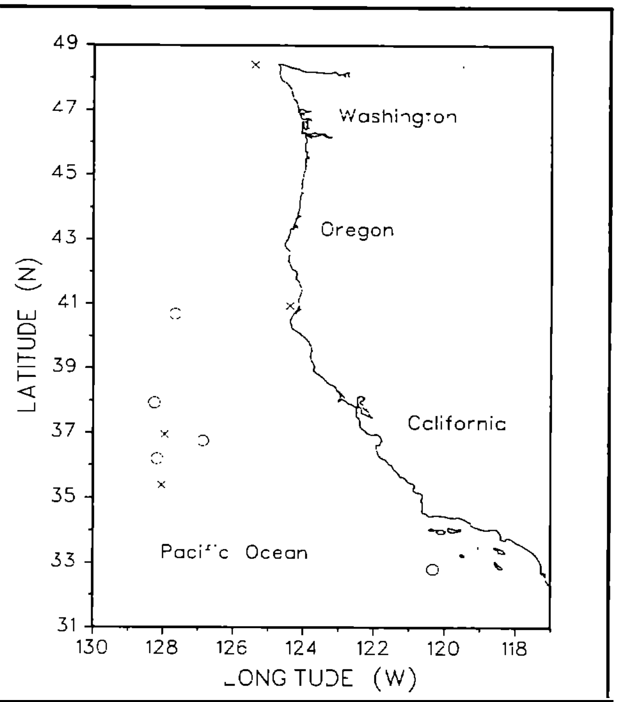

Figure 1. Kogia breviceps (o) and Kogia sp. (x) sighting based on aerial and shipboard surveys off California, Oregon and Washington, 197593 (see text for data sources).

POPULATION SIZE

Although pygmy sperm whales have been sighted along the U.S. west coast on several line transect surveys utilizing both aerial and shipboard platform sightings have generally been too rare to produce reliable population estimates. Forney (1994) reviews all available data and concludes that the best population estimate currently available is 870 animals (C.V. = 0.80) based on a 1991 ship survey along the California coast (Barlow 1995). However, in addition to being imprecise, this estimate is biased downward by an unknown amount because pygmy sperm whales spend a large proportion of time submerged and are very difficult to detect at the surface unless seas are calm. Furthermore, the ship survey covered only California waters, and thus could not observe animals off Oregon/Washington. Additional surveys and studies of the proportion of time this species spends diving will be needed to obtain more accurate abundance estimates for this species in the future.

Minimum Population Estimate

Based on the above abundance estimate and C.V., the minimum population estimate (defined as the log-normal 20th percentile of the abundance estimate) for pygmy sperm whales in California: Oregon, and Washington is 481 animals. As with the best population estimate above, this value is an underestimate, but the degree of inaccuracy is unknown.

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

Based on this stock's unknown status and growth rate, the recovery factor (F,) is 0.5, and $1/2R_{max}$ is the default value of 0.02. Multiplying these two values times the minimum population estimate of 481 yields a potential biological removal (PBR) of 4.8 animals per year.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Pygmy sperm whales are incidentally killed in California drift gillnet fisheries, which are used by approximately 149 vessels (J. Cordaro, Southwest Region, NMFS, pers. comm.) to catch swordfish, thresher shark, and mako shark in California offshore waters (Hanan et al. 1993). Fishing effort has decreased from approximately 10,000 sets per year in the mid-1980s to 6600 in 1993 (Barlow et al. 1994). Between July 1990 and December 1993, with approximately 4-13% of California drift gillnet fisheries observed, two pygmy sperm whales were recorded killed in driftnets (Lennert et al. 1994; Perkins et al. 1992; Julian 1993, 1994). Additionally, three unidentified cetaceans, which may have been pygmy sperm whales, were reported in the driftnet fishery. Based only on the identified animals, total annual mortality estimates for pygmy sperm whales are zero for 1990-91, eight (s.e. 7.0) in 1992 and nine (se. 8.6) for 1993. Corresponding mortality rates per fishing day for pygmy sperm whales are zero in 1990-91, 0.002 animals in 1992, and 0.001 animals for 1993. Preliminary mortality data for 1994 indicate that no pygmy sperm whales, unidentified *Kogia* or unidentified cetaceans were observed killed (NMFS unpublished data). The average annual estimated mortality of pygmy sperm whales for this fishery for the three complete years of monitoring. 1991-93, is 5.7 animals.

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, 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 1990-93 (0.15 marine mammals per set), but species-specific information is not available for the Mexican fisheries.

Fishery Mortality Rate

The total fishery mortality and serious injury for pygmy sperm whales during 1991-93 (5.7 animals per year) is greater than the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. This determination cannot be made for individual fisheries until the implementing regulations for Section 118 of the MMPA have been reviewed by the public and finalized.

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. They are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. Because the average estimated fishery mortality of this species in 1991-93 exceeds the PBR, pygmy sperm whales off California, Oregon and Washington are classified as a "strategic" stock under the MMPA.

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DWARF' SPERM WHALE (Kogia simus): 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; data from Dohl et al. 1983; Green et al. 1992; Mangels and Gerrodette 1994), and some of these may have been dwarf sperm whales. At least three dwarf sperm whales stranded in California between 1967 and 1981 (Roest 1970; Jones 1981; J. Heyning, pers. comm.), and one stranding is reported for western Canada and (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.

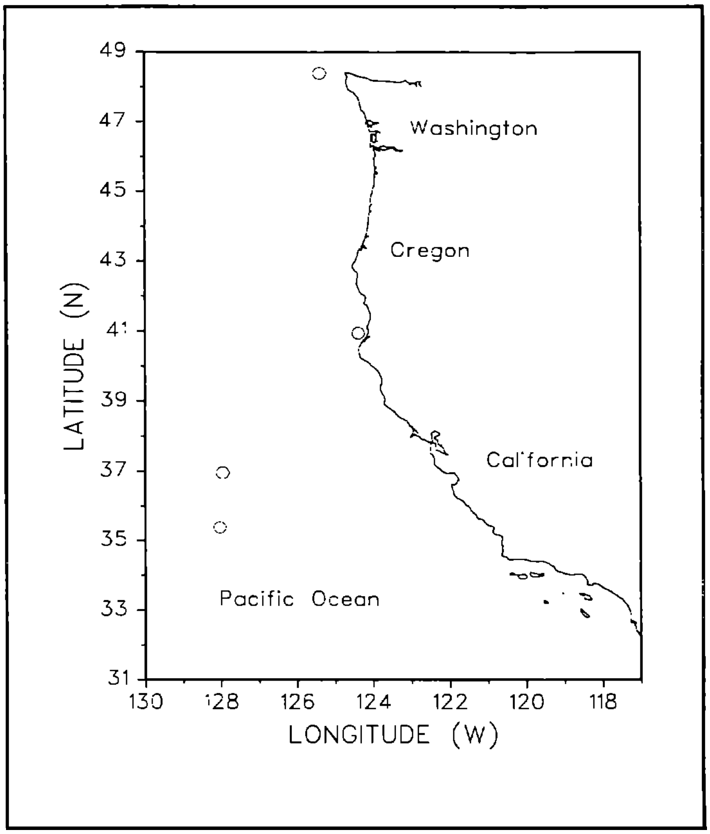

Figure *1. Kogia* sp. (o) sightings based on aerial and shipboard surveys off California, Oregon and Washington, 1975-93 (see text for data sources).

POPULATION SIZE

No information is available to estimate the population size of dwarf sperm whales off California.

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,) is 0.5, and $1/2R_{max}$ 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

Dwarf sperm whales are susceptible to mortality in California drift gillnet fisheries, which are used by approximately 149 vessels (J. Cordaro, Southwest Region, NMFS, pers. comm.) to catch swordfish, thresher shark, and mako shark in California offshore waters (Hanan et al. 1993). Fishing effort has decreased from approximately 10,000 sets per year in the mid- 1980s to 6600 in 1993 (Barlow et al. 1994). Between July 1990 and December 1993, with approximately 4-13% of California drift gillnet fisheries observed, no dwarf sperm whales were recorded killed in driftnets (Lennert et al. 1994; Perkins et al. 1992; Julian 1993. 1994) but three unidentified cetaceans, which may have been dwarf sperm whales, were reported in the driftnet fishery. Preliminary mortality data for 1994 indicate that no dwarf sperm whales, unidentified *Kogia,* or unidentified cetaceans were observed killed (NMFS, unpublished data). Excluding the unidentified cetaceans, no mortality of dwarf sperm whales species has been observed in the drift gillnet fishery. However, based on the small body size of this species and on patterns of take for other cetaceans: it is likely that gillnet mortality of this species will occur in the future.

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, 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 (IO 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.

Fishery Mortality Rate

The total fishery mortality and serious injury for this stock can be considered to be insignificant and approaching zero, because no fishery takes have been reported.

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. They are not listed as “threatened” or “endangered” under the Endangered Species Act nor as “depleted” under the MMPA. Because there has been no observed fishery mortality of this species. dwarf sperm whales off California: Oregon and Washington are not classified as a “strategic” stock under the MMPA.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Sperm whales are widely distributed across the entire North Pacific, primarily south of 40°N (Gosho et al. 1984). For management, the lnternational Whaling Commission (IWC) had divided the North Pacific into two management regions (Donovan 1991) defined by a zig-zag line which starts at 150°W at the equator, is l6O°W between 40-5O°N, and ends up at 180°W north of 50°N; however, the IWC has not reviewed this stock boundary in many years (Donovan 1991). Sperm whales are found year-round in California waters (Dohl et al. 1983; Barlow 1995; Forney et al. 1995) and any possible affinity between sperm whales along the U.S. West Coast and animals found further offshore or further south is unknown. 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: I) California, Oregon and Washington waters (this report), 2) waters around Hawaii, and 3) Alaska waters. Recent 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 l50°W) and tapers off northward towards the tip of Baja California. The structure of sperm whale populations in the eastern tropical Pacific is not known, but the only matches of known individuals from this area have been between the Galapagos Islands and coastal waters of South America (Dufault and Whitehead 1995), suggesting that the eastern tropical animals constitute a distinct stock.

POPULATION SIZE

Barlow (1995) estimates 756 (CV=O.49) sperm whales in California coastal waters during summer/fall based on ship line transect surveys (95% C.I.=303-1,886). Forney et al. (1995) estimate 892 (CV=O.99) sperm whales there during winter/spring based on aerial line-transect surveys (95% C.I.=176-4,506), but this estimate does not correct for diving whales that were missed. Because of the long dive time of sperm whales (Leatherwood et al. 1982), it is reasonable to assume that the true abundance would be 3 to 8 times the estimates from aerial surveys. Green et al. (1992) report that sperm whales were the third most abundant large whale (after gray and humpback whales) in aerial surveys of Oregon and Washington, but they did not estimate population size for that area. The only abundance estimates for the entire eastern North Pacific is for 1982 (Gosho et al. 1984) and is based on a CPUE method which is no longer accepted as valid by the International Whaling Commission. Using a different method (line transects), the abundance of sperm whales has been estimated recently as 22,700 (95% C.I.=14,800-34,600) in the eastern tropical Pacific (Wade and Gerrodette 1993), but this area does not include areas where sperm whales are taken by drift gillnet fisheries in the U.S. EEZ and there is no evidence of sperm whale movements from the eastern tropical Pacific to the U.S. EEZ. The most precise estimate of sperm whale abundance within the area of the drift gillnet fishery is therefore from the ship survey estimate of Barlow (1995).

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 summer/fall ship survey in California waters (Barlow 1995) or approximately 512. More sophisticated methods of estimating minimum population size would be available if a correction factor (and associated variance) were available to correct the aerial survey estimates for missed animals. Additional information is needed on the abundance of sperm whales in waters off Oregon and Washington.

Current Population Trend

Sperm whale abundance appears to have been fairly stable in California coastal waters between 1979/80 and 1991 (Barlow 1994). 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 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 for any sperm whale population (Best 1993).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the California portion of this stock is calculated as the minimum population size (5 12) times one half the default maximum net growth rate for cetaceans (l/2 of 4%) times a recovery factor of 0.1 (for an endangered species), resulting in a PBR of 1.0.

ANNUAL HUMAN-CAUSED MORTALITY

Historic Whaling

The reported take of North Pacific sperm whales by commercial whalers totalled 258.000 between 1947 and 1987 (C. Allison, IWC, pers. comm.). There has been a prohibition on taking sperm whales in the North Pacific since 1988, but large-scale pelagic whaling stopped earlier, in 1980.

Fishery Information

Sperm whales are likely to be caught only in offshore drift gillnets. Drift gillnets are used by approximateiy 149 vessels (J. Cordaro, Southwest Region, NMFS, pers. comm.) to catch swordfish, thresher shark, and mako shark in California offshore waters (Hanan et al. 1993). Driftnet fishing effort has decreased from approximately 10,000 sets per year in the mid-1980s to 6,600 in 1993 (Barlow et al. 1994). Two unidentified whales, possibly sperm whales, were taken in the approximately 1% of drift gillnets observed in 1980-85 (Hanan 1986; Heyning and Lewis 1990). Six sperm whales have been observed taken from 1990 to 1993 in gillnet observation programs which covered 5-13% of fishing effort (Lennert et al. 1994; Perkins et al. 1992; Julian 1993, 1994) of which, three were released alive (although probably injured). The resulting estimates of annual mortality and serious injury for sperm whales are 23 in 1992 (Julian 1993) and 27 in 1993 (Julian 1994). In addition, much of the gillnet mortality of large whales may go unobserved because whales swim away with portion of the net. The deaths of two stranded sperm whales in California were attributed to entanglement in fishing gear between 1983 and 1991 (J. Cordaro, Southwest Region, NMFS, pers. comm.).

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, which has increased from two vessels in 1986 to 29 vessels in 1992-(Sosa-Nishizaki et al. 1993). The total number of sets in this fishery in 1992 can be estimated from data provided by these authors to be approximately 2,700, with an observed rate of marine mammal bycatch of 0.13 animals per set (10 marine mammals in 77 observed sets; Sosa-Nishizaki et al. 1993). This overall mortality rate is similar to that observed in California driftnet fisheries during 1990-93 (0.15 marine mammals per set), but species-specific information is not available for the Mexican fisheries.

Fishery Mortality Rates

Over the last 3 years, the average annual rate of mortality and serious injury in fisheries has been I7 sperm whales per year. This exceeds the calculated PBR; therefore, total fishery mortality is not approaching zero mortality and serious injury rate. This determination cannot be made for individual fisheries until the implementing regulations for Section 118 of the MMPA have been reviewed by the public and finalized. In comparing gillnet mortality with the PBR, it should be remembered that the PBR does not include sperm whales found off Oregon and Washington and does not include animals further offshore which possibly belong to the same population. A fishery interaction problem appears to exist for sperm whales taken in the drift gillnet fishery, but enough uncertainties exist that one should not conclude from this information that sperm whales are necessarily declining in abundance off the U.S. West Coast. Additional research is clearly needed for this species.

Ship Strikes

Ship strikes were implicated in the deaths of two unidentified whales (possibly sperm whales) in 1990 (J. Cordaro, Southwest Region, NMFS, pers. comm.). 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

Overall, sperm whales were estimated to be at 88% (274,000 out of 3 11,000 mature whales) of historical carrying capacity in the eastern North Pacific and 64% (198,100 out of 309,400 mature whales) in the western North Pacific (Gosho et al. 1984). Sperm whales are formally listed as “endangered” under the Endangered Species Act (ESA), and consequently the California to Washington stock is automatically considered as a “depleted” and “strategic” stock under the MMPA. The annual rate of kill and serious injury is greater than the calculated PBR for this stock.

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HUMPBACK WHALE *(Megaptera novaeangliae):* California/Oregon/Washington - Mexico 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). Four relatively separate migratory populations have been identified in the North Pacific (Barlow 1994a) based on sightings of distinctively-marked individuals: the coastal California/Oregon/Washington - Mexico stock, the Mexico offshore island stock (feeding destination unknown), the central North Pacific stock (Hawaii/Alaska), and the western North Pacific stock (Japan/feeding destination probably the Aleutian Islands). This assessment will cover the stock of humpback whales that ranges from Costa Rica (Steiger et al. 1991) to southern British Columbia (Calambokidis et al. 1993) but which is most common in coastal waters of California (in summer/fall) and Mexico (in winter/spring). Other Marine Mammal Protection Act (MMPA) stock assessment reports include the central North Pacific (Hawaii/Alaska) stock and the western North Pacific (Japan'?) stock. Significant levels of genetic differences were found between the California and Alaska feeding groups based on analyses of mitochondrial DNA (Baker et al. 1990) and nuclear DNA (Baker et al. 1993). The genetic exchange rate between California and Alaska is estimated to be less than 1 female per generation (Baker 1992). Two breeding areas (Hawaii and coastal Mexico) showed fewer genetic differences than did the two feeding areas (Baker 1992). This is substantiated by the observed movement of individually-identified whales between Hawaii and Mexico (Baker et al. 1990). There have been no individual matches between 607 humpbacks photographed in California and 567 humpbacks photographed in Alaska (Calambokidis et al. 1993). Few of the whales photographed in British Columbia have matched with a California catalog (Calambokidis et al. 1993), indicating that British Columbia is an approximate geographic boundary between feeding populations.

POPULATION SIZE

Based on whaling statistics, the pre-1905 population of humpback whales in the North Pacific was estimated to be 15,000 (Rice 1978) but this population was reduced by whaling to approximately 1,200 by 1966 (Johnson and Wolman 1984). The North Pacific total now almost certainly exceeds 3,000 humpback whales (Barlow 1994,). Dohl et al. (1983) first estimated the central California feeding population to be 338 (CV=O.29) based on aerial surveys in August through November of 1980-83; however, this estimate does not include a correction for submerged animals. More recently, the size of the "California" feeding stock of humpback whales has been estimated by three independent methods. 1) Calambokidis and Steiger (1994) estimated the number of humpback whales in California-Washington to be 597 (CV=O.O7) based on mark-recapture estimates comparing their 1992 and 1993 photo-identification catalogs. 2) Barlow (1995) estimates 626 (CV=O.41) humpbacks in California waters based on ship line-transect surveys in summer/autumn 1991. 3) Forney et al. (1995) estimate 319 (CV=O.41) humpback whales in California coastal waters based on aerial line-transect surveys in winter/spring 1991. In addition, Green et al. (1992) report that humpback whales were the second most abundant large whale (after the gray whale) in aerial surveys of Oregon and Washington, but they did not estimate population size. These estimates for the west-coast stock are not significantly different for each other, but the survey estimates are likely to be negatively biased. The aerial surveys are likely to be biased because submerged animals are missed, and both the ship and aerial line-transect estimates do not include members of this stock that were in Washington, Oregon, or Mexico at the time of the survey (this is especially true of the winter/spring survey, during which it was surprising to see any humpback whales north of Mexico). Mark-recapture estimates may also be negatively biased due to heterogeneity in sighting probabilities (Hammond 1986). However, given that the above mark-recapture estimate is based on a large fraction of the entire population (the 1992-93 catalog contained 480 known individuals), this bias is likely to be minimal. Also, when methods were used which account for heterogeneity, estimates were comparable or smaller (Calambokidis et al. 1993). The most precise and least biased estimate is likely to be the mark-recapture estimate of 597 (CV=O.O7) humpback whales for this population.

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 1992-93 abundance estimated from mark-recapture methods (Calambokidis and Steiger 1994) or approximately 563.

Current Population Trend

There is some indication that humpback whales have increased in abundance in California coastal waters between 1979/80 and 1991 (Barlow! 1994b), but this trend is not significant. Mark-recapture population estimates have increased steadily from 1988/90 to l992/93 at about 5% per year (Calambokidis and Steiger 1994). Although the population in the North Pacific is expected to have grown since being given protected status in 1966: 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 humpback whale populations in the North Pacific (Best 1993). The proportion of calves in the California/Mexico stock appears much lower than has been measured for humpback whales in other areas (Calambokidis and Steiger 1994).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (563) times one half the default maximum net growth rate for cetaceans (1/2 of 4%) times a recovey factor of 0.1 (for an endangered species), resulting in a PBR of 1. 1. Because this stock spends approximately half its time in Mexican waters, the PBR allocation for U.S. waters is 0.5 whales per year.

ANNUAL HUMAN-CAUSED MORTALITY

Historic Whaling

The reported take of North Pacific humpback whales by commercial whalers totalled approximately 7,700 between 1947 and 1987 (C. Allison! IWC, pers. comm.). In addition, approximately 7,300 were taken along the west coast of North America from 19 19 to 1929 (Tonnessen and Johnsen 1982). Total 1910- 1965 catches from the California-Washington stock includes at least the 2,000 taken in Oregon and Washington, the 3,400 taken in California, and the 2,800 taken in Baja California (Rice 1978). There has been a prohibition on taking humpback whales since 1966.

Fishery Information

Humpback whales are likely to be caught only in offshore drift gillnets. Drift gillnets are used by approximately 149 vessels (J. Cordaro, Southwest Region, NMFS, pers. comm.) to catch swordfish, thresher shark. and mako shark in California offshore waters (Hanan et al. 1993). Fishing effort has decreased from approximately 10,000 sets per year in the mid-1980s to 6,600 in 1993 (Barlow et al. 1994). The deaths of two humpback whales in the Southern California Bight have been attributed to entanglement in fishing gear (Heyning and Lewis 1990). Also. two unidentified whales, possibly humpbacks, were taken in the approximately 1% of drift gillnets observed in 1980-85 (Hanan 1986; Heyning and Lewis 1990). No humpback whales or unidentified baleen whales have been observed taken from 1990 to 1993 in gillnet observation programs which covered 5- 13% of fishing effort (Lennert et al. 1994; Perkins et al. 1992; Julian 1993, 1994); however, much of the gillnet mortality of large whales may go unobserved because whales swim away with a portion of the net.

Similar drift gillnet fisheries for swordfish and sharks exist along the entire Pacific coast of Baja California, Mexico and probably take animals from the same 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 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.

Fishery Mortality Rates

Whale mortality in gillnets cannot be measured accurately because they swim away with part of the net and the mortality is not observed unless the entangled whales subsequently strand. However, based on observed strandings, humpback whale mortality in California's drift gillnet fishery is probably about 0.5 whales per year and is almost certainly greater than 10% of the PBR. Therefore, total fishery mortality is not approaching zero mortality and serious injury rate. This determination cannot be made for individual fisheries until the implementing regulations for Section 118 of the

MMPA have been reviewed by the public and finalized.

Ship Strikes

Ship strikes were implicated in the deaths of at least 2 humpback whales in 1993 and 2 unidentified whales (possibly humpbacks) in 1990 (J. Cordaro, Southwest Region, NMFS, pers. comm.). 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 death by ship strikes from 1991-93 is 0.66 whales per year.

STATUS OF STOCK

Humpback whales in the North Pacific were estimated to have been reduced to 13% of carrying capacity (K) by commercial whaling (Braham 1991). Clearly the North Pacific population is severely depleted. The initial abundance has never been estimated separately for the "California" stock, but this stock was also probably depleted by whaling. Humpback whales are formally listed as "endangered" under the Endangered Species Act (ESA), and consequently the California/Mexico stock is automatically considered as a "depleted" and "strategic" stock under the MMPA. The estimated annual mortality due to entanglement (0.5/yr) plus ship strikes (0.7/yr) in California is thus greater than the PBR allocation of 0.5 for U.S. waters. The California stock appears to be increasing in abundance.

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BLUE WHALE *(Balaenoptera musculus):* California/Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The International Whaling Commission (IWC) has formally considered only one management stock for blue whales in the North Pacific (Donovan 1991), but now this ocean is thought to include more than one population (Ohsumi and Wada 1972; Braham 1991). One group of animals migrates from Mexico to feed in California waters from June to November. During this feeding period, there is an apparent hiatus in distribution south of the tip of Baja California (Reilly and Thayer 1990; Wade and Gerrodette 1993) and north of California in Oregon and Washington (Green et al. 1992; Barlow 1995). [Two blue whales were, however? tracked using on a seafloor seismic **array** approximately 500 km offshore from Astoria, Oregon in August 1990 (McDonald et al. 1994) and may have been part of the California/Mexico stock.] Although there are blue whales near the Costa Rican Dome in the eastern tropical Pacific from June to November, Reilly and Thayer (1990) speculate that these are likely to be part of a southern hemisphere population or an isolated resident population. Rice (1974) hypothesized that blue whales from Baja California migrated far offshore to fed in the eastern Aleutians or Gulf of Alaska and returned to feed in California waters; however, he has more recently concluded that the California population is separate from the Gulf of Alaska population (Rice 1992). Recently, blue whale feeding aggregations have not been found in Alaska despite several surveys (Leatherwood et al. 1982; Stewart et al. 1987; NMFS unpubl. data). Blue whales are now very common in southern California in June-September (Barlow 1995). Distinctively marked individuals have been shown to move between feeding areas in California and coastal waters of Mexico, including the Gulf of California (Calambokidis et al. 1990). Strong evidence exists for a separate population that spends winter/spring in Mexican coastal waters and summer/autumn in California waters, and there are no verified links to any other feeding areas. One other stock of North Pacific blue whales (in Hawaiian waters) is recognized in the Marine Mammal Protection Act (MMPA) Stock Assessment Reports.

POPULATION SIZE

The size of the feeding stock of blue whales in California was estimated recently by both line-transect and mark-recapture methods. Barlow (1995) estimates 2,250 (CV=O.38) blue whales in California waters based on ship line-transect surveys. Calambokidis and Steiger (1994) used photographic mark-recapture and estimated population sizes of 2,038 (CV=O.33) based on photographs of left sides and 1,997 (CV=O.42) based on right sides. The average of the mark-recapture estimates (2,017, CV=O.38) is in surprisingly good agreement with the line-transect estimate. Mark-recapture estimates are often negatively biased by individual heterogeneity in sighting probabilities (Hammond 1986); however, Calambokidis and Steiger (1994) minimize such effects by selecting one sample that was taken randomly with respect to distance from the coast. Similarly, the line-transect estimates may also be negatively biased because some blue whales in this stock are probably along Baja California and: therefore, out of the study area at the time of survey (Wade and Gerrodette 1993). The best estimate of blue whale abundance is the average of the line-transect and mark-recapture estimates, weighted by their variances, or 2,134 (CV=O.27). No blue whales were seen in recent aerial surveys off Oregon and Washington (Green et al. 1992), although one or two individuals were known to be present offshore of northern Oregon in August 1990 (McDonald et al. 1994).

Minimum Population Estimate

The minimum population estimate for blue whales is taken as the lower 20th percentile of the log-normal distribution of abundance estimated from the combined mark-recapture and line-transect estimates, or approximately 1,709.

Current Population Trend

There is some indication that blue whales have significantly increased in abundance in California coastal waters between 1979/80 and 1991 (Barlow 1994). 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 is too large to be accounted for by population growth alone. Although the population in the North Pacific is expected to have grown since being given protected status in 1966, the possibility of continued unauthorized takes after blue whales were protected (Yablokov 1994) and the existence of incidental ship strikes and gillnet mortality makes this uncertain.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (1:709) times one half the default maximum net growth rate for cetaceans (l/2 of 4%) times a recovery factor of 0.1 (for an endangered species), resulting in a PBR of 3.4. Because this stock spends approximately half its time in Mexican waters, the PBR allocation for U.S. waters is 1.7 whales per year.

ANNUAL HUMAN-CAUSED MORTALITY

Historic Whaling

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

Fisheries Information

Blue whales are likely to be caught only in offshore drift gillnets. Drift gillnets are used by approximately 149 vessels (J. Cordaro, Southwest Region: NMFS, pers. comm.) to catch swordfish, thresher shark, and mako shark in California offshore waters (Hanan et al. 1993). Fishing effort has decreased from approximately 10,000 sets per year in the mid-1980s to 6,600 in 1993 (Barlow et al. 1994). Two unidentified whales, possibly blue whales, were taken in the approximately 1% of drift gillnets observed in 1980-85 (Hanan 1986; Heyning and Lewis 1990). No blue whales or unidentified baleen whales have been observed taken from 1990 to 1993 in gillnet observation programs which covered 5-13% of fishing effort (Lennert et al. 1994; Perkins et al. 1992; Julian 1993, 1994); however, much of the gillnet mortality of large whales may go unobserved because whales swim away with a portion of the net.

Similar drift gillnet fisheries for swordfish and sharks exist along the entire Pacific coast of Baja California? Mexico and probably take animals from the same 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 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.

Fishery Mortality Rates

To date, no blue whale mortality has been associated with California gillnet fisheries. but the true mortality rate must be considered unknown because of unobserved mortality. Therefore, we cannot evaluate whether total fishery mortality is approaching zero mortality and serious injury rate. This determination cannot be made for individual fisheries until the implementing regulations for Section 118 of the MMPA have been reviewed by the public and finalized.

Ship Strikes

Ship strikes were implicated in the deaths of blue whales in 1980, 1986, 1987, and 1993, plus 2 unidentified whales (possibly blue whales) in 1990 (J. Cordaro, Southwest Region, NMFS and J. Heyning, pers. comm.). 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.).

STATUS OF STOCK

Previously, blue whales in the entire North Pacific were estimated to be at 33% (1,600 out of 4,900) of historic carrying capacity (Minoch et al. 1984). The initial abundance has never been estimated separately for the "California" stock, but this stock was almost certainly depleted by whaling. Blue whales are formally listed as "endangered" under the Endangered Species Act (ESA), and consequently the California/Mexico stock is automatically considered as a "depleted" and "strategic" stock under the MMPA. The annual incidental mortality from ship strikes is probably less than 1 per year and is therefore less than the calculated PBR for this stock. The population appears to be growing.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The International Whaling Commission (IWC) recognized two stocks of fin whales in the North Pacific: the East China Sea and the rest of the North Pacific (Donovan 1991). Mizroch et al. (1984) cites evidence for additional fin whale subpopulations in the North Pacific. From whaling records, fin whales that were marked in winter 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 1995; 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). Fin whales appear very scarce in the eastern tropical Pacific in summer (Wade and Gerrodette 1993) and winter (Lee 1993).

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. Coincidentally, fin whale abundance in the Gulf of California increases seasonally in winter and spring (Tershy et al. 1993). It is premature, however, to conclude that the Gulf whales are part of the U.S. west coast population. The Marine Mammal Protection Act (MMPA) stock assessment reports recognize three stocks of fin whales in the North Pacific: 1) the California/Oregon/Washington stock (this report), 2) the Hawaii stock, and 3) the Alaska stock.

POPULATION SIZE

The initial pre-whaling population of fin whales in the North Pacific was estimated to be 42,000-45,000 (Ohsumi and Wada 1974). In 1973, the North Pacific population was estimated to have been reduced to 13,620-18,680 (Ohsumi and Wada 1974), of which 8,520-10,970 were estimated to belong to the eastern Pacific stock. A minimum of 148 individually-identified fin whales are found in the Gulf of California (Tershy et al. 1990). Recently, 935 (CV=O.63) fin whale were estimated to be in California waters based on ship surveys in summer/autumn 1991 (log-normal 95% C.l.=299-2,925) (Barlow 1995). Fin whale abundance in California was estimated as only 49 (CV=l .O) based on aerial surveys in winter/spring of 1991/92 (Forney et al. 1995); however, this estimate does not include a correction for diving animals that were missed. No estimates exist for Oregon or Washington, but fin whales were reported to be the fourth most abundant large whale in that area (Green et al. 1992).

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 summer/fall ship survey (Barlow 1995) or approximately 575.

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), but this trend is not significant. Although the population in the North Pacific is expected to have grown since receiving protected status in 1976, the possible effects of continued unauthorized take (Yablokov 1994) and incidental ship strikes and gillnet mortality make this uncertain.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (575) times one half the default maximum net growth rate for cetaceans (l/2 of 4%) times a recovery factor of 0.1 (for an endangered species), resulting in a PBR of 1.1.

ANNUAL HUMAN-CAUSED MORTALITY

Historic Whaling

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

Fisheries Information

Fin whales are likely to be caught only in offshore drift gillnets. Drift gillnets are used by approximately 149 vessels (J. Cordaro. Southwest Region, NMFS, pers. comm.) to catch swordfish, thresher shark, and mako shark in California offshore waters (Hanan et al. 1993). Fishing effort has decreased from approximately 10,000 sets per year in the mid- 1980s to 6,600 in 1993 (Barlow et al. 1994). Two unidentified whales. possibly fin whales, were taken in the approximately 1% of drift gillnets observed in 1980-85 (Hanan 1986; Heyning and Lewis 1990). No fin whales or unidentified baleen whales have been observed taken from 1990 to 1993 in gillnet observation programs which covered 5-l3% of fishing effort (Lennert et al. 1994; Perkins et al. 1992; Julian 1993, 1994); however? much of the gillnet mortality of large whales may go unobserved because whales swim away with portion of the net.

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, which has increased from two vessels in 1986 to 29 vessels in 1992-(Sosa-Nishizaki et al. 1993). The total number of sets in this fishery in 1992 can be estimated from data provided by these authors to be approximately 2,700, with an observed rate of marine mammal bycatch of 0.13 animals per set (I 0 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.

Fishery Mortality Rates

To date, no fin whale mortality has been associated with California gillnet fisheries, but the true mortality rate must be considered unknown because of unobserved mortality. Therefore, we cannot evaluate whether total fishery mortality is approaching zero mortality and serious injury rate. This determination cannot be made for individual fisheries until the implementing regulations for Section 118 of the MMPA have been reviewed by the public and finalized.

Ship Strikes

Ship strikes were implicated in the deaths of one fin whale in 1991 and two unidentified whales (possibly fins) in 1990 (J. Heyning and J. Cordaro, Southwest Region, NMFS, pers. comm.). 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

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 (Minoch et al. 1984). The initial abundance has never been estimated separately for the “west coast” stock, but this stock was also probably depleted by whaling. Fin whales are formally listed as “endangered” under the Endangered Species Act (ESA), and consequently the California to Washington stock is automatically considered as a “depleted” and “strategic” stock under the MMPA. The observed incidental mortality due to fisheries and ship strikes appears to be less than 1 animal per year and is therefore less than the calculated PBR.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The International Whaling Commission (IWC) recognizes 3 stocks of Bryde's whales in the North Pacific (eastern, western, and East China Sea), 3 stocks in the South Pacific (eastern, western and Solomon Islands), and one cross-equatorial stock (Peruvian) (Donovan 1991). Bryde's whales are distributed widely across the tropical and warm-temperate Pacific (Leatherwood et al. 1982), and there is no real justification for splitting stocks between the northern and southern hemispheres (Donovan 1991). Recent surveys (Wade and Gerrodette 1993; Lee 1993) have shown them to be common and distributed throughout the eastern tropical Pacific with a concentration around the equator east of 110°W (corresponding approximately to the IWC's "Peruvian stock") and a reduction west of 140°W. They are also the most common baleen whale in the central Gulf of California (Tershy et al. 1990). Only one was positively identified in surveys of California coastal waters (Barlow 1995). Bryde's whales in California are likely to belong to a larger population inhabiting at least the eastern part of the tropical Pacific. For the Marine Mammal Protection Act (MMPA) stock assessment reports, Bryde's whales within the Pacific U.S. Exclusive Economic Zone are divided into two areas: 1) the eastern tropical Pacific (east of 150°W and including the Gulf of California and waters off California; this report), and 2) Hawaiian waters.

POPULATION SIZE

In the western North Pacific, Bryde's whale abundance in the early 1980s was estimated independently by tag mark-recapture and ship survey methods to be 22,000 to 24,000 (Tillman and Mizroch 1982; Miyashita 1986). Bryde's whale abundance has never been estimated for the entire eastern Pacific; however, a portion of that stock in the eastern tropical Pacific was estimated recently as 13,000 (CV=O.20: 95% C.I.=8,900-19,900) (Wade and Gerrodette 1993) and the minimum number in the Gulf of California is 160 based on individually-identified whales (Tershy et al. 1990). Only 1 confirmed sighting of Bryde's whales and 5 possible sightings (identified as sei or Bryde's whales) were made in California waters during extensive ship and aerial surveys in 1991, 1992, and 1993 (Hill and Barlow 1992; Carretta and Forney 1993; Mangels and Gerrodette 1994). Green et al. (1992) did not report any sightings of Bryde's whales in aerial surveys of Oregon and Washington. The estimated abundance of Bryde's whales in California coastal waters is 61 (CV=l .1) (Barlow 1995).

Minimum Population Estimate

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

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (11,163) times one half the default maximum net growth rate for cetaceans (l/2 of 4%) times a recovery factor of 0.5 (for a stock of unknown status), resulting in a PBR of 112. Only 0.5% of the stock is estimated to be in U.S. waters (61 out of 13,000), so the PBR allocation to U.S. waters is only 0.5 Bryde's whales per year.

ANNUAL HUMAN-CAUSED MORTALITY

Historic Whaling

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

Fishery Information

Bryde's whales are likely to be caught only in offshore drift gillnets. Drift gillnets are used by approximately 149 vessels (J. Cordaro, Southwest Region, NMFS, pers. comm.) to catch swordfish, thresher shark, and mako shark in California offshore waters (Hanan et al. 1993). Fishing effort has decreased from approximately 10,000 sets per year in the mid-1980s to 6,600 in 1993 (Barlow et al. 1994). Two unidentified whales, possibly Bryde's whales, were taken in the approximately 1% of drift gillnets observed in 1980-85 (Hanan 1986; Heyning and Lewis 1990). No Bryde's whales or unidentified baleen whales have been observed taken from 1990 to 1993 in gillnet observation programs which covered 5-13% of fishing effort (Lennert et al. 1994; Perkins et al. 1992; Julian 1993, 1994); however, much of the gillnet mortality of large whales may go unobserved because whales swim away with a portion of the net.

Similar drift gillnet fisheries for swordfish and sharks exist along the entire Pacific coast of Baja California, Mexico and probably take animals from the same 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 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.

Fishery Mortality Rates

To date, no Bryde's whale mortality has been associated with California gillnet fisheries (although some mortality may have gone unobserved). The total mortality rate is not thought to be greater than the PBR; therefore, under the MMPA, total fishery mortality is approaching zero mortality and serious injury rate. This determination cannot be made for individual fisheries until the implementing regulations for Section 118 of the MMPA have been reviewed by the public and finalized.

Ship Strikes

Ship strikes may occasionally kill Bryde's whales as they are known to kill their larger relatives: blue and fin whales.

STATUS OF STOCK

Commercial whaling of Bryde's whales was largely limited to the western Pacific. Bryde's whales are not listed as "threatened" or "endangered" under the Endangered Species Act (ESA). Bryde's whales in the eastern tropical Pacific would not be considered a strategic stock under the MMPA.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The International Whaling Commission (IWC) only considers one stock of sei whales in the North Pacific (Donovan 1991), but some evidence exists for multiple populations (Masaki 1977; Mizroch et al. 1984; Horwood 1987). Sei whales are distributed far out to sea in temperate regions of the world and do not appear to be associated with coastal features. The catch has been distributed continuously across the North Pacific between 45-55°N (Masaki 1977). Two sei whales that were tagged off California were later killed off Washington and British Columbia (Rice 1974) and the movement of tagged animals has been noted in many other regions of the North Pacific. Sei whales are now rare in California waters (Dohl et al. 1983; Barlow 1995; Forney et al. 1995; Mangels and Gerrodette 1994), but were the fourth most common whale taken by California coastal whalers in the 195Os-1960s (Rice 1974). They are extremely rare south of California (Wade and Gerrodette 1993; Lee 1993). Lacking additional information on sei whale population structure, sei whales in the eastern North Pacific (east of longitude 180") will be considered as a separate stock.

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 one confirmed sighting of sei whales and 5 possible sightings (identified as sei or Bryde's whales) were made in California waters during extensive ship and aerial surveys in 1991, 1992, and 1993 (Hill and Barlow 1992; Carretta and Forney 1993; Mangels and Gerrodette 1994). Green et al. (1992) did not report any sightings of sei whales in aerial surveys of Oregon and Washington. There are no abundance estimates for sei whales along the west coast of the U.S. or in the eastern North Pacific.

Minimum Population Estimate

Minimum population estimates do not exist for sei whales in the eastern North Pacific.

Current Population Trend

There are no data on trends in sei whale abundance in California coastal 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

No estimate exists for the minimum abundance of the eastern North Pacific stock of sei whales. Estimates for the entire North Pacific are more than 10 years old and do not include statistical estimates of precision. Consequently, PBR levels cannot be calculated.

ANNUAL HUMAN-CAUSED MORTALITY

Historic Whaling

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

Fishery Information

Sei whales are likely to be caught only in offshore drift gillnets. Drift gillnets are used by approximately 149 vessels (J. Cordaro, Southwest Region, NMFS, pers. comm.) to catch swordfish, thresher shark, and mako shark in California offshore waters (Hanan et al. 1993). Fishing effort has decreased from approximately 10,000 sets per year in the mid-1980s to 6,600 in 1993 (Barlow et al. 1994). Two unidentified whales, possibly sei whales, were taken in the approximately 1% of drift gillnets observed in 1980-85 (Hanan 1986; Heyning and Lewis 1990). No sei whales or unidentified baleen whales have been observed taken from 1990 to 1993 in gillnet observation programs which covered 5-13% of fishing effort (Lennert et al. 1994; Perkins et al. 1992; Julian 1993, 1994); however, much of the gillnet mortality of large whales may go unobserved because whales swim away with a portion of the net.

Fishery Mortality Rates

To date, no sei whale mortality has been associated with any eastern North Pacific fisheries, but the true mortality rate must be considered unknown because of unobserved mortality. Therefore, we cannot evaluate whether total fishery mortality is approaching zero mortality and serious injury rate. This determination cannot be made for individual fisheries until the implementing regulations for Section 118 of the MMPA have been reviewed by the public and finalized.

Ship **Strikes**

Ship strikes may occasionally kill sei whales as they have been shown to kill their larger relatives: blue and fin whales.

STATUS OF STOCK

Previously, sei whales were estimated to have been reduced to 20% (8,600 out of 42,000) of their pre-whaling abundance in the North Pacific (Tillman 1977). The initial abundance has never been reported separately for the eastern North Pacific stock, but this stock was also probably depleted by whaling. Sei whales are formally listed as “endangered” under the Endangered Species Act (ESA), and consequently the eastern North Pacific stock is automatically considered as a “depleted” and “strategic” stock under the Marine Mammal Protection Act (MMPA).

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The International Whaling Commission (IWC) recognizes 3 stocks of minke whales in the North Pacific: one in the Sea of Japan/East China Sea, one in the rest of the western Pacific west of 180°N, and one in the "remainder" of the Pacific (Donovan 1991). The "remainder" stock only reflects the lack of exploitation in the eastern Pacific and does not imply that only one population exists in that area (Donovan 1991). In the "remainder" area, minke whales are relatively common in the Bering and Chukchi seas and in the Gulf of Alaska, but are not considered abundant in any other part of the eastern Pacific (Leatherwood et al. 1982; Brueggeman et al. 1990). Minke whales are usually seen over continental shelves (Brueggeman et al. 1990). ln 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; Barlow 1995; Forney et al. 1995) 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 will be considered as a separate stock. Minke whales in Alaskan waters are considered in a separate stock assessment report.

POPULATION SIZE

No estimates have been made for the number of minke whales in the entire North Pacific. In California coastal waters, the number of minke whales is estimated as 526 (CV=O.97; log-normal 95% C.I.=106-2,596) (Barlow 1995). Forney et al. (1995) estimate at total of 73 (CV=O.62) in the same area based on an aerial survey, but this estimate is negatively biased because it excludes diving whales. In addition, Green et al. (1992) report 4 sightings of minke whales in aerial surveys of Oregon and Washington, but they did not estimate population size for that 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 the summer/fall ship survey in California waters (Barlow 1995) or approximately 265. More sophisticated methods of estimating minimum population size would be available if a correction factor (and associated variance) were available to correct the aerial survey estimates for missed animals. Minimum estimates of abundance are still needed for Oregon and Washington.

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 (265) times one half the default maximum net growth rate for cetaceans (1 /2 of 4%) times a recovery factor of 0.5 (for a stock of unknown status), resulting in a PBR of 2.6.

ANNUAL HUMAN-CAUSED MORTALITY

Historic Whaling

The estimated take of western North Pacific minke whales by commercial whalers was approximately 31,OOO from 1930 to 1987 (C. Allison, IWC, pers. comm.). None were reported taken by shore-based whaling stations in central California between 1958 and 1965 (Rice 1974), and minke whales were not harvested commercially in the eastern North Pacific. Reported aboriginal takes of minke whales in Alaska totalled 7 between 1930 and 1987 (C. Allison, IWC, pers. comm.).

Fishery Information

Minke whales may occasionally be caught in both coastal set gillnets and offshore drift gillnets. Set gillnets are used by approximately 134 vessels (J. Cordaro, Southwest Region, NMFS: pers. comm.) to catch halibut, flounder, angel shark, yellowtail, white seabass, and white croaker in California coastal waters, and marine mammal mortality has been noted in all these fisheries (Barlow et al. 1994). As a result of area closures, setnet fishing effort has decreased from approximately 40,000 sets per year in the mid- 1980s to 16,000 in 1993 (Barlow et al. 1994) and is expected to decrease again in 1994 because of a new ban on fishing within 3 nmi of shore in southern California. Drift gillnets are used by approximately 149 vessels (J. Cordaro, Southwest Region, NMFS. pers. comm.) to catch swordfish, thresher shark, and mako shark in California offshore waters (Hanan et al. 1993). Driftnet fishing effort has decreased from approximately 10,000 sets per year in the mid-1980s to 6,600 in 1993 (Barlow et al. 1994). The deaths of two minke whales which stranded in the Southern California Bight (in 1983 and 1988) have been attributed to entanglement in fishing gear (Heyning and Lewis 1990). Also, two minke whales and two unidentified whales were taken in the approximately 1% of drift gillnets observed in 1980-86 (one minke whale was released alive) (Hanan 1986; Hanan et al. 1993). No minke whales or unidentified baleen whales have been observed taken from 1990 to 1993 in gillnet observation programs which covered 5-13% of fishing effort (Lennert et al. 1994; Perkins et al. 1992; Julian 1993, 1994). One was observed killed in the driftnet fishery in 1994 (NMFS, unpubl. data). Minke whales are also likely to be caught in salmon drift gillnets in Puget Sound, Washington.

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, which has increased from two vessels in 1986 to 29 vessels in 1992-(Sosa-Nishizaki et al. 1993). The total number of sets in this fishery in 1992 can be estimated from data provided by these authors to be approximately 2.700. with an observed rate of marine mammal bycatch of 0.13 animals per set (10 marine mammals in 77 observed sets; Sosa-Nishizaki et al. 1993). This overall mortality rate is similar to that observed in California driftnet fisheries during 1990-93 (0.15 marine mammals per set), but species-specific information is not available for the Mexican fisheries. The number of set gillnets used in Mexico is unknown.

Fishery Mortality Rates

The total fishery mortality for this species is known to be at least 5 animals over the last 10 years, which gives an annual rate (0.5) that exceeds 10% of the calculated PBR. Therefore, total fishery mortality is not approaching zero mortality and serious injury rate. This determination cannot be made for individual fisheries until the implementing regulations for Section 118 of the Marine Mammal Protection Act (MMPA) have been reviewed by the public and finalized.

Ship Strikes

Ship strikes were implicated in the death of one minke whale in 1977 and 2 unidentified whales (possibly minke whales) in 1990 (J. Heyning and J. Cordaro, pers. comm.). Additional mortality from ship strikes probably goes unreported because the whales do not strand or, if they do, they do not always have obvious signs of trauma.

STATUS OF STOCK

There were no known commercial takes of minke whales from Baja California to Washington. Minke whales are not listed as “endangered” under the Endangered Species Act and are not considered “depleted” under the MMPA. The greatest uncertainty in their status is whether entanglement in commercial gillnets and ship strikes could have reduced this relatively small population. Total fishery mortality for minke whales was not estimated for the 1980-86 observer program? but based on the 2 observed deaths in 1% of the total sets, the total mortality during this time may have been on the order of 200 minke whales or 40 per year. Because of this, the status of the west-coast stock should be considered “unknown”. For the past 3 years, the annual mortality due to fisheries and ship strikes appears to be less than the calculated PBR for this stock, so they would not be considered a “strategic” stock under the MMPA. The observation of even one entanglement per year would, however, result in an extrapolated mortality estimate that would exceed the PBR. There is no information on trends in the abundance of this stock.

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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 (Miyazaki and Perrin 1994). They are present around all the main Hawaiian islands (Shallenberger 1981; Tomich 1986) and have been observed at least as far northwest as French Frigate Shoals (Nitta and Henderson 1993). Five strandings have been reported from Maui, Oahu, and the island of Hawaii (Nitta 1991). Nothing is known about stock structure for this species in the North Pacific. For the Marine Mammal Protection Act (MMPA) stock assessment reports, there is a single Pacific management stock including only animals found within the U.S. Exclusive Economic Zone of the Hawaiian Islands.

POPULATION SIZE

A population estimate for this species has been made in the eastern tropical Pacific (Wade and Gerrodette 1993), but there are no data for a population estimate in Hawaiian waters.

Minimum Population Estimate

No data are available for 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 species at this time.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

No estimate of annual human-caused mortality and serious injury is available: as no mortality of this species has been documented in Hawaiian fisheries (Nitta and Henderson 1993). However, mortality of other cetacean species has been observed in Hawaiian fisheries, and the gear types used in these 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, Donovan and Barlow 1994).

Fishery Information

Pelagic, bottomfish and lobster fisheries occur in Hawaiian waters. Pelagic fisheries include commercial fisheries (troll, handline, longline: local inshore gillnet), commercial charter and recreational troll fishing. Only the longline fishery is subject to active management through a Fishery Management Plan. The growth of the longline fleet between 1989 and 1991 generated concerns regarding impact on fish stocks (especially swordfish), on other fisheries (troll, handline), and on protected species (mainly sea turtles). The value of longline landings increased to almost $45 million in 1992 and 1993. Regulations established longline fishery permit and reporting requirements, area closures in the Northwestern Hawaiian Islands (NWHI) to protect Hawaiian monk seals and in the main Hawaiian Islands to prevent gear conflicts, a limited entry program, a mandatory observer program, and a requirement for installation and operation of vessel monitoring equipment on longline vessels in Hawaii. Approximately 165 longline permits have been issued. The commercial non-longline fisheries (troll: handline, gillnet) have more than 2,000 participants but account only for about $10 - $l5 million per year in landings. The number of anglers and value of recreational fishing are unknown. Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries, and some of these interactions involved rough-toothed dolphins (Nitta and Henderson 1993). They 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).**

The commercial lobster fishery in the NWHI is managed by federal regulations which include size limits, area closures, seasons: gear restrictions, annual quotas and reporting requirements. Fifteen permits have been issued for this fishery. The fishery was closed in 1993 and only five vessels operated in the fishery in 1994. No interactions between marine mammals and this fishery have been recorded in the past five years.

The bottomfish fishery occurs throughout the NWHI and the main Hawaiian Islands using handlines. In the NWHI, there are two zones in which fishing takes place. The Ho’omalu Zone has limited entry and the Mau Zone has open access. There are currently 11 permits for the Ho’omalu Zone and 30 for the Mau Zone. However, in 1994, only five vessels fished in the Ho’omalu Zone and 15-20 vessels fished in the Mau Zone. Total landings of bottomfish in Hawaii from all waters have fluctuated little in recent years, about 400,000 pounds per year from the NWHI and about 500,000 pounds per year from the main Hawaiian Islands. Fishermen claim interactions with dolphins who steal bait and catch are increasing.

Other Mortality

At least 22 rough-toothed dolphins were live-captured in Hawaiian waters between 1963 and 1976 (Shallenberger 1981).

Fishery Mortality Rate

The total fishery mortality and serious injury cannot be considered to be insignificant and approaching zero because the population size of this stock of rough-toothed dolphins is unknown. Determination cannot be made for individual fisheries until the implementing regulations for section 118 of the MMPA have been reviewed by the public and finalized.

STATUS OF STOCK

The status of rough-toothed dolphins in Hawaiian waters is unknown. The stock’s status relative to OSP under the MMPA is also unknown. The species is not listed as threatened or endangered under the Endangered Species Act (1973). Although information on rough-toothed dolphins in Hawaiian waters is limited, this stock would be considered non-strategic under the 1994 amendments to the MMPA given the absence of reported fisheries related mortality.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Risso's dolphins are found in tropical to warm-temperate waters worldwide (Kruse *et al.* In press). They appear to be rare in Hawaiian waters. Of three reported sightings of this species by Shallenberger (1981). only one was verified. There are four stranding records from the main islands (Nitta 1991). Balcomb (1987) referred to a sighting of a large herd off the Kona Coast in February 1985. 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) Hawaiian waters (this report), and 2) waters off California, Oregon and Washington.

POPULATION SIZE

Population estimates have been made off Japan (Miyashita 1993) and in the eastern tropical Pacific (Wade and Gerrodette 1993), but there are no data for a population estimate in Hawaiian waters.

Minimum Population Estimate

No data are available for 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 for Hawaiian animals.

POTENTIAL BIOLOGICAL REMOVAL

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

ANNUAL HUMAN CAUSED MORTALITY AND SERIOUS INJURY

No estimate of annual human-caused mortality and serious injury is available as there are no reports of direct or incidental takes of Risso's dolphins in Hawaiian waters. However? mortality of other cetacean species has been observed in Hawaiian fisheries? and the gear types used in these 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, Donovan and Barlow 1994).

Fishery Information

Pelagic, bottomfish and lobster fisheries occur in Hawaiian waters. Pelagic fisheries include commercial fisheries (troll: handline, longline, local inshore gillnet), commercial charter and recreational troll fishing. Only the longline fishery is subject to active management through a Fishery Management Plan. The growth of the longline fleet between 1989 and 1991 generated concerns regarding impact on fish stocks (especially swordfish), on other fisheries (troll, handline), and on protected species (mainly sea turtles). The value of longline landings increased to almost $45 million in 1992 and 1993. Regulations established longline fishery permit and reporting requirements, area closures in the Northwestern Hawaiian Islands (NWHI) to protect Hawaiian monk seals and in the main Hawaiian Islands to prevent gear conflicts, a limited entry program, a mandatory observer program, and a requirement for installation and operation of vessel monitoring equipment on longline vessels in Hawaii. Approximately 165 longline permits have been issued. The commercial non-longline fisheries (troll. handline. gillnet) have more than 2,000 participants but account only for about $10 - $l5 million per year in landings, The number of anglers and value of recreational fishing are unknown. Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nina and Henderson 1993), but no interactions with Risso's dolphins have been documented.

The commercial lobster fishery in the NWHI is managed by federal regulations which include size limits: area closures. seasons, gear restrictions. annual quotas and reporting requirements. Fifteen permits have been issued for this fishery. The fishery was closed in 1993 and only five vessels operated in the fishery in 1994. No interactions between marine mammals and this fishery have been recorded in the past five years.

The bottomfish fishery occurs throughout the NWHI and the main Hawaiian Islands using handlines. In the NWHI, there are two zones in which fishing takes place. The Ho'omalu Zone has limited entry and the Mau Zone has open access. There are currently 11 permits for the Ho'omalu Zone and 30 for the Mau Zone. However, in 1994, only five vessels fished in the Ho'omalu Zone and 15-20 vessels fished in the Mau Zone. Total landings of bottomfish in Hawaii from all waters have fluctuated little in recent years, about 400,000 pounds per year from the NWHI and about 500,000 pounds per year from the main Hawaiian Islands. Fishermen claim interactions with dolphins who steal bait and catch are increasing.

Fishery Mortality Rate

The total fishery mortality and serious injury cannot be considered to be insignificant and approaching zero because the population size of this stock of Risso's dolphins is unknown. Determination cannot be made for individual fisheries until the implementing regulations for section 118 of the MMPA have been reviewed by the public and finalized.

STATUS OF STOCK

The status of Risso's dolphins in Hawaiian waters is unknown. The stock's status relative to OSP under the MMPA is also unknown. The species is not listed as threatened or endangered under the Endangered Species Act (1973). Although information on Risso's dolphins in Hawaiian waters is limited, this stock would be considered non-strategic under the 1994 amendments to the MMPA given the absence of reported fisheries related mortality.

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BOTTLENOSE DOLPHIN *(Tursiops truncatus):* Hawaiian Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

Although only three strandings have been reported (Nina 1991), bottlenose dolphins are common throughout the Hawaiian Islands, from the island of Hawaii to Kure Atoll (Shallenberger 1981). In the Northwestern Hawaiian Islands, they are found primarily in relatively shallow inshore waters (Rice 1960). In the main Hawaiian Islands, they are found in both shallow inshore waters and deep channels between islands.

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 the bottlenose dolphins in Hawaiian waters belong to a separate stock from those in the ETP. 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) Hawaiian stock (this report), 2) California, Oregon and Washington offshore stock, and 3) California coastal stock.

POPULATION SIZE

Population estimates have been made in Japanese waters (Miyashita 1993) and the eastern tropical Pacific (Wade and Gerrodette 1993), but no data are available to make a population estimate in Hawaiian waters. In 1987, a minimum count of 430 bottlenose dolphins was obtained from vessel and aerial surveys of inshore waters around Oahu, Molokai, Lanai, Maui and Hawaii (Naval Ocean Systems Center unpublished data, cited in Nitta and Henderson 1993). It is unclear what proportion of the species' range was surveyed in this study.

Minimum Population Estimate

No data from the past five years are available to make 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 rates for Hawaii.

POTENTIAL BIOLOGICAL REMOVAL

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

ANNUAL HUMAN-CAUSED MORTALITY

Although some mortality of bottlenose dolphins has been observed in inshore gillnets, no estimate of annual human-caused mortality and serious injury is available. The gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Gillnets appear to capture marine mammals wherever they are used, and float lines from lobster traps and longlines can be expected to occasionally entangle whales (Perrin, Donovan and Barlow 1994).

Fishery Information

Pelagic, bottomfish and lobster fisheries occur in Hawaiian waters. Pelagic fisheries include commercial fisheries (troll, handline, longline, local inshore gillnet), commercial charter and recreational troll fishing. Only the longline fishery is subject to active management through a Fishery Management Plan. The growth of the longline fleet between 1989 and 1991 generated concerns regarding impact on fish stocks (especially swordfish), on other fisheries (troll, handline), and on protected species (mainly sea turtles). The value of longline landings increased to almost $45 million in 1992 and 1993. Regulations established longline fishery permit and reporting requirements, area closures in the Northwestern Hawaiian Islands (NWHI) to protect Hawaiian monk seals and in the main Hawaiian Islands to prevent gear conflicts, a limited entry program, a mandatory observer program, and a requirement for installation and operation of vessel monitoring equipment on longline vessels in Hawaii. Approximately 165 longline permits have been issued. The commercial non-longline fisheries (troll, handline, gillnet) have more than 2,000 participants but account only for about $10 - $15 million per year in landings. The number of anglers and value of recreational fishing are unknown. Monofilament small-mesh (about 5cm stretched) gillnets are commonly set on shallow reefs around all the main islands, usually at depths of less than 10 meters (Nitta and Henderson 1993). Inshore reef fish are the targets of this fishing. During 1992/93 the State of Hawaii received 288 applications for fishing permits that listed nets as the primary gear and gillnets were specified in 161 additional applications for permits (Nitta and Henderson 1993). Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries, and many of these interactions involved bottlenose dolphins (Nitta and Henderson 1993). They are one of the species commonly reported to take bait and catch from several Hawaiian sport and commercial fisheries (Nitta and Henderson 1993; Schlais 1984). Observations of bottlenose dolphins taking bait or catch have also been made in the day handline fishery (palu-ahi) for tuna, the handline fishery for mackerel scad, the troll fishery for billfish and tuna, and the inshore set gillnet fishery (Nitta and Henderson 1993). Beginning in the early 1970s the National Marine Fisheries Service received reports of fishermen shooting at bottlenose dolphins to deter them from taking fish catches (Nitta and Henderson 1993). Nitta and Henderson (1993) also reported that one bottlenose dolphin calf was removed from small-mesh set gillnet off Maui in 1991 and expressed surprise that bottlenose dolphins are “rarely reported entangled or raiding set gill nets in Hawaii,” considering that they so often remove fish from fishing lines.

The commercial lobster fishery in the NWHI is managed by federal regulations which include size limits, area closures, seasons, gear restrictions, annual quotas and reporting requirements. Fifteen permits have been issued for this fishery. The fishery was closed in 1993 and only five vessels operated in the fishery in 1994. No interactions between marine mammals and this fishery have been recorded in the past five years.

The bottomfish fishery occurs throughout the NWHI and the main Hawaiian Islands using handlines. In the NWHI, there are two zones in which fishing takes place. The Ho’omalu Zone has limited entry and the Mau Zone has open access. There are currently 11 permits for the Ho’omalu Zone and 30 for the Mau Zone. However, in 1994, only five vessels fished in the Ho’omalu Zone and 15-20 vessels fished in the Mau Zone. Total landings of bottomfish in Hawaii from all waters have fluctuated little in recent years, about 400,000 pounds per year from the NWHI and about 500,000 pounds per year from the main Hawaiian Islands. 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 who steal bait and catch are increasing.

Other Mortality

At least 36 bottlenose dolphins were live-captured in Hawaiian waters between 1963 and 1981 (Shallenberger 1981). The main capture area was around Oahu.

Fishery Mortality Rate

The total fishery mortality and serious injury cannot be considered to be insignificant and approaching zero because the population size of this stock of bottlenosed dolphins is unknown. Determination cannot be made for individual fisheries until the implementing regulations for section 118 of the MMPA have been reviewed by the public and finalized.

STATUS OF STOCK

The status of bottlenose dolphins in Hawaiian waters is unknown. The stocks status relative to OSP under the MMPA is also unknown. They are not listed as threatened or endangered under the Endangered Species Act (1973). Although information on bottlenose dolphins in Hawaiian waters is limited, this stock would be considered non-strategic under the 1994 amendments to the MMPA given the insignificance of reported fisheries related mortality.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Pantropical spotted dolphins are primarily found in tropical and subtropical waters worldwide (Perrin and Hohn 1994). Much of what is known about the species in the North Pacific has been learned from specimens obtained in the large directed fishery in Japan and in the eastern tropical Pacific (ETP) tuna purse-seine fishery (Perrin and Hohn 1994). These dolphins are common and abundant throughout the Hawaiian archipelago, particularly in channels between islands, over offshore banks (e.g. Penguin Banks), and off the lee shores of the islands (see Shallenberger 1981). Nitta (1991) only documented three strandings of this species in Hawaii. 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. 1994). Their possible affinities with other stocks elsewhere in the Pacific have not been investigated. For the Marine Mammal Protection Act (MMPA) stock assessment reports, there is a single Pacific management stock including only animals found within the U.S. Exclusive Economic Zone of the Hawaiian Islands. Spotted 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 no data are available to estimate population size for this species in any part of the central Pacific.

Minimum Population Estimate

No data are available for 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 species at this time.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

No estimate of annual human-caused mortality and serious injury is available as there are no reports of direct or incidental takes of pantropical spotted dolphins in Hawaiian waters (Nitta and Henderson 1993). However, mortality of other cetacean species has been observed in Hawaiian fisheries, and the gear types used in these 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, Donovan and Barlow 1994).

Fishery Information

Pelagic, bottomfish and lobster fisheries occur in Hawaiian waters. Pelagic fisheries include commercial fisheries (troll, handline, longline, local inshore gillnet), commercial charter and recreational troll fishing. Only the longline fishery is subject to active management through a Fishery Management Plan. The growth of the longline fleet between 1989 and 1991 generated concerns regarding impact on fish stocks (especially swordfish), on other fisheries (troll, handline), and on protected species (mainly **sea** turtles). The value of longline landings increased to almost $45 million in 1992 and 1993. Regulations established longline fishery permit and reporting requirements, area closures in the Northwestern Hawaiian Islands (NWHI) to protect Hawaiian monk seals and in the main Hawaiian Islands to prevent gear conflicts, a limited entry program, a mandatory observer program, and a requirement for installation and operation of vessel monitoring equipment on longline vessels in Hawaii. Approximately 165 longline permits have been issued. The commercial non-longline fisheries (troll, handline: gillnet) have more than 2,000 participants but account only for about \$10 - \$15 million per year in landings. The number of anglers and value of recreational fishing are unknown. Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nitta and Henderson 1993), but no interactions with pantropical spotted dolphins have been documented.

The commercial lobster fishery in the NWHI is managed by federal regulations which include size limits, area closures, seasons, gear restrictions, annual quotas and reporting requirements. Fifteen permits have been issued for this fishery. The fishery was closed in 1993 and only five vessels operated in the fishery in 1994. No interactions between marine mammals and this fishery have been recorded in the past five years.

The bottomfish fishery occurs throughout the NWHI and the main Hawaiian Islands using handlines. In the NWHI, there are two zones in which fishing takes place. The Ho'omalu Zone has limited entry and the Mau Zone has open access. There are currently 11 permits for the Ho'omalu Zone and 30 for the Mau Zone. However, in 1994, only five vessels fished in the Ho'omalu Zone and 15-20 vessels fished in the Mau Zone. Total landings of bottomfish in Hawaii from all waters have fluctuated little in recent years. about 400,000 pounds per year from the NWHI and about 500,000 pounds per year from the main Hawaiian Islands. Fishermen claim interactions with dolphins who steal bait and catch are increasing.

Other Mortality

At least 52 pantropical spotted dolphins were live-captured in Hawaii between 1963 and 1978 (Shallenberger 1981).

Fishery Mortality Rate

The total fishery mortality and serious injury cannot be considered to be insignificant and approaching zero because the population size of this stock of pantropical spotted dolphins is unknown. Determination cannot be made for individual fisheries until the implementing regulations for section 118 of the MMPA have been reviewed by the public and finalized.

STATUS OF STOCK

The status of pantropical spotted dolphins in Hawaiian waters is unknown. The stock's status relative to OSP under the MMPA is also unknown. The species is not listed as threatened or endangered under the Endangered Species Act (1973). Although information on pantropical spotted dolphins in Hawaiian waters is limited, this stock would be considered non-strategic under the 1994 amendments to the MMPA given the absence of reported fisheries related mortality.

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SPINNER DOLPHIN *(Stenella longirostris):* Hawaiian Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Spinner dolphins are found throughout the world in tropical and warm-temperate waters (Perrin and Gilpatrick 1994). They are common and abundant throughout the entire Hawaiian archipelago (Shallenberger 1981; Norris and Dohl 1980; Norris et *al.* 1994). There is some suggestion from an intensive study of spinner dolphins off the Kona Coast of Hawaii that the waters surrounding this island may have a large, relatively stable "resident" population (Norris *et al.* 1994).

Hawaiian spinner dolphins belong to a stock that is separate from those involved in the tuna purse-seine fishery in the eastern tropical Pacific (Perrin 1975; Dizon et *al.* 1994). The Hawaiian form is referrable to the subspecies S. *longirostris lougirostris*, which occurs pantropically (Perrin 1990). For the Marine Mammal Protection Act (MMPA) stock assessment reports, there is a single Pacific management stock including only animals found within the U.S. Exclusive Economic Zone of the Hawaiian Islands. Spinner dolphins involved in eastern tropical Pacific tuna purse-seine fisheries are managed separately under the MMPA.

POPULATION SIZE

Wade and Gerrodette (1993) estimated the sizes of populations in the eastern tropical Pacific. Although spinner dolphins are clearly among the most abundant cetaceans in Hawaiian waters, available population estimates apply only to the west coast of Hawaii. Norris *et al.* (1994) photoidentified 192 individuals along the west coast of Hawaii and estimated 960 animals for this area in 1979- 1980. Ostman (1994) photoidentified 677 individual spinner dolphins in the same area from 1989 to 1992. Using the same estimation procedures as Norris et *al.* (1994), Ostman (1994) estimated a population size of 2.334 for his study area along the Kona coast of Hawaii.

Minimum Population Estimate

The available population estimates apply to only a portion of the species' extensive range in Hawaiian waters. Ostman's (1994) total of 677 spinner dolphins can be regarded as a minimum count, but it must be noted that it applies only to the west coast of the island of Hawaii.

Current Population Trend

No data on current population trend are available.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Based on this species' unknown status and growth rate. the recovery factor (F_R) is 0.5 and $1/2R_{max}$ is the default value 0.02. Using these values and the minimum count of 677, the PBR is 6.8 animals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Although some mortality of spinner dolphins has been observed in inshore gillnets, no estimate of annual human-caused mortality and serious injury is available. The gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Gillnets appear to capture marine mammals wherever they are used, and float lines from lobster traps and longlines can be expected to occasionally entangle whales (Perrin, Donovan and Barlow 1994).

Fishery Information

Pelagic, bottomfish and lobster fisheries occur in Hawaiian waters. Pelagic fisheries include commercial fisheries (troll, handline, longline, local inshore gillnet), commercial charter and recreational troll fishing. Only the longline fishery is subject to active management through a Fishery Management Plan. The growth of the longline fleet between 1989 and 1991 generated concerns regarding impact on fish stocks (especially swordfish), on other fisheries (troll, handline), and on protected species (mainly sea turtles). The value of longline landings increased to almost $45 million in 1992 and 1993. Regulations established longline fishery permit and reporting requirements, area closures in the Northwestern Hawaiian Islands (NWHI) to protect Hawaiian monk seals and in the main Hawaiian Islands to prevent gear conflicts, a limited entry program, a mandatory observer program, and a requirement for installation and operation of vessel monitoring equipment on longline vessels in Hawaii. Approximately 165 longline permits have been issued. The commercial non-longline fisheries (troll, handline, gillnet) have more than 2,000 participants but account only for about $10 - $l5 million per year in landings. The number of anglers and value of recreational fishing are unknown. Monofilament small-mesh (about 5cm stretched) gillnets are commonly set on shallow reefs around all the main islands, usually at depths of less than 10 meters (Nitta and Henderson 1993). Inshore reef fish are the targets of this fishing. During 1992/93 the State of Hawaii received 288 applications for fishing permits that listed nets as the primary gear and gillnets were specified in 161 additional applications for permits (Nitta and Henderson 1993). Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries, and there are records of spinner dolphins taken in inshore monofilament gillnets and net fragments in Hawaiian waters (Nitta and Henderson 1993).

The commercial lobster fishery in the NWHI is managed by federal regulations which include size limits, area closures, seasons, gear restrictions, annual quotas and reporting requirements. Fifteen permits have been issued for this fishery. The fishery was closed in 1993 and only five vessels operated in the fishery in 1994. No interactions between marine mammals and this fishery have been recorded in the past five years.

The bottomfish fishery occurs throughout the N WHI and the main Hawaiian Islands using handlines. In the NWHI, there are two zones in which fishing takes place. The Ho'omalu Zone has limited entry and the Mau Zone has open access. There are currently 11 permits for the Ho'omalu Zone and 30 for the Mau Zone. However, in 1994, only five vessels fished in the Ho'omalu Zone and 15-20 vessels fished in the Mau Zone. Total landings of bottomfish in Hawaii from all waters have fluctuated little in recent years, about 400,000 pounds per year from the NWHI and about 500,000 pounds per year from the main Hawaiian Islands. Fishermen claim interactions with dolphins who steal bait and catch are increasing.

Other Mortality

At least 85 spinner dolphins were live-captured in Hawaiian waters from 1962 to 1981 (Shallenberger 1981). The main capture area was around Oahu.

Fishery Mortality Rate

The total fishery mortality and serious injury cannot be considered to be insignificant and approaching zero because the total annual mortality of this stock of spinner dolphins is unknown. Determination cannot be made for individual fisheries until the implementing regulations for section 118 of the Marine Mammal Protection Act have been reviewed by the public and finalized.

STATUS OF STOCK

The status of spinner dolphins in Hawaiian waters is unknown. The stock's status relative to OSP under the MMPA is alsounknown. They are not listed as threatened or endangered under the U.S. Endangered Species Act (1973). The Hawaiian stock would not be considered a strategic stock under the 1994 amendments to the MMPA because the level of documented take does not exceed the PBR level.

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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.* 1994). There is an incongruity between the frequency of strandings and the infrequency of sightings of this species in Hawaii. Nitta (1991) found more stranding records of striped dolphins (13) than of any other species between 1936 and 1988, yet Shallenberger (1981) was aware of only two at-sea sightings, one near Niihau and one west of Oahu. The Sea Life Park collecting crew never encountered striped dolphins from the early 1960s through the late 1970s during their live-capture operations (Shallenberger 1981).

Striped dolphins have been intensively/ exploited in the western North Pacific, where three migratory stocks are provisionally recognized (Kishiro and Kasuya 1993). In the eastern Pacific all striped dolphins are provisionally considered to belong to a single stock (Dizon *et al.* 1994). For the Marine Mammal Protection Act (MMPA) stock assessment reports, striped dolphins within the Pacific U.S. Exclusive Economic Zone are divided into two discrete, non-contiguous areas: 1) waters off California, Oregon and Washington, and 2) waters around Hawaii (this report). Striped dolphins involved in eastern tropical Pacific tuna purse-seine fisheries are managed separately under the MMPA.

POPULATION SIZE

Population estimates are available for Japanese waters (Miyashita 1993) and the eastern tropical Pacific (Wade and Gerrodette 1993), but no data are available for a population estimate in Hawaiian waters.

Minimum Population Estimate

No data are available for 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.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

No estimate of annual human-caused mortality and serious injury is available as there are no reports of direct or incidental takes of striped dolphins in Hawaiian waters (Nitta and Henderson 1993). However, mortality of other cetacean species has been observed in Hawaiian fisheries, and the gear types used in these 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, Donovan and Barlow 1994).

Fishery Information

Pelagic, bottomfish and lobster fisheries occur in Hawaiian waters, Pelagic fisheries include commercial fisheries (troll, handline, longline, local inshore gillnet), commercial charter and recreational troll fishing. Only the longline fishery is subject to active management through a Fishery Management Plan. The growth of the longline fleet between 1989 and 1991 generated concerns regarding impact on fish stocks (especially swordfish): on other fisheries (troll, handline), and on protected species (mainly sea turtles). The value of longline landings increased to almost $45 million in 1992 and 1993. Regulations established longline fishery permit and reporting requirements, area closures in the Northwestern Hawaiian Islands (NWHI) to protect Hawaiian monk seals and in the main Hawaiian Islands to prevent gear conflicts, a limited entry program, a mandatory observer program, and **a** requirement for installation and operation of vessel monitoring equipment on longline vessels in Hawaii. Approximately 165 longline permits have been issued. The commercial non-longline fisheries (troll, handline, gillnet) have more than 2,000 participants but account only for about $ 10 - $ 15 million per year in landings. The number of anglers and value of recreational fishing are unknown. Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nitta and Henderson 1993), but no interactions with striped dolphins have been documented.

The commercial lobster fishery in the NWHI is managed by federal regulations which include size limits, area closures, seasons, gear restrictions, annual quotas and reporting requirements. Fifteen permits have been issued for this fishery. The fishery was closed in 1993 and only five vessels operated in the fishery in 1994. No interactions between marine mammals and this fishery have been recorded in the past five years.

The bottomfish fishery occurs throughout the NWHI and the main Hawaiian Islands using handlines. In the NWHI, there are two zones in which fishing takes place. The Ho'omalu Zone has limited entry and the Mau Zone has open access. There are currently 11 permits for the Ho'omalu Zone and 30 for the Mau Zone. However, in 1994, only five vessels fished in the Ho'omalu Zone and 15-20 vessels fished in the Mau Zone. Total landings of bottomfish in Hawaii from all waters have fluctuated little in recent years, about 4OO,OOO pounds per year from the NWHI and about 500,000 pounds per year from the main Hawaiian Islands. Fishermen claim interactions with dolphins who steal bait and catch are increasing.

Fishery Mortality Rate

The total fishery mortality and serious injury cannot be considered to be insignificant and approaching zero because the population size of this stock of striped dolphins is unknown. Determination cannot be made for individual fisheries until the implementing regulations for section 118 of the MMPA have been reviewed by the public and finalized.

STATUS OF STOCK

The status of striped dolphins in Hawaiian waters is unknown. The stock's status relative to OSP under the MMPA is also unknown. This species is not listed as threatened or endangered under the Endangered Species Act (1973). Although information on striped dolphins in Hawaiian waters is limited. this stock would be considered non-strategic under the 1994 amendments to the MMPA given the absence of reported fisheries related mortality.

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MELON-HEADED WHALE *(Peponocephala efectra):* 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). Little is known about this species elsewhere in its range, and most knowledge about its biology comes from mass strandings (Perryman *et al.* 1994). Ten strandings are known from Hawaii (Nishiwaki and Norris 1966; Shallenberger 1981; Nitta 1991). For the Marine Mammal Protection Act (MMPA) stock assessment reports, there is a single Pacific management stock including only animals found within the U.S. Exclusive Economic Zone of the Hawaiian Islands.

POPULATION SIZE

An estimate of melon-headed whales is available for the eastern tropical Pacific (Wade and Gerrodette 1993), but there are no data for population estimates elsewhere. In Hawaii, the size of herds is often reported to exceed 500 individuals (Shallenberger 1981). A group of 75-100 animals was consistently observed off the north Kohala coast of Hawaii during the 1970s (Shallenberger 1981).

Minimum Population Estimate

No data are available for making 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

It is not possible to calculate a PBR for this stock at this time.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Melon-headed whales are not known to be taken directly or incidentally in Hawaiian waters and no mortality of this species has been documented in Hawaiian fisheries (Nitta and Henderson 1993). However, mortality of other cetacean species has been observed in Hawaiian fisheries, and the gear types used in these 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, Donovan and Barlow 1994).

Fishery Information

Pelagic, bottomfish and lobster fisheries occur in Hawaiian waters. Pelagic fisheries include commercial fisheries (troll, handline, longline, local inshore gillnet), commercial charter and recreational troll fishing. Only the longline fishery is subject to active management through a Fishery Management Plan. The growth of the longline fleet between 1989 and 1991 generated concerns regarding impact on fish stocks (especially swordfish), on other fisheries (troll: handline), and on protected species (mainly sea turtles). The value of longline landings increased to almost $45 million in 1992 and 1993. Regulations established longline fishery permit and reporting requirements, area closures in the Northwestern Hawaiian Islands (NWHI) to protect Hawaiian monk seals and in the main Hawaiian Islands to prevent gear conflicts, a limited entry program, a mandatory observer program, and a requirement for installation and operation of vessel monitoring equipment on longline vessels in Hawaii. Approximately 165 longline permits have been issued. The commercial non-longline fisheries (troll, handline, gillnet) have more than 2,000 participants but account only for about $10 - $15 million per year in landings. The number of anglers and value of recreational fishing are unknown. 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.

The commercial lobster fishery in the NWHI is managed by federal regulations which include size limits, area closures, seasons: gear restrictions, annual quotas and reporting requirements. Fifteen permits have been issued for this fishery. The fishery was closed in 1993 and only five vessels operated in the fishery in 1994. No interactions between marine mammals and this fishery have been recorded in the past five years.

The bottomfish fishery occurs throughout the NWHI and the main Hawaiian Islands using handlines. In the NWHI, there are two zones in which fishing takes place. The Ho'omalu Zone has limited entry and the Mau Zone has open access. There are currently 11 permits for the Ho'omalu Zone and 30 for the Mau Zone. However, in 1994, only five vessels fished in the Ho'omalu Zone and 15-20 vessels fished in the Mau Zone. Total landings of bottomfish in Hawaii from all waters have fluctuated little in recent years, about 400,000 pounds per year from the NWHI and about 500,000 pounds per year from the main Hawaiian Islands. Fishermen claim interactions with dolphins who steal bait and catch are increasing.

Historical Mortality

Peale (1848) reported that 60 whales of this species were driven ashore by natives in Hilo Bay, Hawaii in 1841. At least three melon-headed whales were live-captured for public display between 1966 and 1978 (Shallenberger 1981).

Fishery Mortality Rate

The total fishery mortality and serious injury cannot be considered to be insignificant and approaching zero because the population size of this stock of melon-headed whales is unknown. Determination cannot be made for individual fisheries until the implementing regulations for section 118 of the MMPA have been reviewed by the public and finalized.

STATUS OF STOCK

The status of melon-headed whales in Hawaiian waters is unknown. The stock's status relative to OSP under the MMPA is also unknown. This species is not listed as threatened or endangered under the Endangered Species Act (1973). Although information on melon-headed whales in Hawaiian waters is limited, this stock would be considered non-strategic under the 1994 amendments to the MMPA given the absence of reported fisheries related mortality.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Pygmy killer whales are found in tropical and subtropical waters throughout the world (Ross and Leather-wood 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. Nitta (1991) documented five strandings from Maui and the island of Hawaii. For the Marine Mammal Protection Act (MMPA) stock assessment reports, there is a single Pacific management stock including only animals found within the U.S. Exclusive Economic Zone of the Hawaiian Islands.

POPULATION SIZE

A population estimate has been made for this species in the eastern tropical Pacific (Wade and Gerrodette 1993), but no data are available to estimate population size in any other area of the North Pacific.

Minimum Population Estimate

No data are available for 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 species at this time.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

No estimate of annual human-caused mortality and serious injury is available as there are no reports of direct or incidental takes of pygmy killer whales in Hawaiian waters. However, mortality of other cetacean species has been observed in Hawaiian fisheries, and the gear types used in these 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, Donovan and Barlow 1994).

Fishery Information

Pelagic, bottomfish and lobster fisheries occur in Hawaiian waters. Pelagic fisheries include commercial fisheries (troll, handline, longline, local inshore gillnet), commercial charter and recreational troll fishing. Only the longline fishery is subject to active management through a Fishery Management Plan. The growth of the longline fleet between 1989 and 1991 generated concerns regarding impact on fish stocks (especially swordfish), on other fisheries (troll, handline), and on protected species (mainly sea turtles). The value of longline landings increased to almost $45 million in 1992 and 1993. Regulations established longline fishery permit and reporting requirements, area closures in the Northwestern Hawaiian Islands (NWHI) to protect Hawaiian monk seals and in the main Hawaiian Islands to prevent gear conflicts, a limited entry program, a mandatory observer program, and a requirement for installation and operation of vessel monitoring equipment on longline vessels in Hawaii. Approximately 165 longline permits have been issued. The commercial non-longline fisheries (troll, handline, gillnet) have more than 2,000 participants but account only for about $10 - $15 million per year in landings. The number of anglers and value of recreational fishing are unknown. 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.

The commercial lobster fishery in the NWHI is managed by federal regulations which include size limits, area closures, seasons, gear restrictions, annual quotas and reporting requirements. Fifteen permits have been issued for this fishery. The fishery was closed in 1993 and only five vessels operated in the fishery in 1994. No interactions between marine mammals and this fishery have been recorded in the past five years.

The bottomfish fishery occurs throughout the NWHI and the main Hawaiian Islands using handlines. In the NWHI, there are two zones in which fishing takes place. The Ho'omalu Zone has limited entry and the Mau Zone has open access. There are currently 11 permits for the Ho'omalu Zone and 30 for the Mau Zone. However, in 1994, only five vessels fished in the Ho'omalu Zone and 15-20 vessels fished in the Mau Zone. Total landings of bottomfish in Hawaii from all waters have fluctuated little in recent years, about 400,000 pounds per year from the NWHI and about 500,000 pounds per year from the main Hawaiian Islands. Fishermen claim interactions with dolphins who steal bait and catch are increasing.

Other Mortality

Three specimens were live-captured by Sea Life Park between 1963 and 1971 (Pryor *et al.* 1965; Pryor 1975; Shallenberger 1981).

Fishery Mortality Rate

The total fishery mortality and serious injury cannot be considered to be insignificant and approaching zero because the population size of this stock of pygmy killer whales is unknown. Determination cannot be made for individual fisheries until the implementing regulations for section 118 of the MMPA have been reviewed by the public and finalized.

STATUS OF STOCK

The status of pygmy killer whales in Hawaiian waters is unknown. The stock's status relative to OSP under the MMPA is also unknown. This species is not listed as threatened or endangered under the U.S. Endangered Species Act (1973). Although information on pygmy killer whales in Hawaiian waters is limited, this stock would be considered non-strategic under the 1994 amendments to the MMPA given the absence of reported fisheries related mortality.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

False killer whales are found worldwide mainly in tropical and warm-temperate waters (Stacey et *al. 1994).* In the North Pacific? this species is well known from southern Japan, Hawaii, and the eastern tropical Pacific. It occurs around all the main Hawaiian Islands, but its presence around the Northwestern Hawaiian Islands has not yet been established (Nitta and Henderson 1993). There are only 4 stranding records from Hawaiian waters (Nitta 1991). Large numbers of false killer whales have been taken in direct fisheries in southern Japan, and small numbers have been taken incidental to fishing operations in the eastern tropical Pacific. Most knowledge about this species comes from outside Hawaiian waters (Stacey *et al.* 1994). For the Marine Mammal Protection Act (MMPA) stock assessment reports, there is a single Pacific management stock including only animals found within the U.S. Exclusive Economic Zone of the Hawaiian Islands.

POPULATION SIZE

Population estimates for this species have been made from shipboard surveys in Japan (Miyashita 1993) and the eastern tropical Pacific (Wade and Gerrodette 1993) but there are no estimates for any area of the central Pacific. A series of aerial surveys was flown in 1989 to obtain a minimum count of false killer whales. These surveys, which only covered portions of the lee shores of Hawaii, Lanai, and Oahu to a maximum distance of 30 nm offshore, produced a minimum count of 470 false killer whales (Leatherwood and Reeves 1989).

Minimum Population Estimate

No data from the past five years are available to make 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.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

No estimate of annual human-caused mortality and serious injury is available as there are no reports of direct or incidental takes of false killer whales in Hawaiian waters (Nitta and Henderson 1993). However, mortality of other cetacean species has been observed in Hawaiian fisheries, and the gear types used in these 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, Donovan and Barlow 1994).

Fishery Information

Pelagic, bottomfish and lobster fisheries occur in Hawaiian waters. Pelagic fisheries include commercial fisheries (troll, handline, longline, local inshore gillnet), commercial charter and recreational troll fishing. Only the longline fishery is subject to active management through a Fishery Management Plan. The growth of the longline fleet between 1989 and 1991 generated concerns regarding impact on fish stocks (especially swordfish), on other fisheries (troll, handline), and on protected species (mainly sea turtles). The value of longline landings increased to almost $45 million in 1992 and 1993. Regulations established longline fishery permit and reporting requirements, area closures in the Northwestern Hawaiian Islands (NWHI) to protect Hawaiian monk seals and in the main Hawaiian Islands to prevent gear conflicts, a limited entry program, a mandatory observer program, and a requirement for installation and operation of vessel monitoring equipment on longline vessels in Hawaii. Approximately 165 longline permits have been issued. The commercial non-longline fisheries (troll, handline, gillnet) have more than 2,000 participants but account

only for about $10 - $15 million per year in landings. The number of anglers and value of recreational fishing are unknown. Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries, and false killer whales have been identified in fishermen's logs as taking catches from pelagic longlines (Nitta and Henderson 1993). They have also been observed feeding on mahi mahi, *Cotyphaena hippurus*, and yellowfin tuna, *Thunnus albacares*, and frequently steal large fish (up to 70 pounds) (Shallenberger 1981) from the trolling lines of both commercial and recreational fishermen (S. Kaiser, pers. comm.).

The commercial lobster fishery in the NWHI is managed by federal regulations which include size limits, area closures, seasons? gear restrictions, annual quotas and reporting requirements. Fifteen permits have been issued for this fishery. The fishery was closed in 1993 and only five vessels operated in the fishery in 1994. No interactions between marine mammals and this fishery have been recorded in the past five years.

The bottomfish fishery occurs throughout the NWHI and the main Hawaiian Islands using handlines. In the NWHI, there are two zones in which fishing takes place. The Ho'omalu Zone has limited entry and the Mau Zone has open access. There are currently 11 permits for the Ho'omalu Zone and 30 for the Mau Zone. However, in 1994: only five vessels fished in the Ho'omalu Zone and 15-20 vessels fished in the Mau Zone. Total landings of bottomfish in Hawaii from all waters have fluctuated little in recent years, about 400,000 pounds per year from the NWHI and about 500,000 pounds per year from the main Hawaiian Islands. Fishermen claim interactions with dolphins who steal bait and catch are increasing.

Other Mortality

Since the early 1960's, at least 12 false killer whales have been live-captured by aquaria or the Navy (Pryor 1975; Shallenberger 1981; J. Thomas pers. comm.).

Fishery Mortality Rate

The total fishery mortality and serious injury cannot be considered to be insignificant and approaching zero because the population size of this stock of false killer whales is unknown. Determination cannot be made for individual fisheries until the implementing regulations for section 118 of the MMPA have been reviewed by the public and finalized.

STATUS OF STOCK

The status of false killer whales in Hawaiian waters is unknown. The stock's status relative to OSP under the MMPA is also unknown. This species is not listed as threatened or endangered under the Endangered Species Act (1973). Although information on false killer whales in Hawaiian waters is limited, this stock would be considered non-strategic under the 1994 amendments to the MMPA given the absence of reported fisheries related mortality.

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KILLER WHALE *(Orcinus orca):* Hawaiian Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Killer whales are found worldwide in tropical to polar waters (Heyning and Dahlheim 1988). They are rare in Hawaiian waters. One stranding from the island of Hawaii was reported in 1950 (Richards 1952). Two sightings have been reported, one in January 1978 off the Waianae Coast of Oahu and another in December 1979 near Kauai (Shallenberger 1981). Except in the northeastern Pacific where "resident" and "transient" stocks have been described for coastal waters of Alaska, British Columbia, and Washington (Bi gg 1982; Leatherwood *et al.* 1990), little is known about stock structure of killer whales in the North Pacific. For the Marine Mammal Protection Act (MMPA) stock assessment reports, killer whales within the Pacific U.S. EEZ are divided into four stocks: 1) aHawaiian stock (this report), 2) a transient stock in Alaska and Washington inland waters, 3) a resident stock in Alaska and Washington inland water, and 4) a California, Oregon and Washington stock.

POPULATION SIZE

Population sizes for killer whales in the coastal waters of British Columbia and Washington are known from photoidentification 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). No data to estimate population size are available for the central Pacific.

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 and maximum net productivity rate in Hawaiian waters.

POTENTIAL BIOLOGICAL REMOVAL

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

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

No estimate of annual human-caused mortality and serious injury is available. In 1990, a solitary killer whale was reported to have removed the catch from a longline in Hawaii (Dollar 1991). No other fisheries interactions involving killer whales have been reported. However, mortality of other cetacean species has been observed in Hawaiian fisheries, and the gear types used in these 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, Donovan and Barlow 1994).

Fishery Information

Pelagic, bottomfish and lobster fisheries occur in Hawaiian waters. Pelagic fisheries include commercial fisheries (troll, handline, longline, local inshore gillnet), commercial charter and recreational troll fishing. Only the longline fishery is subject to active management through a Fishery Management Plan. The growth of the longline fleet between 1989 and 1991 generated concerns regarding impact on fish stocks (especially swordfish), on other fisheries (troll, handline), and on protected species (mainly sea turtles). The value of longline landings increased to almost $45 million in 1992 and 1993. Regulations established longline fishery permit and reporting requirements, area closures in the Northwestern Hawaiian Islands (NWHI) to protect Hawaiian monk seals and in the main Hawaiian Islands to prevent gear conflicts, a limited entry program, a mandatory observer program, and a requirement for installation and operation of vessel monitoring equipment on longline vessels in Hawaii. Approximately 165 longline permits have been issued. The commercial non-longline fisheries (troll, handline, gillnet) have more than 2,000 participants but account

only for about $10 - $15 million per year in landings. The number of anglers and value of recreational fishing are unknown. Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nitta and Henderson 1993), but no interactions with killer whales have been documented.

The commercial lobster fishery in the NWHI is managed by federal regulations which include size limits, area closures, seasons: gear restrictions, annual quotas and reporting requirements. Fifteen permits have been issued for this fishery. The fishery was closed in 1993 and only five vessels operated in the fishery in 1994. No interactions between marine mammals and this fishery have been recorded in the past five years.

The bottomfish fishery occurs throughout the NWHI and the main Hawaiian lslands using handlines. In the NWHI, there are two zones in which fishing takes place. The Ho'omalu Zone has limited entry and the Mau Zone has open access. There are currently 11 permits for the Ho'omalu Zone and 30 for the Mau Zone. However, in 1994, only five vessels fished in the Ho'omalu Zone and 15-20 vessels fished in the Mau Zone. Total landings of bottomfish in Hawaii from all waters have fluctuated little in recent years, about 400,000 pounds per year from the NWHI and about 500,000 pounds per year from the main Hawaiian Islands. Fishermen claim interactions with dolphins who steal bait and catch are increasing.

Fishery Mortality Rate

The total fishery mortality and serious injury cannot be considered to be insignificant and approaching zero because the population size of this stock of killer whales is unknown. Determination cannot be made for individual fisheries until the implementing regulations for section 118 of the MMPA have been reviewed by the public and finalized.

STATUS OF STOCK

The status of killer whales in Hawaiian waters is unknown. The stocks status relative to OSP under the MMPA is unknown. This species is not listed as threatened or endangered under the Endangered Species Act (1973). Although information on killer whales in Hawaiian waters is limited, this stock would be considered non-strategic under the 1994 amendments to the MMPA given the insignificance of reported fisheries related mortality.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Short-fumed 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 probably also present around the Northwestern Hawaiian Islands (Shallenberger 1981). Several mass strandings have been reported from the main islands (Tomich 1986; Nitta 1991). In Japanese waters, two stocks have beenidentified 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 to the Japanese "southern form." Stock structure of short-finned pilot whales has not been adequately studied in the North Pacific, except in Japanese waters. Preliminary photoidentification work with pilot whales in Hawaii indicated a high degree of site fidelity around the main island of Hawaii (Shane and McSweeney 1990). 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) Hawaiian waters (this report), and 2) waters off California, Oregon and Washington.

POPULATION SIZE

Estimates of short-fumed pilot whale populations have been made off Japan (Miyashita 1993) and in the eastern tropical Pacific (Wade and Gerrodette 1993), but there are no data to make a population estimate in Hawaiian waters.

Minimum Population Estimate

No minimum population estimate is available,

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.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

No estimate of annual human-caused mortality and serious injury is available as there are no reports of direct or incidental takes of short-finned pilot whales in Hawaiian waters, However, mortality of other cetacean species has been observed in Hawaiian fisheries, and the gear types used in these 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, Donovan and Barlow 1994).

Fishery Information

Pelagic, bottomfish and lobster fisheries occur in Hawaiian waters. Pelagic fisheries include commercial fisheries (troll, handline, longline, local inshore gillnet), commercial charter and recreational troll fishing. Only the longline fishery is subject to active management through a Fishery Management Plan. The growth of the longline fleet between 1989 and 1991 generated concerns regarding impact on fish stocks (especially swordfish), on other fisheries (troll, handline), and on protected species (mainly sea turtles). The value of longline landings increased to almost $45 million in 1992 and 1993. Regulations established longline fishery permit and reporting requirements, area closures in the Northwestern Hawaiian Islands (NWHI) to protect Hawaiian monk seals and in the main Hawaiian Islands to prevent gear conflicts, a limited entry program, a mandatory observer program, and a requirement for installation and operation of vessel monitoring equipment on longline vessels in Hawaii. Approximately 165 longline permits have been issued. The commercial non-longline fisheries (troll, handline, gillnet) have more than 2,000 participants but account

only for about $10 - $15 million per year in landings. The number of anglers and value of recreational fishing are unknown. Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nitta and Henderson 1993) but no interactions with short-finned pilot whales have been documented.

The commercial lobster fishery in the NWHI is managed by federal regulations which include size limits, area closures, seasons, gear restrictions, annual quotas and reporting requirements. Fifteen permits have been issued for this fishery. The fishery was closed in 1993 and only five vessels operated in the fishery in 1994. No interactions between marine mammals and this fishery have been recorded in the past five years.

The bottomfish fishery occurs throughout the NWHI and the main Hawaiian Islands using handlines. In the NWHI, there are two zones in which fishing takes place. The Ho'omalu Zone has limited entry and the Mau Zone has open access. There are currently 11 permits for the Ho'omalu Zone and 30 for the Mau Zone. However, in 1994. only five vessels fished in the Ho'omalu Zone and 1.5-20 vessels fished in the Mau Zone. Total landings of bottomfish in Hawaii from all waters have fluctuated little in recent years, about 400,000 pounds per year from the NWHI and about 500,000 pounds per year from the main Hawaiian Islands. Fishermen claim interactions with dolphins who steal bait and catch are increasing.

Other Mortality

Since 1963, at least 20 short-finned pilot whales have been live-captured from Hawaiian waters by Sea Life Park/Oceanic Foundation (Shallenberger 1981).

Fishery Mortality Rate

The total fishery mortality and serious injury cannot be considered to be insignificant and approaching zero because the population size of this stock of short-finned pilot whales is unknown. Determination cannot be made for individual fisheries until the implementing regulations for section 118 of the MMPA have been reviewed by the public and finalized.

STATUS OF STOCK

The status of short-finned pilot whales in Hawaiian waters is unknown. The stock's status relative to OSP under the MMPA is unknown. This species is not listed as threatened or endangered under the U.S. Endangered Species Act (1973). Although information on short-finned pilot whales in Hawaiian waters is limited, this stock would be considered non-strategic under the 1994 amendments to the MMPA given the absence of reported fisheries related mortality.

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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. Balcomb (1987) speculated that this species is "more common in Hawaii than anywhere else in the world." Although all identified Mesoplodon records from Hawaiian waters are of *M. densirostris,* several other species in the genus *Mesoplodon* are known from the North Pacific and may be recorded in Hawaiian waters in the future (see Mead 1989). There is no information on stock structure of Blainville's beaked whale. For the Marine Mammal Protection Act (MMPA) stock assessment reports, three *Mesoplodon* stocks are defined: *1) M. densirostris* in Hawaiian waters (this report), 2) M *stejnegeri* in Alaskan waters, and 3) all *Mesoplodon* species off California, Oregon and Washington.

POPULATION SIZE

No data are available to estimate population size.

Minimum Population Estimate

No data are available for 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 species at this time.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

No estimate of annual human-caused mortality and serious injury is available as there are no reports of direct or incidental takes of Blainville's beaked whales in Hawaiian waters (Nitta and Henderson 1993). However, mortality of other cetacean species has been observed in Hawaiian fisheries, and the gear types used in these 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, Donovan and Barlow 1994).

Fishery Information

Pelagic? bottomfish and lobster fisheries occur in Hawaiian waters. Pelagic fisheries include commercial fisheries (troll, handline, longline, local inshore gillnet), commercial charter and recreational troll fishing. Only the longline fishery is subject to active management through a Fishery Management Plan. The growth of the longline fleet between 1989 and 1991 generated concerns regarding impact on fish stocks (especially swordfish), on other fisheries (troll, handline), and on protected species (mainly sea turtles). The value of longline landings increased to almost $45 million in 1992 and 1993. Regulations established longline fishery permit and reporting requirements, area closures in the Northwestern Hawaiian Islands (NWHI) to protect Hawaiian monk seals and in the main Hawaiian Islands to prevent gear conflicts, a limited entry program, a mandatory observer program, and a requirement for installation and operation of vessel monitoring equipment on longline vessels in Hawaii. Approximately 165 longline permits have been issued. The commercial non-longline fisheries (troll, handline, gillnet) have more than 2,000 participants but account only for about $10 - $15 million per year in landings. The number of anglers and value of recreational fishing are unknown. Interactions with dolphins are reported for all pelagic fisheries, and humpback whales have been entangled in longlines off the Hawaiian Islands (Nitta and Henderson 1993). but no takes of Blainville's beaked whales have been documented.

The commercial lobster fishery in the NWHI is managed by federal regulations which include size limits, area closures, seasons, gear restrictions, annual quotas and reporting requirements. Fifteen permits have been issued for this fishery. The fishery was closed in 1993 and only five vessels operated in the fishery in 1994. No interactions between marine mammals and this fishery have been recorded in the past five years.

The bottomfish fishery occurs throughout the NWHI and the main Hawaiian Islands using handlines. In the NWHI, there are two zones in which fishing takes place. The Ho'omalu Zone has limited entry and the Mau Zone has open access. There are currently 11 permits for the Ho'omalu Zone and 30 for the Mau Zone. However, in 1994, only five vessels fished in the Ho'omalu Zone and 15-20 vessels fished in the Mau Zone. Total landings of bottomfish in Hawaii from all waters have fluctuated little in recent years, about 400,000 pounds per year from the NWHI and about 500,000 pounds per year from the main Hawaiian Islands. Fishermen claim interactions with dolphins who steal bait and catch are increasing.

Fishery Mortality Rate

The total fishery mortality and serious injury cannot be considered to be insignificant and approaching zero because the population size of this stock of Blainville's beaked whales is unknown. Determination cannot be made for individual fisheries until the implementing regulations for section 118 of the MMPA have been reviewed by the public and finalized.

STATUS OF STOCK

The status of Blainville's beaked whales in Hawaiian waters is unknown. The status of this stock relative to OSP under the MMPA is also unknown. This species is not listed as threatened or endangered under the Endangered Species Act (1973). Although information on Blainville's beaked whales in Hawaiian waters is limited, this stock would be considered non-strategic under the 1994 amendments to the MMPA given the absence of reported fisheries related mortality.

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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, strandings have been reported from Midway Islands, Pearl and Hermes Reef, Oahu, and Hawaii Islands (Shallenberger 1981; Galbreath 1963; Richards 1952; Nitta 1991). Sightings, have been reported off Lanai and Maui (Shallenberger 1981). Nothing is known about stock structure for 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) Hawaiian waters (this report), 2) Alaskan waters, and 3) waters off California, Oregon and Washington.

POPULATION SIZE

Wade and Gerrodette (1993) made an estimate for Cuvier's beaked whales in the eastern tropical Pacific, but no data are available for population estimates elsewhere in the North Pacific.

Minimum Population Estimate

No data are available for 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.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

No estimate of annual human-caused mortality and serious injury is available as there are no reports of direct or incidental takes of Cuvier's beaked whales in Hawaiian waters (Nitta and Henderson 1993). However, mortality of other cetacean species has been observed in Hawaiian fisheries, and the gear types used in these 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, Donovan and Barlow 1994).

Fishery Information

Pelagic, bottomfish and lobster fisheries occur in Hawaiian waters. Pelagic fisheries include commercial fisheries (troll, handline, longline, local inshore gillnet), commercial charter and recreational troll fishing. Only the longline fishery is subject to active management through a Fishery Management Plan. The growth of the longline fleet between 1989 and 1991 generated concerns regarding impact on fish stocks (especially swordfish), on other fisheries (troll, handline), and on protected species (mainly sea turtles). The value of longline landings increased to almost $45 million in 1992 and 1993. Regulations established longline fishery permit and reporting requirements, area closures in the Northwestern Hawaiian Islands (NWHI) to protect Hawaiian monk seals and in the main Hawaiian Islands to prevent gear conflicts: a limited entry program, a mandatory observer program! and a requirement for installation and operation of vessel monitoring equipment on longline vessels in Hawaii. Approximately 165 longline permits have been issued. The commercial non-longline fisheries (troll, handline, gillnet) have more than 2,000 participants but account only for about $10 - $15 million per year in landings. The number of anglers and value of recreational fishing are unknown. Interactions with dolphins are reported for all pelagic fisheries, and humpback whales have been entangled in longlines off the Hawaiian Islands (Nitta and Henderson 1993), but no takes of Cuvier's beaked whales have been documented.

The commercial lobster fishery in the NWHI is managed by federal regulations which include size limits, area closures, seasons, gear restrictions, annual quotas and reporting requirements. Fifteen permits have been issued for this fishery, The fishery was closed in 1993 and only five vessels operated in the fishery in 1994. No interactions between marine mammals and this fishery have been recorded in the past five years.

The bottomfish fishery occurs throughout the NWHI and the main Hawaiian Islands using handlines. In the NWHI, there are two zones in which fishing takes place. The Ho'omalu Zone has limited entry and the Mau Zone has open access. There are currently 11 permits for the Ho'omalu Zone and 30 for the Mau Zone. However, in 1994, only five vessels fished in the Ho'omalu Zone and 15-20 vessels fished in the Mau Zone. Total landings of bottomfish in Hawaii from all waters have fluctuated little in recent years, about 400,000 pounds per year from the NWHI and about 500,000 pounds per year from the main Hawaiian Islands. Fishermen claim interactions with dolphins who steal bait and catch are increasing.

Fishery Mortality Rate

The total fishery mortality and serious injury cannot be considered to be insignificant and approaching zero because the population size of this stock of Cuvier's beaked whales is unknown. Determination cannot be made for individual fisheries until the implementing regulations for section 118 of the MMPA have been reviewed by the public and finalized.

STATUS OF STOCK

The status of Cuvier's beaked whales in Hawaiian waters is unknown. The stock's status relative to OSP under the MMPA is also unknown. The species is not listed as threatened or endangered under the Endangered Species Act (1973). Although information on Cuvier's beaked whales in Hawaiian waters is limited. this stock would be considered non-strategic under the 1994 amendments to the MMPA given the absence of reported fisheries related mortality.

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PYGMY SPERM WHALE *(Kugia 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 1982, at least nine strandings of this species were reported in the Hawaiian Islands (Tomich 1986; Nitta 1991). Shallenberger (1981) reported three sightings off Oahu and Maui. A stranded calf was held for several days at Sea Life Park (Pryor 1975:94). 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. Exclusive Economic Zone are divided into two discrete, non-contiguous areas: 1) Hawaiian waters (this report), and 2) waters off California, Oregon and Washington.

POPULATION SIZE

No data are available to estimate population size for this species in the central Pacific.

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.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

No estimate of annual human-caused mortality and serious injury is available as there are no reports of direct or incidental takes of pygmy sperm whales in Hawaiian waters (Nitta and Henderson 1993). However, mortality of other cetacean species has been observed in Hawaiian fisheries? and the gear types used in these 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, Donovan and Barlow 1994).

Fishery Information

Pelagic, bottomfish and lobster fisheries occur in Hawaiian waters. Pelagic fisheries include commercial fisheries (troll, handline, longline, local inshore gillnet), commercial charter and recreational troll fishing. Only the longline fishery is subject to active management through a Fishery Management Plan. The growth of the longline fleet between 1989 and 1991 generated concerns regarding impact on fish stocks (especially swordfish), on other fisheries (troll, handline), and on protected species (mainly sea turtles). The value of longline landings increased to almost $45 million in 1992 and 1993. Regulations established longline fishery permit and reporting requirements, area closures in the Northwestern Hawaiian Islands (NWHI) to protect Hawaiian monk seals and in the main Hawaiian Islands to prevent gear conflicts, a limited entry program, a mandatory observer program? and a requirement for installation and operation of vessel monitoring equipment on longline vessels in Hawaii. Approximately 165 longline permits have been issued. The commercial non-longline fisheries (troll, handline, gillnet) have more than 2,000 participants but account only for about $10 - $15 million per year in landings. The number of anglers and value of recreational fishing are unknown. Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nitta and Henderson 1993), but no interactions with pygmy sperm whales have been documented.

The commercial lobster fishery in the NWHI is managed by federal regulations which include size limits, area closures, seasons, gear restrictions, annual quotas and reporting requirements. Fifteen permits have been issued for this fishery. The fishery was closed in 1993 and only five vessels operated in the fishery in 1994. No interactions between marine mammals and this fishery have been recorded in the past five years.

The bottomfish fishery occurs throughout the NWHI and the main Hawaiian Islands using handlines. In the NWHI, there are two zones in which fishing takes place. The Ho'omalu Zone has limited entry and the Mau Zone has open access. There are currently 11 permits for the Ho'omalu Zone and 30 for the Mau Zone. However, in 1994, only five vessels fished in the Ho'omalu Zone and 15-20 vessels fished in the Mau Zone. Total landings of bottomfish in Hawaii from all waters have fluctuated little in recent years. about 400,000 pounds per year from the NWHI and about 500,000 pounds per year from the main Hawaiian Islands. Fishermen claim interactions with dolphins who steal bait and catch are increasing.

Fishery Mortality Rate

The total fishery mortality and serious injury cannot be considered to be insignificant and approaching zero because the population size of this stock of pygmy sperm whales is unknown. Determination cannot be made for individual fisheries until the implementing regulations for section 118 of the MMPA have been reviewed by the public and finalized.

STATUS OF STOCK

The status of pygmy sperm whales in Hawaiian waters is unknown. The stock's status relative to OSP under the MMPA is also unknown. This species is not listed as threatened or endangered under the Endangered Species Act (1973). Although information on pygmy sperm whales in Hawaiian waters is limited, this stock would be considered non-strategic under the 1994 amendments to the MMPA given the absence of reported fisheries related mortality.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Dwarf sperm whales are found throughout the world in tropical to warm-temperate waters (Nagorsen 1985). One sighting in an unspecified locality, one stranding on Oahu (Tomich 1986): and one stranding on Lanai (Nitta 1991) constitute the only evidence that this species inhabits Hawaiian waters (Tomich 1986). The difficulty of detecting and identifying it at sea, as well as its confusion with the pygmy sperm whale, may partially explain the paucity of records. 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) Hawaiian waters (this report), and 2) waters off California, Oregon and Washington.

POPULATION SIZE

Wade and Gerrodette (1993) provided an estimate for the eastern tropical Pacific, but no data are available to estimate population size for this species in the central Pacific.

Minimum Population Estimate

No data are available for 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 species at this time.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

No estimate of annual human-caused mortality and serious injury is available as there are no reports of direct or incidental takes of dwarf sperm whales in Hawaiian waters (Nitta and Henderson 1993). However, mortality of other cetacean species has been observed in Hawaiian fisheries, and the gear types used in these 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, Donovan and Barlow 1994).

Fishery Information

Pelagic, bottomfish and lobster fisheries occur in Hawaiian waters. Pelagic fisheries include commercial fisheries (troll, handline, longline, local inshore gillnet), commercial charter and recreational troll fishing. Only the longline fishery is subject to active management through a Fishery Management Plan. The growth of the longline fleet between 1989 and 1991 generated concerns regarding impact on fish stocks (especially swordfish), on other fisheries (troll, handline), and on protected species (mainly sea turtles). The value of longline landings increased to almost $45 million in 1992 and 1993. Regulations established longline fishery permit and reporting requirements, area closures in the Northwestern Hawaiian Islands (NWHI) to protect Hawaiian monk seals and in the main Hawaiian Islands to prevent gear conflicts, a limited entry program, a mandatory observer program, and a requirement for installation and operation of vessel monitoring equipment on longline vessels in Hawaii. Approximately 165 longline permits have been issued. The commercial non-longline fisheries (troll, handline, gillnet) have more than 2,000 participants but account only for about $10 - $15 million per year in landings. The number of anglers and value of recreational fishing are unknown. Interactions with cetaceans have been reported for all Hawaiian pelagic fisheries (Nitta and Henderson 1993), but no interactions with dwarf sperm whales have been documented.

The commercial lobster fishery in the NWHI is managed by federal regulations which include size limits, area closures, seasons, gear restrictions, annual quotas and reporting requirements. Fifteen permits have been issued for this fishery, The fishery was closed in 1993 and only five vessels operated in the fishery in 1994. No interactions between marine mammals and this fishery have been recorded in the past five years.

The bottomfish fishery occurs throughout the NWHI and the main Hawaiian Islands using handlines. In the NWHI, there are two zones in which fishing takes place. The Ho'omalu Zone has limited entry and the Mau Zone has open access. There are currently 11 permits for the Ho'omalu Zone and 30 for the Mau Zone. However, in 1994, only five vessels fished in the Ho'omalu Zone and 15-20 vessels fished in the Mau Zone. Total landings of bottomfish in Hawaii from all waters have fluctuated little in recent years, about 400,000 pounds per year from the NWHI and about 500,000 pounds per year from the main Hawaiian Islands. Fishermen claim interactions with dolphins who steal bait and catch are increasing.

Fishery Mortality Rate

The total fishery mortality and serious injury cannot be considered to be insignificant and approaching zero because the population size of this stock of dwarf sperm whales is unknown. Determination cannot be made for individual fisheries until the implementing regulations for section 118 of the MMPA have been reviewed by the public and finalized.

STATUS OF STOCK

The status of dwarf sperm whales in Hawaiian waters is unknown. The stock's status relative to OSP under the MMPA is unknown. This species is not listed as threatened or endangered under the Endangered Species Act (1973). Although information on dwarf sperm whales in Hawaiian waters is limited, this stock would be considered non-strategic under the 1994 amendments to the MMPA given the insignificance of reported fisheries related mortality.

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SPERM WHALE *(Physeter macrocephalus):* Hawaiian Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Sperm whales are found in tropical to polar waters throughout the world (Rice 1989). The Hawaiian Islands marked the center of a major nineteenth century whaling ground for sperm whales (Gilmore 1959; Townsend 1935). Since 1936, at least five strandings have been reported from Oahu, Kauai (Nitta 1991) and Kure Atoll (Woodward 1972). Sperm whales have also been sighted around several of the Northwestern Hawaiian Islands (Rice l960), off the main island of Hawaii (Lee 1993), 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 Fried1 1982).

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. For the Marine Mammal Protection Act (MMPA) stock assessment reports, sperm whales within the Pacific U.S. EEZ are divided into three discrete? non-contiguous areas: 1) waters around Hawaii (this report), 2) California, Oregon and Washington waters, and 3) Alaskan waters.

POPULATION SIZE

Gosho *et al.* (1984) summarized I WC estimates of “initial” (191O) and “current” (1982) stock sizes for sperm whales in the North Pacific based on a CPUE model. Wade and Gerrodette (1993) estimated 22,700 sperm whales for the eastern tropical Pacific from data collected on ship line-transect surveys. Forney et al. (1995) estimated 892 sperm whales in California waters during winter/spring. However, there are no data available for estimating the number of sperm whales in Hawaiian waters.

Minimum Population Estimate

No data are available to make a minimum population estimate.

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

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

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

No estimate of annual human-caused mortality and serious injury is available as there are no reports of recent direct or incidental takes of sperm whales in Hawaiian waters (Nitta and Henderson 1993). However, mortality of other cetacean species has been observed in Hawaiian fisheries, and the gear types used in these 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, Donovan and Barlow 1994).

Fishery Information

Pelagic, bottomfish and lobster fisheries occur in Hawaiian waters. Pelagic fisheries include commercial fisheries (troll, handline: longline, local inshore gillnet), commercial charter and recreational troll fishing. Only the longline fishery is subject to active management through a Fishery Management Plan. The growth of the longline fleet between 1989 and 1991 generated concerns regarding impact on fish stocks (especially swordfish), on other fisheries (troll: handline), and on protected species (mainly sea turtles). The value of longline landings increased to almost $45 million in 1992 and 1993. Regulations established longline fishery permit and reporting requirements, area closures in the Northwestern Hawaiian Islands (NWHI) to protect Hawaiian monk seals and in the main Hawaiian Islands to prevent gear conflicts, a limited entry program, a mandatory observer program, and a requirement for installation and operation of vessel monitoring equipment on longline vessels in Hawaii. Approximately 165 longline permits have been issued. The commercial non-longline fisheries (troll, handline, gillnet) have more than 2,000 participants but account only for about $10 - $15 million per year in landings. The number of anglers and value of recreational fishing are unknown. Interactions with dolphins are reported for all pelagic fisheries, and humpback whales have been entangled in longlines off the Hawaiian Islands (Nitta and Henderson 1993): but no takes of sperm whales have been documented.

The commercial lobster fishery in the NWHI is managed by federal regulations which include size limits, area closures, seasons, gear restrictions, annual quotas and reporting requirements. Fifteen permits have been issued for this fishery. The fishery was closed in 1993 and only five vessels operated in the fishery in 1994. No interactions between marine mammals and this fishery have been recorded in the past five years.

The bottomfish fishery occurs throughout the NWHl and the main Hawaiian Islands using handlines. In the NWHI. there are two zones in which fishing takes place. The Ho'omalu Zone has limited entry and the Mau Zone has open access. There are currently 11 permits for the Ho'omalu Zone and 30 for the Mau Zone. However, in 1994. only five vessels fished in the Ho'omalu Zone and 15-20 vessels fished in the Mau Zone. Total landings of bottomfish in Hawaii from all waters have fluctuated little in recent years, about 400,000 pounds per year from the NWHI and about 500,000 pounds per year from the main Hawaiian Islands. Fishermen claim interactions with dolphins who steal bait and catch are increasing.

Historical Mortality

Sperm whales were exploited throughout their range in the North Pacific and equatorial Pacific during the nineteenth century (see Tillman and Donovan 1983). Approximately 268,972 sperm whales were killed by modem whaling operations in the North Pacific from 1910 to 1976 (Ohsumi 1980). Factory ships operated as far south as 20°N (Ohsumi 1980). Pelagic whaling for sperm whales in the North Pacific ended after the 1979 season (IWC l981), and coastal whaling for this species ended after the 1988 season (IWC 1989). Some of the whales taken during the whaling era were certainly from a population or populations that occur within Hawaiian waters.

Fishery Mortality Rate

The total fishery mortality and serious injury cannot be considered to be insignificant and approaching zero because the population size of this stock of sperm whales is unknown. Determination cannot be made for individual fisheries until the implementing regulations for section 118 of the Marine Mammal Protection Act have been reviewed by the public and finalized.

STATUS OF STOCK

The status of sperm whales in Hawaiian waters is unknown. The stock's status relative to OSP under the MMPA is also unknown. The species is listed as endangered under the U.S. Endangered Species Act (1973); therefore, the Hawaiian stock is classified as a strategic stock according to the 1994 amendments to the MMPA.

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BLUE WHALE *(Balaenoptera* musculus): Hawaiian Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Blue whales are found in tropical to polar waters throughout the world. No sightings or strandings of blue whales have been reported in Hawaii. The only 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). Although the exact positions of the whales producingthe sounds could not be determined, at least some of them were almost certainly within the U.S. Exclusive Economic Zone. The recordings made off Oahu showed bimodal peaks throughout the year, suggesting that the animals were migrating into the area in summer and winter. The stock structure of blue whales in the North Pacific is uncertain (Mizroch et *al.* 1984; Reilly and Thayer 1990). For management in U.S. Pacific waters outside the continental EEZ, the Hawaiian stock includes only those whales within the EEZ of the Hawaiian Islands. One other stock of North Pacific blue whales (off California and Mexico) is recognized in the Marine Mammal Protection Act (MMPA) stock Assessment Reports.

POPULATION SIZE

From ship line-transect surveys, Wade and Gerrodette (1993) estimated 1.400 blue whales for the eastern tropical Pacific. Also from ship line-transect surveys, Barlow (1995) estimated 2,250 blue whales in the Califomia/Mexico stock. No data are available to estimate population size for any other North Pacific blue whale population.

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.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

No estimate of annual human-caused mortality and serious injury is available as there are no reports of recent direct or incidental takes of blue whales in Hawaiian waters. However, mortality of other cetacean species has been observed in Hawaiian fisheries? and the gear types used in these 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, Donovan and Barlow 1994).

Fishery Information

Pelagic, bottomfish and lobster fisheries occur in Hawaiian waters. Pelagic fisheries include commercial fisheries (troll, handline, longline: local inshore gillnet), commercial charter and recreational troll fishing. Only the longline fishery is subject to active management through a Fishery Management Plan. The growth of the longline fleet between 1989 and 1991 generated concerns regarding impact on fish stocks (especially swordfish), on other fisheries (troll, handline), and on protected species (mainly sea turtles). The value of longline landings increased to almost $45 million in 1992 and 1993. Regulations established longline fishery permit and reporting requirements, area closures in the Northwestern Hawaiian Islands (NWHI) to protect Hawaiian monk seals and in the main Hawaiian Islands to prevent gear conflicts. a limited entry program, a mandatory observer program, and a requirement for installation and operation of vessel monitoring equipment on longline vessels in Hawaii. Approximately 165 longline permits have been issued. The commercial non-longline fisheries (troll. handline ,gillnet) have more than 2,000 participants but account only for about $10 - $15 million per year in landings. The number of anglers and value of recreational fishing are unknown. Interactions with dolphins are reported for all pelagic fisheries, and humpback whales have been entangled in longlines off the Hawaiian Islands, but no takes of blue whales have been documented (Nitta and Henderson 1993).

The commercial lobster fishery in the NWHI is managed by federal regulations which include size limits, area closures, seasons, gear restrictions, annual quotas and reporting requirements. Fifteen permits have been issued for this fishery. The fishery was closed in 1993 and only five vessels operated in the fishery in 1994. No interactions between marine mammals and this fishery have been recorded in the past five years.

The bottomfish fishery occurs throughout the NWHI and the main Hawaiian Islands using handlines. In the NWHI, there are two zones in which fishing takes place. The Ho'omalu Zone has limited entry and the Mau Zone has open access. There are currently 11 permits for the Ho'omalu Zone and 30 for the Mau Zone. However, in 1994, only five vessels fished in the Ho'omalu Zone and 15-20 vessels fished in the Mau Zone. Total landings of bottomfish in Hawaii from all waters have fluctuated little in recent years, about 400,000 pounds per year from the NWHI and about 500,000 pounds per year from the main Hawaiian Islands. Fishermen claim interactions with dolphins who steal bait and catch are increasing.

Historical Mortality

At least 9500 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.

Fishery Mortality Rate

The total fishery mortality and serious injury cannot be considered to be insignificant and approaching zero because the population size of this stock of blue whales is unknown. Determination cannot be made for individual fisheries until the implementing regulations for section 118 of the MMPA have been reviewed by the public and finalized.

STATUS OF STOCK

The status of blue whales in Hawaiian waters is unknown. The status of this stock relative to OSP under the MMPA is also unknown. The species is listed as endangered under the Endangered Species Act (1973); therefore, the Hawaiian stock is classified as a strategic stock according to the 1994 amendments to the MMPA.

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FIN WHALE *(Balaenoptera physalus):* Hawaiian Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Fin whales are found throughout all oceans and seas of the world from tropical to polar latitudes. They are rare in Hawaiian waters. There have been only two confirmed sightings off Oahu and a single stranding on Maui (Shallenberger 1981). Balcomb (1987) observed 8- 12 fin whales in a multispecies feeding assemblage on 20 May 1966 approx. 250 mi. south of Honolulu. 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. Exclusive Economic Zone. The stock structure of fin whales in the North Pacific is uncertain (Mizroch *et al.* 1984). The Marine Mammal Protection Act (MMPA) stock assessment reports recognize three stocks of fin whales in the North Pacific: 1) the Hawaii stock (this report), 2) the California/Oregon/Washington stock, and 3) the Alaska stock.

POPULATION SIZE

No data are available to estimate population size.

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.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

No estimate of annual human-caused mortality and serious injury is available as there are no reports of recent direct or incidental takes of fin whales in Hawaiian waters. However. mortality of other cetacean species has been observed in Hawaiian fisheries, and the gear types used in these 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 (Pen-in, Donovan and Barlow 1994).

Fishery Information

Pelagic, bottomfish and lobster fisheries occur in Hawaiian waters. Pelagic fisheries include commercial fisheries (troll, handline. longline, local inshore gillnet), commercial charter and recreational troll fishing. Only the longline fishery is subject to active management through a Fishery Management Plan. The growth of the longline fleet between 1989 and 1991 generated concerns regarding impact on fish stocks (especially swordfish), on other fisheries (troll, handline), and on protected species (mainly sea turtles). The value of longline landings increased to almost $45 million in 1992 and 1993. Regulations established longline fishery permit and reporting requirements, area closures in the Northwestern Hawaiian Islands (NWHI) to protect Hawaiian monk seals and in the main Hawaiian Islands to prevent gear conflicts, a limited entry program, a mandatory observer program, and a requirement for installation and operation of vessel monitoring equipment on longline vessels in Hawaii. Approximately 165 longline permits have been issued. The commercial non-longline fisheries (troll, handline, gillnet) have more than 2.000 participants but account only for about $10 - $15 million per year in landings. The number of anglers and value of recreational fishing are unknown. Interactions with dolphins are reported for all pelagic fisheries, and humpback whales have been entangled in longlines off the Hawaiian Islands (Nitta and Henderson 1993) but no takes of fin whales have been documented.

The commercial lobster fishery in the NWHI is managed by federal regulations which include size limits, area closures, seasons, gear restrictions, annual quotas and reporting requirements. Fifteen permits have been issued for this fishery. The fishery was closed in 1993 and only five vessels operated in the fishery in 1994. No interactions between marine mammals and this fishery have been recorded in the past five years.

The bottomfish fishery occurs throughout the NWHI and the main Hawaiian Islands using handlines. In the NWHl, there are two zones in which fishing takes place. The Ho'omalu Zone has limited entry and the Mau Zone has open access. There are currently 11 permits for the Ho'omalu Zone and 30 for the Mau Zone. However, in 1994, only five vessels fished in the Ho'omalu Zone and 15-20 vessels fished in the Mau Zone. Total landings of bottomfish in Hawaii from all waters have fluctuated little in recent years, about 400,000 pounds per year from the NWHI and about 500,000 pounds per year from the main Hawaiian Islands. Fishermen claim interactions with dolphins who steal bait and catch are increasing.

Historical Mortality

Large numbers of fin whales were taken by commercial whalers throughout the North Pacific from the early 20th century until the 1970s (Tonnessen and Johnsen 1982). 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.

Fishery Mortality Rate

The total fishery mortality and serious injury cannot be considered to be insignificant and approaching zero because the population size of this stock of fin whales is unknown. Determination cannot be made for individual fisheries until the implementin g regulations for section 118 of the MMPA have been reviewed by the public and finalized.

STATUS OF STOCK

The status of fin whales in Hawaiian waters is unknown. This stocks status relative to OSP under the MMPA is also unknown. This species is listed as endangered under the Endangered Species Act (1973); therefore, the Hawaiian stock is classified as a strategic stock under the 1994 amendments to the MMPA.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bryde's whales occur in tropical and warm temperate waters throughout the world. Shallenberger (1981) reported a sighting of a Bryde's whale southeast of Nihoa in April 1977 (see DeLong and Brownell 1977; Leatherwood *et* al. 1982: Fig. 39c). Leatherwood et al. (1982) described the species as relatively abundant in summer and fall on the Mellish and Miluoki banks northeast of Hawaii and around Midway Islands, but the basis for this statement was not explained. Ohsumi and Masaki (1975) reported the taking of "many" Bryde's whales between the Bonin and Hawaiian Islands in the winters of 1971 and 1972 (Ohsumi 1977). 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. Exclusive Economic Zone are divided into two areas: I) Hawaiian waters (this report), and 2) the eastern tropical Pacific (east of 150°W and including the Gulf of California and waters off California).

POPULATlON 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=O.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.

Minimum Population Estimate

No data are available for 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.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

No estimate of annual human-caused mortality and serious injury is available as there are no reports of recent direct or incidental takes of Bryde's whales in Hawaiian waters. However, mortality of other cetacean species has been observed in Hawaiian fisheries, and the gear types used in these fisheries are responsible for marine mammai 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 Donovan and Barlow 1994).

Fishery Information

Pelagic. bottomfish and lobster fisheries occur in Hawaiian waters. Pelagic fisheries include commercial fisheries (troll, handline, longline. local inshore gillnet), commercial charter and recreational troll fishing. Only the longline fishery is subject to active management through a Fishery Management Plan. The growth of the longline fleet between 1989 and 1991 generated concerns regarding impact on fish stocks (especially swordfish), on other fisheries (troll, handline), and on protected species (mainly sea turtles). The value of longline landings increased to almost $45 million in 1992 and 1993. Regulations established longline fishery permit and reporting requirements, area closures in the Northwestern Hawaiian Islands (NWHI) to protect Hawaiian monk seals and in the main Hawaiian Islands to prevent gear conflicts: a limited entry program, a mandatory observer program, and a requirement for installation and operation of vessel monitoring equipment on longline vessels in Hawaii. Approximately 165 longline permits have been issued. The commercial non-longline fisheries (troll, handline, gillnet) have more than 2,000 participants but account only for about $10 - $15 million per year in landings. The number of anglers and value of recreational fishing are unknown. Interactions with dolphins are reported for all pelagic fisheries, and humpback whales have been entangled in longlines off the Hawaiian Islands (Nitta and Henderson 1993), but no takes of Bryde's whales have been documented.

The commercial lobster fishery in the NWHI is managed by federal regulations which include size limits, area closures, seasons, gear restrictions, annual quotas and reporting requirements. Fifteen permits have been issued for this fishery. The fishery was closed in 1993 and only Jive vessels operated in the fishery in 1994. No interactions between marine mammals and this fishery have been recorded in the past five years.

The bottomfish fishery occurs throughout the NWHI and the main Hawaiian Islands using handlines. In the NWHJ: there are two zones in which fishing takes place. The Ho'omalu Zone has limited entry and the Mau Zone has open access. There are currently 11 permits for the Ho'omalu Zone and 30 for the Mau Zone. However, in 1994, only five vessels fished in the Ho'omalu Zone and 15-20 vessels fished in the Mau Zone. Total landings of bottomfish in Hawaii from all waters have fluctuated little in recent years, about 400,000 pounds per year from the NWHI and about 500.000 pounds per year from the main Hawaiian Islands. Fishermen claim interactions with dolphins who steal bait and catch are increasing.

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 I981), and coastal whaling for this species ended in the western Pacific in 1987 (IWC 1989).

Fishery Mortality Rate

The total fishery mortality and serious injury cannot be considered to be insignificant and approaching zero because the population size of this stock of Bryde's whales is unknown. Determination cannot be made for individual fisheries until the implementing regulations for section 118 of the MMPA (MMPA) have been reviewed by the public and finalized.

STATUS OF STOCK

The status of Bryde's whales in Hawaiian waters is unknown. This species is not listed as threatened or endangered under the Endangered Species Act (1973). The status of this stock relative to OSP under the MMPA is unknown. Although information on Bryde's whales in Hawaiian waters is limited, this stock would be considered non-strategic under the 1994 amendments to the MMPA given the absence of reported fisheries related mortality.

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