NOAA Technical Memorandum NMFS-AFSC-57

Alaska Marine Mammal Stock Assessments 1995

by
R. J. Small and D. P. DeMaster

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

September 1995

NOAA Technical Memorandum NMFS

The National Marine Fisheries Service's Alaska Fisheries Science Center 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 reflect sound professional work and may be referenced in the formal scientific and technical literature.

The NMFS-AFSC Technical Memorandum series of the Alaska Fisheries Science Center continues the NMFS-F/NWC series established in 1970 by the Northwest Fisheries Center. The new NMFS-NWFSC series will be used by the Northwest Fisheries Science Center.

This document should be cited as follows:

Small, R. J., and D. P. DeMaster. 1995. Alaska marine mammal stock assessments 1995. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-57, 93 p.

NOAA Technical Memorandum NMFS-AFSC-57

Alaska Marine Mammal Stock Assessments 1995

by
R. J. Small and D. P. DeMaster

with contributions from
H. Braham, G. Antonelis, M. Dahlheim, R. Ferrero, B. Hanson, R. Hobbs,
J. Laake, J. Lerczak, T. Loughlin, B. Mansfield, R. Merrick, S. Mizroch, M. Perez,
D. Rice, D. Rugh, J. Sease, L. Shaw, K. Shelden, P. Wade, J. Waite,
A. York, S. Zimmerman, and the AFSC Publications Unit

Alaska Fisheries Science Center
7600 Sand Point Way N.E., BIN C-15700
Seattle, WA 98115-0070

U.S. DEPARTMENT OF COMMERCE
Ronald H. Brown, Secretary
National Oceanic and Atmospheric Administration
D. James Baker, Under Secretary and Administrator
National Marine Fisheries Service
Rolland A. Schmitten, Assistant Administrator for Fisheries

September 1995

THIS PAGE INTENTIONALLY LEFT BLANK

PREFACE

On April 30,1994, Public Law 103-238 was enacted allowing significant changes to provisions within the Marine Mammal Protection Act. Interactions between marine mammals and commercial fisheries are addressed under three new Sections. This new regime replaced the interim exemption that has regulated fisheries-related incidental takes since 1988. Section 117, Stock Assessments, required the establishment of three regional scientific review groups to advise and report on the status of marine mammal stocks within Alaskan waters, along the Pacific Coast (including Hawaii), and the Atlantic Coast (including the Gulf of Mexico). This report provides information on the marine mammal stocks of Alaska under the jurisdiction of the National Marine Fisheries Service.

Each stock assessment includes a description of the stock's geographic range, a minimum population estimate, current population trends, current and maximum net productivity rates, optimum sustainable population levels and allowable removal levels, and estimates of annual human-caused mortality and serious injury through interactions with commercial fisheries and subsistence hunters. Under the new regime, these data will be used to evaluate the progress of each fishery towards achieving its goal of zero mortality and serious injury.

This is a working document. Each stock assessment report is designed to stand alone and will be updated as new information becomes available. The authors wish to solicit any new data or comments that would serve to improve future stock assessment reports.

THIS PAGE INTENTIONALLY LEFT BLANK

CONTENTS

Preceding page blank

STELLER SEA LION (*Eumetopias jubatus*): Western U.S. Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Steher sea lions range along the North Pacific Ocean rim from northern Japan to California (Loughlin et al. 1984), with centers of abundance and distribution in the Gulf of Alaska and Aleutian Islands, respectively. The species is not known to migrate, but individuals disperse widely outside of the breeding season (late May-early July), thus potentially intermixing with animals from other areas. Loughlin (1994) considered the following information when classifying stock structure based on the phylogeographic approach of Dizon et al. (1992): (1) Distributional data: geographic distribution continuous, yet a high degree of natal site fidelity and low (<10%) exchange rate of breeding animals between rookeries; (2) Population response data: substantial differences in population dynamics (Merrick and York 1993); (3) Phenotypic data: unknown; and (4) Genotypic data: substantial differences in mitochondrial DNA (Bickham et al. in press). Based on this information, two separate stocks of Steller sea lions are now recognized within U.S. waters: an Eastern stock, which includes animals east of Cape Suckling, Alaska (144°W), and a Western U.S. stock, which includes animals at and west of Cape Suckling.

POPULATION SIZE

The most recent estimate of Steller sea lion abundance in Alaska is based on aerial surveys performed in June 1994 from Southeast Alaska to the western Aleutian Islands. The data from these surveys represent actual counts of nonpups at 95 'trend sites', where sea lions have been monitored since the 1970s, and a few additional sites. Aerial and ship-based surveys of Steller sea lions conducted at these same trend sites during June and July 1992 resulted in coefficients of variation (CV) in counts from 0.025 to 0.12 for 7 distinct subareas of Alaska, with an overall CV of 0.0184 (Sease et al. 1993). An indication of variance for the 1994 survey is represented by the difference of 5% between the minimum count vs. the mean counts. The methodology established from the 1989 rangewide survey (Loughlin et al. 1992) produced a correction factor of 1.331 to be multiplied by the nonpup count to estimate total nonpup abundance, and recommended dividing the nonpup count by 2.63 to estimate the number of pups. Using these correction factors and the 1994 counts for the Gulf of Alaska, Aleutian Islands, and the Bering Sea resulted in an estimate of 33,600 nonpups and 9,600 pups, for a total abundance estimate of 43,200 Steller sea lions in the Western U.S. stock (Table 1) (NMFS unpubl. data, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98115).

TABLE 1. Estimates of the number of Steller sea lions by year and geographical area for the Western U.S. stock for the 1960s through 1994. Numbers are adjusted to account for missed sites and animals at-sea by the methods of Loughlin et al. (1992). The percentage of the U.S. population each area represents is also shown. Estimates from 1960 through 1989 from Loughlin et al. (1992) for the Bering Sea have been adjusted based on new data (NMFS unpubl. data, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98 115).

Area	1960s	%	1970s	%	1985	%	1989	%	1994	%
Gulf of Alaska	88,700	36	70,700	34	48,900	33	40,600	46	22,000	33
Aleutians	127,300	51	115,700	56	78,400	53	24,400	27	19,000	28
Bering Sea	11,600	5	5,200	2	3,800	3	1,200	1	2,200	3
Total	227,600	92	.191,600	92	131,100	89	66,200	75	43,200	64

Minimum Population Estimate

For the Western U.S. stock of Steller sea lions, the minimum population estimate (N_{MIN}) is calculated from equation 1 from the PBR Guidelines (NMFS in prep): $N_{MIN} = N/\exp(0.842*[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 43,200 and an associated CV of 0.0184, N_{MIN} for the Western U.S. stock is 42,536. Even though CVs are not currently available for the correction factors, this estimate of N_{MIN} is such that the true number of animals in the population is very likely to be greater than N_{MIN}. This approach is consistent with the recommendations of the Alaska Scientific Review Group (DeMaster 1995: pp. 10).

Current Population Trend

The first reported trend counts (an index to examine population trends) of Steller sea lions in Alaska were made in 1956-60 which indicated that there were at least 140,000 (no correction factors applied) sea lions in the Gulf of Alaska and Aleutian Islands (Merrick et al. 1987). Subsequent surveys indicated a major population decrease, first detected in the eastern Aleutian Islands in the mid-1970s (Braham et al. 1980). The decline appears to have spread eastward to the Kodiak Island area during the late 1970s and early 1980s and then westward to the central and western Aleutian Islands during the early and mid-1980s (Merrick et al. 1987, Byrd 1989). The greatest declines occurred in the eastern Aleutian Islands and western Gulf of Alaska, but declines also occurred in the central Gulf of Alaska and central Aleutian Islands. Counts from 1976 to 1979 indicated about 104,000 sea lions (no correction factors applied) (NMFS 1992). Most recently, Steller sea lions in the Western U.S. stock decreased 37.4% from 1989 to 1994 (NMFS unpubl. data). Population estimates (correction factors applied) for the Gulf of Alaska, Aleutian Islands, and the Bering Sea are given in Table 1, and are compared to the Eastern stock in Figure 1.

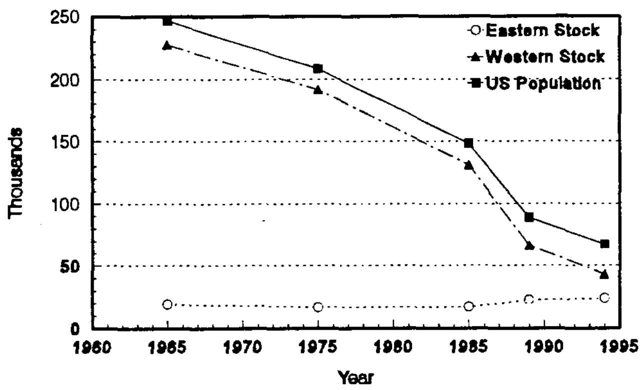

Figure 1. Estimated U.S. population of Steller sea lion adults, juveniles, and pups by stock for 1965-94.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

There are no reliable estimates of maximum net productivity rates for this Steller sea lion. Hence, until additional data become available, it is recommended that the theoretical maximum net productivity rate (R_{MAX}) for pinnipeds of 12% be employed for this (NMFS in prep).

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 0.3, a value half-way between the default values for threatened (0.5) and endangered (0.1) stocks (DeMaster 1995: pp. 11), and is supported by the population decline of 37% over the last 5 years and with the current reevaluation of this species under the Endangered Species Act (ESA) (NMFS in prep). Thus, for the Western U.S. stock of Steller sea lions, PBR = (42,536 x 0.06 x 0.3), or 766 animals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

NMFS observers monitored incidental take on six different fisheries within the range of the Western U.S. stock of Steller sea lions during 1990-93: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries, and Gulf of Alaska groundfish trawl, longline, and pot fisheries. The mean annual (total) mortality was 15 (CV=0.12) for the Bering Sea groundfish trawl fishery, 2 (CV=0.44) for the Gulf of Alaska groundfish trawl fishery, and 2 (CV=0.93) for the Gulf of Alaska groundfish longline fishery. No sea lion mortality was observed by NMFS observers in the remaining three fisheries. Fishing effort (based on total tons of fish caught), observer coverage (defined as the percentage of effort observed), and incidental catch rate (defmed as the number of observed dead in the catch divided by the observed effort (metric tons) multiplied by 10^4) were also estimated for those fisheries where incidental mortality occurred: Bering Sea groundfish trawl: effort=l.84 million tons, observer coverage=64%, and catch rate=0.0793 (CV=0.12); Gulf of Alaska groundfish trawl:

effort=212,000 tons, observer coverage=42%, and catch rate=0.0845 (CV=0.44); and Gulf of Alaska groundfish longline: effort=11,000 tons, observer coverage=13%, and catch rate=1.7415 (CV=0.93).

Observers alsomonitored the Prince William Sound driftnet fishery in 1991 and 1992, recording 2 mortalities in 1991, extrapolated to 28.7 (95% CI 1-108) kills for the entire fishery (Wynne et al. 1992). No mortalities were observed during 1990 for this fishery (Wynne et al. 1991), resulting in a mean kill rate of 14.4 animals per year for 1990 and 1991. In 1990, observers boarded 300 (57.3%) of the 524 vessels that fished in the Prince William Sound driftnet fishery, monitoring a total of 3,090 sets, or 3.9% of the estimated number of sets made by the fleet after 1 July when observers were fully deployed. The South Unimak driftnet fishery was monitored in 1990 (but not 1991), and observers boarded 59 (38.3%) of 154 vessels, monitoring a total of 373 or 4.1% of the sets. In 1991, 5.04% of 116,674 sets were observed in Prince William Sound districts. Based on the observed mortalities in 1991, the estimated mortality rate of Steller sea lions was 0.0002 deaths per set. Combining the estimates from the Bering Sea and Gulf of Alaska groundfish trawl and longline fisheries present above (15+2+2=19) with the estimate from the Prince William sound driftnet fishery (14.4) results in an estimated annual observed incidental kill rate of 33.4 sea lions per year.

An additional source of information on the number of Steller sea lions killed or injured incidental to commercial fishery operations is the logbook reports maintained by boat operators as required by the MMPA interim exemption program. During the 3-year period between 1990 and 1992, logbook reports included an annual mean of 8 injuries and 2 mortalities from interactions with fishing operations, with an additional 4 injuries and 2 mortalities due to illegal deterrence. Incidental takes of additional sea lions were reported in the Gulf of Alaska fisheries, yet were listed as “unknown species”, indicating the animals could have been either a Steller sea lion or a California Sea lion. Based on all logbook reports for both species within the Gulf, California sea lions represented only 2.2% of all interactions. Thus, the reports of injured and killed "unknown” sea lions were considered to be Steller sea lions: 1 injured and 1 killed due to gear interaction, 1 injured and 3 killed due to illegal deterrence annually from 1990 to 1992. The total annual incidental take reported from logbook records during 1990-1992 is therefore estimated at 9 injured and 3 killed from gear interactions, and 5 injured and 5 killed from illegal deterrence. These totals are based on all available logbook reports for Alaska fisheries, except the groundfish trawl fisheries in the Bering sea, Aleutian Islands, and Gulf of Alaska, for which observer data were presented above. The fisheries for which the majority of the incidental take occurred in the Gulf of Alaska were the Copper River salmon drift gillnet and the Alaska Peninsula salmon set gillnet. In the Bering Sea, the fishery for which the majority of the incidental take occurred was in the Bristol Bay salmon drift gillnet fishery.

The estimated mortality rate incidental to commercial fisheries is 41 sea lions per year, based on observer data (33) and logbook data (8) where observer data were not available. At present, annual mortality levels less than 77 animals per year (i.e., 10% of PBR) can be considered insignificant. However, because logbook records are most likely negatively biased (Credle et al. 1994), and the 1992 Recovery Plan (NMFS 1992) recommendation that immediate actions be taken to reduce human-caused mortality to the ‘lowest level practicable” to safeguard against further population declines, the current annual level of incidental mortality is not considered insignificant.

Subsistence/Native Harvest Information

The 1992 and 1993 subsistence harvest of Steller sea lions in Alaska was estimated by the Alaska Department of Fish and Game, under contract with the NMFS (Wolfe and Mishler 1993, Wolfe and Mishler 1994). In both years, data were collected through systematic interviews with hunters and users of marine mammals in approximately 2,100 households in about 60 coastal communities within the geographic range of the Steller sea lion in Alaska; interviews were conducted in approximately 45 communities in the range of the Western U.S. stock. The great majority (99%) of the statewide subsistence take was from the Western U.S. stock in both 1992 and 1993: harvest, 541 (95% CI 452-711) and 486 (95% CI 391-630); struck and lost, 178 (32.9%) and 138 (28.4%). In both years, the majority (79%) of sea lions were taken by Aleut hunters in the Aleutian and Pribilof Islands. The mean annual subsistence take for this stock during 1992 and 1993 was 514 sea lions. The age-specific kill of the harvest for both years was approximately 29% adults, 61% juveniles, 7% pups, and 3% of unknown age: sex-specific kill was approximately 62% males, 16% females, and 22% of unknown sex.

Other Mortality

Shooting of sea lions by commercial fishers was thought to be a potentially significant source of mortality prior to the listing of sea lions as threatened under the ESA in 1990, which made such shooting illegal (note: recent regulations implemented under the authority of the MMPA prohibit commercial fishers from shooting at any marine mammals).

STATUS OF STOCK

The estimated annual level of total human-caused mortality and serious injury (41+514=555) does not exceed the PBR (766) for this stock. The Steller sea lion is currently listed as threatened under the ESA, but is under consideration for endangered status. Thus, the Western U.S. stock of Steller sea lions is classified as a strategic stock. A summary of management actions recently implemented include no-entry buffer zones around rookeries, prohibition of groundfish trawling within 10-20 nautical miles of certain rookeries, and spatial and temporal allocation of Gulf of Alaska pollock total allowable catch.

REFERENCES

Bickham, J. W., J. C. Patton, and T. R. Loughlin. In press. High variability for control-region sequences in a marine mammal: Implications for conservation and biogeography of Steller sea lion (Eumetopias jubatus). J. Mammal.

Braham, H., W., R. D. Everitt, and D. J. Rugh. 1980. Northern sea lion decline in the eastern Aleutian Islands. J. Wildl. Manage. 44:25-33.

Byrd, G. V. 1989. Observations of northern sea lions at Ugamak Island, Buldir, and Agattn Islands, Alaska in 1989. Unpubl. rep., U.S. Fish and Wildlife Service. Alaska Maritime National Wildlife Refuge, P.O. BOX 5251, NSA Adak, FPO Seattle, WA 98791.

Credle, V. R., D. P. DeMaster, M. M. Merklein, M. B. Hanson, W. A. Karp, and S. M. Fitzgerald (eds). 1994. NMFS observer programs: minutes and recommendations from a workshop held in Galveston, Texas, November 10-11, 1993. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-94-1, 96 pp.

DeMaster, D.P. 1995. Minutes from the 4-5 and 11 January 1995 meeting of the Alaska Scientific Review Group, Anchorage, Alaska. 27 pp. + appendices. (available upon request- D.P. DeMaster, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98 115).

Dizon, A. E., C. Lockyer, W. F. Perrin, D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 6:24-36.

Loughlin, T. R. 1994. Using the phylogeographic method to identify Steller sea lion stocks. Working paper GSID 17, workshop on use of genetic data to diagnose management units, Sept. 26-28, 1994, La Jolla, CA.

Laughlin, T. R., Perlov, A. S., and V. A. Vladimirov. 1992. Range-wide survey and estimation of total number of Steller sea lions in 1989. Mar. Mammal Sci. 8:220-239.

Merrick, R. L., and A. E. York. 1993. A viability analysis for the Alaskan Steller sea lion population. Abstracts, 10th Biennial Conf. Biol. Mar. Mamm., Galveston, TX, Nov. 11-15,1993. Pp. 16.

Merrick, R. L., T. R. Loughlin, and D. G. Calkins. 1987. Decline in abundance of the northern sea lion, Eumetopias jubatus, in 1956-86. Fish. Bull., U.S. 85:351-365.

National Marine Fisheries Service. 1992. Recovery Plan for the Steller Sea Lion (Eumetopias jubatus). Prepared by the Steller Sea Lion Recovery Team for the National Marine Fisheries Service, Silver Spring, MD. 92 pp.

National Marine Fisheries Service. In prep. Guidelines for Estimating Potential Biological Removals. U.S. Dep. Commer., NOAA Tech. Rep.

Sease, J. L, J. P. Lewis, D. C. McAllister, R. L. Merrick, and S. M. Mello. 1993. Aerial and ship-based surveys of Steller sea lions (Eumetopias jubatus) in Southeast Alaska, the Gulf of Alaska, and Aleutian Islands during June and July 1992. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-17,57 pp.

Wolfe, R. J., and C. Mischler. 1993. The subsistence harvest of harbor seal and sea lion by Alaska natives in 1992. Final report for year one, subsistence study and monitor system (no. 50ABNF20055). Prepared for the NMFS by Alaska Dept. Fish and Game, Juneau, Alaska, 94 pp. + append.

Wolfe, R. J., and C. Mischler. 1994. The subsistence harvest of harbor seal and sea lion by Alaska natives in 1993. Draft final report for year two, subsistence study and monitor system (no. 50ABNF20055). Prepared for NMFS by Alaska Dept. Fish and Game, Juneau, Alaska, 60 pp. + append.

Wynne, K. M., D. Hicks, and N. Munro. 1991. 1990 salmon gillnet fisheries observer programs in Prince William Sound and South Unimak Alaska. Annual Rept. NMFS/NOAA Contract 50ABNF000036. 65 pp. NMFS, Alaska Region, Office of Marine Mammals, P.O. Box 21668, Juneau, AK 99802.

Wynne, K. M., D. Hicks, and N. Munro. 1992. 1991 Marine mammal observer program for the salmon driftnet fishery of Prince William Sound Alaska. Annual Rept. NMFS/NOAA Contract 50ABNF000036. 53 pp. NMFS, Alaska Region, Office of Marine Mammals, P.O. Box 21668, Juneau, AK 99802.

STELLER SEA LION (*Eumetopias jubatus*): Eastern Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Steller sea lions range along the North Pacific Ocean rim from northern Japan to California (Loughlin et al. 1984), with centers of abundance and distribution in the Gulf of Alaska and Aleutian Islands, respectively. The species is not known to migrate, but individuals disperse widely outside of the breeding season (late May-early July), thus potentially intermixing with animals from other areas. Loughlin (1994) considered the following information when classifying stock structure based on the phylogeographic approach of Dizon et al. (1992): (1) Distributional data: geographic distribution continuous, yet a high degree of natal site fidelity and low (<10%) exchange rate of breeding animals between rookeries: (2) Population response data: substantial differences in population dynamics (Merrick and York 1993); (3) Phenotypic data: unknown; and (4) Genotypic data: substantial differences in mitochondrial DNA (Bickham et al. in press). Based on this information, two separate stocks of Steiler sea lions are now recognized within U.S. waters: an Eastern stock, which includes animals east of Cape Suckling, Alaska (144°W), and a Western U.S. stock, which includes animals at and west of Cape Suckling. Steller sea lions in Canada are considered part of the Eastern stock, but based on the advice of the Alaska Scientific Review Group (DeMaster 1995: pp. 11), the Canadian animals were not incorporated into the minimum abundance estimate.

POPULATION SIZE

The most recent estimate of Steller sea lion abundance in Southeast Alaska is based on aerial surveys performed in June 1994 (NMFS unpubl. data, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98115). The data from these surveys represent actual counts of nonpups at 'trend sites', where sea lions have been monitored since the 1970s and a few additional sites. Aerial and ship-based surveys of Steller sea lions conducted at these same trend sites during June and July 1992 resulted in coefficients of variation (CV) in counts from 0.025 to 0.12 for 7 distinct subareas of Alaska, with an overall CV of 0.0184 (Sease et al. 1993). Counts in California were conducted in 1989 (Loughlin et al. 1992) and 1990-92 (NMFS unpubl. data, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98115), and in 1992 in Oregon (Brown and Riemer 1992); no comparable data are available for Washington State because no sea lion rookeries exist there. The methodology established from the 1989 rangewide survey (Loughlin et al. 1992) produced a correction factor of 1.331 to be multiplied by the nonpup count to estimate total nonpup abundance, and recommended dividing the nonpup count by 2.63 to estimate the number of pups. Using these correction factors and the 1994 counts for Southeast Alaska, California, and Oregon resulted in an estimate of 18,600 nonpups and 5,300 pups, for a total abundance estimate of 23,900 Steller sea lions in the Eastern stock (Table 1).

Aerial surveys in British Columbia during 1994 produced counts of 8,091 nonpups, and 1,186 pups (P. Olesiuk, pers. comm., Pacific Biological Station, Nanaimo, BC V9R 5K6). If the same correction factors are applied to the nonpup count only, the estimated population of Steller sea lions in British Columbia is 13,846 (8.091 x 1.331 + 8,091/2.63) animals. Because Steller sea lions are considered nonmigratory, the population estimate for Canada is not included in the minimum population estimate for this stock (see NMFS in prep., DeMaster 1995: pp. 12).

TABLE 1. Estimates of the number of Steller sea lions by year and geographical area for the Eastern stock for the 1960s through 1994. Numbers are adjusted to account for missed sites and animals at-sea by the methods of Loughlin et al. (1992). The percentage of the U.S. population each area represents is also shown.

Area	1960s	%	1970s	%	1985	%	1989	%	1994	%
Oregon and California	10,300	4	6,400	3	6,700	4	6,800	8	9,300	14
Southeast Alaska	9,000	4	10,300	5	10,300	7	15,800	18	14,600	22
Total	19,300	8	16,700	8	17,000	11	22,600	26	23,900	36

Minimum Population Estimate

For the Eastern stock of Steller sea lions, the minimum population estimate (N_{MIN}) is calculated from equation 1 from the PBR Guidelines (NMFS in prep.): $N_{MIN} = N/exp(0.842*[ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 23,900 and au associated CV of 0.0184, N_{MIN} for the Eastern stock is 23,533. Even though CVs are not currently available for the correction factors, the Alaska Scientific Review Group concluded that this estimate is such that the true number of animals in the population is very likely greater, and so would thus serve as an estimate of N_{MIN} (DeMaster 1995: pp. 10-11).

Current Population Trend

Trend counts (an index to examine population trends) for Steller sea lions in Oregon were relatively stable in the 1980s at about 2,000-3,000 sea lions (no correction factors applied) (NMFS 1992). Counts in Oregon have shown a gradual increase since 1976, as the adult and juvenile count for that year was 1,486 compared to 3,522 for 1994 (Brown and Riemer 1992). This increase is likely due to a recovery from reduced numbers caused by mortality prior to 1972, as immigration from other areas has not been documented (R. Brown, pers. comm., Oregon Dept. Fish & Wildlife, 2040 SE Marine Science Dr., Newport, OR 97365). Counts in California declined by over 50% from 5,000 to 7,000 between 1927 and 1947 to 2,000 to 2,500 between 1980 and 1990; limited information suggests that counts in northern California have increased from the late 1970s to the early 1990s (R. Brown unpubl. data, Oregon Dept. Fish & Wildlife, 2040 SE Marine Science Dr., Newport, OR 97365). At Ano Nuevo, California, a steady decline in ground counts started around 1970, resulting in a 85% reduction in the breeding population by 1987 (LeBoeuf et al. 1991). In recent vertical aerial photographic counts, from 1990 to 1993, pups declined at a rate of 9.9%, while non-pups declined at a rate of 31.5% (Westlake et al. in review). Most recently, population estimates (correction factors applied) for Steller sea lions in the Eastern stock increased 5.8% from 1989 (22,600) to 1994 (23,900) (NMFS unpubl. data, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98115). Population estimates for Oregon and California and Southeast Alaska are given in Table 1 and are compared to the Western U.S. stock in Figure 1.

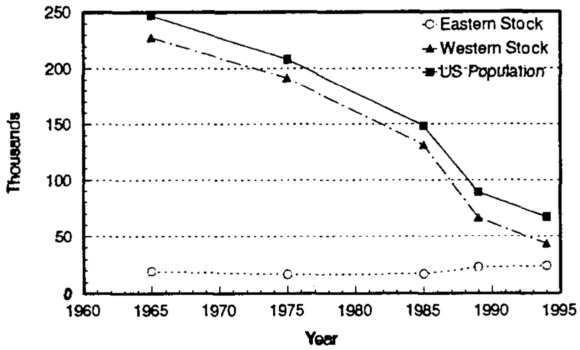

Figure 2. Estimated U.S. population of Steller sea lion adults, juveniles, and pups by stock for 1965-94.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

There are no reliable estimates of maximum net productivity rates for this Steller sea lion stock. Hence, until additional data become available, it is recommended that the pinniped maximum theoretical net productivity rate (R_{MAX}) of 12% be employed for this stock (NMFS in prep.).

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 default recovery factor (F_R) for stocks listed as threatened under the Endangered Species Act (ESA) is 0.5 (NMFS in prep.). However, as total population estimates for the Eastern stock have remained stable or increased over the last 20 years, the recovery factor is set at 0.75; midway between 0.5 (recovery factor for a threatened stock) and 1.0 (recovery factor for a stock within its optimal sustainable population (OSP) level). This approach is consistent with the recommendations of the Alaska Scientific Review Group (DeMaster 1995: pp. 11). Thus, for the Eastern stock of Steller sea lions, PBR = (23,533 x 0.06 x 0.75), or 1,059 animals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

One Steller sea lion mortality incidental to the California shark/swordfish driftnet fishery was observed in 1992, which resulted in an extrapolated estimated total kill of 8 animals (SE=7) per year (Julian 1993). The only available measure of effort was the number of fishing days, thus kill per unit of effort was estimated at 1.681×10^{-3} animals killed per day. There were 4,504 effort days for 1992, and an overall observer coverage rate of 13%, yet some areas had coverage rates less than 8%. No other observed mortality incidental to commercial fisheries was reported. Averaging the 1992 incidental take data over the most recent 4-year period between 1990-93 results in an estimated observed annual incidental kill rate of 2 sea lions per year. No mortalities were reported by NMFS observers monitoring drift and set gillnet fisheries in Washington and Oregon in the last 5 years: however, mortalities have been reported previously. However, a sea lion tagged at Rogue Reef, Oregon, drowned in a salmon gillnet near Petersburg, Alaska (R. Brown, pers. comm., Oregon Dept. Fish & Wildlife, 2040 SE Marine Science Dr., Newport, OR 97365).

An additional source of information on the number of Steller sea lions killed or injured incidental to commercial fishery operations is the logbook reports maintained by boat operators as required by the Marine Mammal Protection Act (MMPA) interim exemption program. During the 3-year period between 1990-92, logbook reports, where observer data were not available, included an annual mean of 0 injuries and 1 mortality from interactions with fishing operations, with an additional 1 injury and 1 mortality due to illegal deterrence. However, because logbook records are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. The Southeast Alaska salmon drift gillnet was the only fishery for which logbook records indicated injury or mortality of sea lions.

The estimated annual mortality rate incidental to commercial fisheries (4.0; based on observer data (2) and logbook reports (2) where observer data were not available) is less than 10% of the PBR (106). Therefore, the current annual level of incidental mortality is considered insignificant and approaching a zero mortality and serious injury rate.

Subsistence/Native Harvest Information

The 1992 and 1993 subsistence harvest of Steller sea lions in Alaska was estimated by the Alaska Department of Fish and Game, under contract with the NMFS (Wolfe and Mishler 1993, Wolfe and Mishler 1994). In both years, data were collected through systematic interviews with hunters and users of marine mammals in approximately 2,100 households in about 60 coastal communities within the geographic range of the Steller sea lion in Alaska; interviews were conducted in 18 communities in the range of the Eastern stock. Only a very small percentage (1%) of the statewide subsistence take was from the Eastern stock, with 5 sea lions harvested in 1992, and 1 sea lion in 1993; 1 animal was struck and lost each year. Thus, the mean annual subsistence take for this stock during 1992 and 1993 was 4.0 sea lions.

Other Mortality

Shooting of sea lions by commercial fishers was thought to be a potentially significant source of mortality prior to the listing of sea lions as threatened under the ESA in 1990, which made such shooting illegal (note: recent regulations implemented under the authority of the MMPA prohibit commercial fishers from shooting at any marine mammals).

STATUS OF STOCK

The estimated annual level of total human-caused mortality and serious injury (4+4=8) does not exceed the PBR (1,059) for this stock. The Steller sea lion is currently listed as threatened under the ESA but is under consideration for endangered status. Thus, the Eastern stock of Steller sea lions is classified as a strategic stock. However, due to the recent classification of two stocks, the status of the Eastern stock will likely be re-evaluated.

REFERENCES

Bickham, J. W., J. C. Patton, and T. R. Loughlin. In press. High variability for control-region sequences in a marine mammal: Implications for conservation and biogeography of Steller sea lion (Eumetopias jubatus). J. Mammal.

Brown R. F., and S. D. Riemer. 1992. Steller sea lion counts in Oregon during June and July, 1975-1991. In-house Rep., Nongame Wildlife Prog., Oregon Dept. Fish and Wildl., Newport, OR, 97365.

Credle, V. R., D. P. DeMaster, M. M. Merklein, M. B. Hanson, W. A. Karp, and S. M. Fitzgerald (eds.). 1994. NMFS observer programs: minutes and recommendations from a workshop held in Galveston, Texas, November 10-11, 1993. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-W-1,96 pp.

DeMaster, D.P. 1995. Minutes from the 4-5 and 11 January 1995 meeting of the Alaska Scientific Review Group, Anchorage, Alaska. 27 pp. + appendices. (available upon request- D.P. DeMaster, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98115).

Dizon, A. E., C. Lockyer, W. F. Perrin, D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 6:24-36.

Julian F. 1993. Pinniped and cetacean mortality in California gillnet fisheries: preliminary estimates for 1992, Rept. Intl. Whaling Comm., working paper SC/45/0 22.

LeBoeuf, B J., K. A. Ono, and J. Reiter. 1991. History of the Steller sea lion population at Ano Nuevo Island, 1961-1991. Southwest Fish. Sci. Cent. Admin. Rep. LJ-91-45c. 24 pp. (available upon request- SWFSC, P.O. Box 271, La Jolla, CA 92038).

Loughlin, T. R. 1994. Using the phylogeographic method to identify Steller sea lion stocks. Working paper GSID 17, workshop on use of genetic data to diagnose management units, Sept. 26-28,1994, La Jolla, CA.

Laughlin, T. R., D. J. Rugh, and C. H. Fiscus. 1984. Northern sea lion distribution and abundance: 1956-1980. J. Wildl. Manage. 48:729-740.

Laughlin, T. R., Perlov, A. S., and V. A. Vladimirov. 1992. Range-wide survey and estimation of total number of Steller sea lions in 1989. Marine Mammal Sci. 8:220-239.

Merrick, R. L., and A. E. York. 1993. A viability analysis for the Alaskan Steller sea lion population. Abstracts, 10th Biennial Conf. Biol. Mar. Mamm., Galveston, TX, Nov. 11-15,1993. Pp. 16.

Merrick, R. L., T. R. Loughlin, and D. G. Calkins. 1987. Decline in abundance of the northern sea lion, Eumetopias jubatus, in 1956-86. Fish. Bull., U.S. 85:351-365.

National Marine Fisheries Service. 1992. Recovery Plan for the Steller Sea Lion (Eumetopias jubatus). Prepared by the Steller Sea Lion Recovery Team for the National Marine Fisheries Service, Silver Spring, MD. 92 pp.

National Marine Fisheries Service. In prep. Guidelines for Estimating Potential Biological Removals. U.S. Dep. Commer., NOAA Tech. Rep.

Sease, J. L, J. P. Lewis, D. C. McAllister, R. L. Met-rick, and S. M. Mello. 1993. Aerial and ship-based surveys of Steller sea lions (Eumetopias jubatus) in Southeast Alaska, the Gulf of Alaska, and Aleutian Islands during June and July 1992. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-17,57 pp.

Westlake, R. L., Perryman, W. L., and Ono, K. A. In press. Comparison of vertical aerial photographic and ground censuses of Steller sea lions at Ano Nuevo Island, July 1990-1993. Southwest Fish. Sci. Cent. Admin. Rep. (available upon request- SWFSC, P.O. Box 271, La Jolla, CA 92038).

Wolfe, R. J., and C. Mischler. 1993. The subsistence harvest of harbor seal and sea lion by Alaska natives in 1992. Final report for year one, subsistence study and monitor system (no. 50ABNF20055). Prepared for the NMFS by Alaska Dep. Fish and Game, Juneau, Alaska, 94 pp. + appendices.

Wolfe, R. J., and C. Mischler. 1994. The subsistence harvest of harbor seal and sea lion by Alaska natives in 1993. Draft final report for year two, subsistence study and monitor system (no. 50ABNF20055). Prepared for the NMFS by Alaska Dep.Fish and Game, Juneau, Alaska, 60 pp. + appendices.

NORTHERN FUR SEAL (*Callorhinus ursinus*): Eastern Pacific 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 onto land at other sites in Alaska, British Columbia, and on islets along the coast of the continental U.S., but generally do so outside of the breeding season (Fiscus 1983).

Adults usually occur on shore during a 6-month period, principally during the reproductive season (June-November), then migrate south and spend the next 6 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 generally migrate only as far south as the Gulf of Alaska (Kajimura 1984). The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: (1) Distributional data: geographic distribution continuous, geographic separation during the breeding season, high natal site fidelity (DeLong 1982); (2) Population response data: substantial differences in population dynamics between Pribilofs and San Miguel Island (DeLong 1982, DeLong and Antonelis 1991, NMFS 1993); (3) Phenotypic data: unknown: and (4) Genotypic data: unknown. Based on this information, two separate stocks of northern fur seals are recognized within U.S. waters: an Eastern Pacific stock and a San Miguel Island stock.

POPULATION SIZE

The population estimate for the Eastern Pacific stock of fur seals is calculated as the estimated number of pups at rookeries multiplied by a series of different expansion factors determined from a life table analysis to estimate the number of yearlings, 2 year olds, 3 year olds, and animals at least 4 years old (Lander 1981). The resulting population estimate is 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 ofjuvenile males was terminated: currently, CVs are unavailable. As the great majority of pups are born on the Pribilof Islands, pup estimates are concentrated on these islands, though additional counts are made on Bogoslof Island. Based on the average mean pup count of 226,613 (CV=0.0593) from 1990 (234,919), 1992 (219,151), and 1994 (225,770) on the Pribilofs and a total population estimate of 5,173 for Bogoslof Island in 1994 (NMFS unpubl. data, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98115), the most recent estimate for the number of fur seals in the Northern Pacific stock is approximately 1,019,192 (1,014,019+5,173).

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock is calculated from equation 1 from the PBR Guidelines (NMFS in prep.): $N_{MIN} = N/\exp(0.842*[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 1,019,192 and the CV (0.0593) associated with the pup counts, N_{MIN} for the Eastern Pacific stock of northern fur seals is 969,595. Even though CVs are not currently available for the correction factor, the Alaska Scientific Review Group concluded that this estimate is such that the true number of animals in the population is very likely greater, and so would thus serve as an estimate of N_{MIN} (DeMaster 1995: pp. 9).

Current Population Trend

The Alaskan population of northern fur seals recovered to approximately 1.25 million in 1974 after the killing of females in the pelagic fur seal harvest was terminated in 1968. The population then began to decrease with pup production declining at a rate of 6.5-7.8% per year into the 1980s (York 1987); the total stock estimate in 1983 was 877,000 (Briggs and Fowler 1984). Annual pup production on St. Paul Island has remained relatively stable since 1981 (Fig. 3), indicating that stock size has not changed much in recent years (York and Fowler 1992). The most recent stock estimates prior to 1994 were 984,000 in 1992, and 1.01 million in 1990 (NMFS 1993). The northern fur seal was designated as depleted under the MMPA in 1988 because population levels had declined to less than 50% of levels observed in the late 1950s and there was no compelling evidence that carrying capacity(K) had changed substantially since the late 1950s (NMFS 1993). Under the Marine Mammal Protection Act (MMPA), this stock will remain listed as depleted until population levels reach at least the lower limit of optimum sustainable population (OSP) (60% of K)

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The northern fur seal population increased steadily during 1912-40 after the commercial harvest no longer included pregnant females. During this period, the rate of population growth was approximately 8.6% (SE=1.47) per year (York, unpubl. data, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98115), the maximum recorded for this species. Given the extremely low density of the population in the early 1900s, this rate of increase is considered a reliable estimate of R_{MAX}.

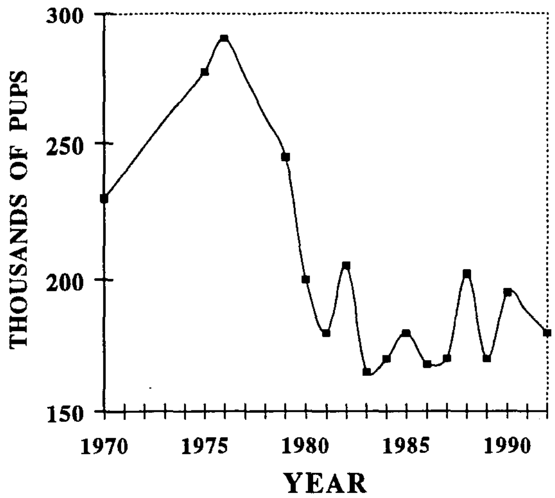

Figure 3. Annual production of Northern Fur Seal pups on St. Paul Island, Alaska, 1970-92

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized 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 depleted stocks under the MMPA (NMFS in prep.). Thus, for the Eastern Pacific stock of northern fur seals, PBR = (969,595 x 0.043 x 0.5), or 20,846 animals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

The NMFS estimate of the total number of northern fur seals killed incidental to both the foreign and joint U.S.-foreign commercial groundfish trawl fisheries in the North Pacific from 1978 to 1988 was 246 (95% Confidence Interval: 68 - 567), which results in an estimated mean annual rate of 22 fur seals. High seas driftnet fisheries are no longer operative, thus information from those fisheries were not included in the calculations of incidental mortality rates.

NMFS observers monitored incidental take on 6 different fisheries during 1990-93 that could have interacted with northern fur seals: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries, and Gulf of Alaska groundfish trawl, longline, and pot fisheries. The only fishery for which observed incidental mortality occurred was the Gulf of Alaska groundfish trawl, with a mean annual (total) mortality of 2.4 (CV=0.54). Fishing effort (based on total metric tons of fish caught) was 1.84 million tons, observer coverage (defined as the percentage of effort observed) was 64%, and incidental catch rate (defined as the number of observed dead in the catch divided by the observed effort (tons) multiplied by 10’) was 0.0129 (CV=0.25).

An additional source of information on the number of northern fur seals killed or injured incidental to commercial fishery operations is the logbook reports maintained by boat operators as required by the MMPA interim exemption program. During the 3-year period between 1990-92, logbook reports, where observer data were not available, included an annual mean of 18 injured and 2 mortalities from interactions with fishing operations, with an additional 18 injured and 2 mortalities due to illegal deterrence. However, because logbook records are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. the great majority of the logbook incidental take occurred in the Bristol Bay salmon drift gillnet fishery.

The estimated annual mortality rate incidental to commercial fisheries (6.4; based on observer data (2.4) and logbook reports (4) where observer data were not available) is less than 10% of the PBR (2,085) and, therefore, is considered insignificant and approaching a zero mortality and serious injury rate.

Subsistence/Native Harvest Information

Alaskan natives residing on the Pribilof Islands are allowed an annual subsistence harvest of northern fur seals, with a take range determined from annual household surveys. During 1985 to 1993 the annual subsistence harvest level averaged 1,622 and 200 for St. Paul and St. George Islands, respectively. The subsistence harvest in 1994 was 1,616 and 161 on St.

Paul and St. George, respectively, for a total of 1,777. only juvenile males are taken in the subsistence harvest, which likely results in a much smaller impact on population growth than a harvest of equal proportions of males and females. Subsistence take in areas other than the Pribilof Islands is not unknown, but believed to be minimal (NMFS unpubl. data, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98115).

STATUS OF STOCK

The estimated annual level of total human-caused mortality and serious injury (6+1,777 = 1,783) does not exceed the PBR (20,846) for this stock. The Eastern Pacific stock of the northern fur seal is classified as a strategic stock because it is designated as depleted under the MMPA.

REFERENCES

Briggs, L., and C. W. Fowler. 1984. Table and figures of the basic population data for northern fur seals of the Pribilof Islands. In Background papers submitted by the United States to the 27th annual meeting of the Standing Scientific Committee of the North Pacific Fur Seal Commission, March 29-April 9, 1984, Moscow, U.S.S.R. Available U.S. Dept Comm., NMML, AFSC, 7600 Sand Point Way NW, Seattle, WA, 98115

Credle, V. R., D. P. DeMaster, M. M. Merklein, M. B. Hanson, W. A. Karp, and S. M. Fitzgerald (eds.). 1994. NMFS observer programs: minutes and recommendations from a workshop held in Galveston, Texas, November 10-11, 1993. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-94-1, 96 pp.

DeLong, R L 1982. Population biology of northern fur seals at San Miguel Island, California. Ph.D. dissertation, University of California, Berkeley, CA. 185 pp.

DeLong, R. L., and G. A. Antonelis. 1991. Impacts of the 1982-1983 El Nino on the northern fur seal population at San Miguel Island, California. Pp. 75-83, In F. Trillmich and K. Ono (eds.), Pinnipeds and El Nino: responses to environmental stress. University of California Press: Berkeley, CA.

DeMaster, D.P. 1995. Minutes from the 4-5 and 11 January 1995 meeting of the Alaska Scientific Review Group, Anchorage, Alaska. 27 pp + appendices. (available upon request- D.P. DeMaster, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98 115).

Dizon, A. E., C. Lockyer, W. F. Perrin, D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 6:24-36.

Fiscus, CF. 1983. Fur seals. In Background papers submitted by the United States to the 26th annual meeting of the Standing Scientific Committee of the North Pacific Fur Seal Commission, Washington, D.C., 28 March -5 April, 1983. National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115.

Kajimura, H. 1984. Opportunistic feeding of the northern fur seal, Callorhinus ursinus, in the eastern North Pacific Ocean and eastern Bering Sea. U.S. Dep. Commer., NOAA Tech. Rep. NMFS SSRF-779,49 pp.

Lander, R. H. 1981. A life table and biomass estimate for Alaskan fur seals. Fish. Res. (Amst.) 1:55-70.

Lander, R. H., and H. Kajimura. 1982. Status of northern fur seals. FAO Fisheries Series 5:319-345.

National Marine Fisheries Service. 1993. Final Conservation Plan for the northern fur seal (Callorhinus ursinus). Prepared by the National Marine Mammal Laboratory/Alaska Fisheries Science Center, Seattle, Washington, and the Office of Protected Resources/National Marine Fisheries Service, Silver Spring, Maryland. 80 pp.

National Marine Fisheries Service. In prep. Guidelines for Estimating Potential Biological Removals. U.S. Dep. Commer., NOAA Tech. Rep.

York, A. E. 1987. Northern fur seal, Callorhinus ursinus, eastern Pacific population (Pribilof Islands, Alaska, and San Miguel Island, California). In J. P. Croxall and R. L. Gentry (eds.), Status, biology, and ecology of fur seals, pp. 9-21. U.S. Dep. Commer., NOAA Tech. Rep. NMFS 51.

York, A. E. and C. W. Fowler. 1992. Population assessment, Pribilof Islands, Alaska. Pp. 9-26 In H. Kajimura and E. Sinclair (eds.), Fur seal investigations, 1990. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-2.

HARBOR SEAL (*Phoca vitulina richardsi*): Southeast Alaska Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Harbor seals inhabit coastal and estuarine waters off Baja California, north along the western coasts of the U.S., British Columbia, and Southeast Alaska, and west through the Gulf of Alaska and Aleutian Islands, and in the Bering Sea north to Cape Newenham and the Pribilof Islands. They haul out on rocks, reefs, beaches, and drifting glacial ice, and feed in marine, estuarine, and occasionally fresh waters. Harbor seals generally are non-migratory, with local movements associated with such factors as tides, weather, season, food availability, and reproduction (Scheffer and Slipp 1944; Fisher 1952; Bigg 1969,1981), although some long-distance movement (174 km) of tagged animals in Alaska has been recorded (Pitcher and McAllister 1981). Strong fidelity of individuals for haul out sites also has been recorded (Pitcher and Calkins 1979, Pitcher and McAllister 1981).

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: (1) Distributional data: geographic distribution continuous, natal dispersal characteristics unknown breeding dispersal very limited, year-round site fidelity observed, seasonal movements greater than 300 km rare (Harvey 1987) except in western Alaska (Hoover-Miller 1994); (2) Population response data: substantial differences in population dynamics between Southeast Alaska, Gulf of Alaska, and Bering Sea (Hoover-Miller 1994); (3) Phenotypic data: clinal variation in body size and color phase (Shaughnessy and Fay 1977, Kelly 1981); (4) Genotypic data: undetermined for Alaska, mitochondrial DNA analyses currently underway. Based on this information, harbor seal stock structure is equivocal. Preliminary mtDNA results show no evidence of geographical separation of populations; however, until additional samples are analyzed (projected for June 1995) preliminary conclusions regarding Alaskan harbor seal stock structure based on genetic analyses are premature (Westlake et al. unpubl. report). Specifically, the small number of samples analyzed to date (31) does not provide sufficient statistical power to accept the conclusion of a single stock. Therefore, based primarily on the significant population decline of seals in the Gulf of Alaska versus the stable population in Southeast Alaska and the apparent stability of the population in the Bering Sea, three separate stocks are recognized in Alaskan waters: Southeast Alaska, Gulf of Alaska, and Bering Sea. The Alaska Scientific Review Group concluded that the scientific data available to determine stock structure were equivocal, and thus stock structure of harbor seals could not be defined.

POPULATION SIZE

The most recent aerial survey of harbor seals in Southeast Alaska was conducted during the autumn molt in 1993. Eleven separate areas, with a mean of 39 (21-59) sites each, were surveyed 5-9 times each: the minimum number of surveys for each of the 427 sites was usually 4 or 5. Ten of 11 areas were surveyed during the 3rd week of September: one area was surveyed from 31 August to 6 September. Some of the survey effort was therefore after the molt peak, and if it is assumed that harbor seals decrease their amount of time hauled out after the molt, the counts from the 1993 surveys may have underestimated the number of seals. All known harbor seal haul out sites in each area were surveyed, and reconnaissance surveys were flown prior to photographic surveys to establish the location of additional sites. Aerial surveys were flown within 2 hours on either side of low tide, based on the assumption that at locations affected by tides, harbor seals haul out in greatest numbers at and around the time of low tide (Pitcher and Calkins 1979, Calambokidis et al. 1987). Glacial haul-outs were flown as close to noon as possible because haul out behavior is thought to be mostly diurnal rather than affected by tide (Hoover 1988).

The sum of all mean counts was 21,523 with a combined CV=0.026 (Loughlin 1994). This method of estimating abundance and its CV assumes that during the survey period no migration occurs between sites and that there was no trend in the number of animals ashore. The number of seals moving between areas was assumed to be small considering each areas large geographic size, though a small number of seals may have been counted twice. A correction factor to account for animals in the water is currently unavailable for this stock, but it is under investigation. Thus, the correction factor developed for harbor seals in the state of Washington (1.61, CV=0.062) was utilized, resulting in a population estimate of 34,652 (21,523 x 1.61; CV=0.0673) for the Southeast Alaska stock of harbor seals. This correction factor is based on the proportion of seals hauled during the pupping season, which in Alaska is higher than the proportion hauled during the molt. Consequently, the correction factor is considered conservative.

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock is calculated from equation 1 from the PBR Guidelines

(NMFS in prep.): N_{MIN}= N/exp(0.842*[ln(1+[CV(N)]^2)]^{½}). Using the population estimate (N) of 34,652 and its associated CV of 0.0673, N_{MIN} for this stock of harbor seals is 32,745.

Current Population Trend

Population trend data are available from 2 sites for the Southeast Alaska stock: Sitka and Ketchikan. When counts from 1993 were compared with those made in the 1980s, mean counts of harbor seals were lower, but were not significantly different at Sitka trend sites whereas counts decreased significantly at the Ketchikan sites (Loughlin 1994). Prior to the 1993 surveys, Pitcher (1990) reported that harbor seal numbers in Southeast Alaska appeared relatively stable.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Reliable rates of maximum net productivity have not been estimated for the Southeast Alaska stock of harbor seal. Population growth rates of 6% and 8% were observed between 1991 and 1992 in Oregon and Washington, respectively. Harbor seals have been protected in British Columbia since 1970, and the population has responded with an annual rate of increase of approximately 12.5% since 1973 (Olesiuk et al. 1990). However, until additional data become available, it is recommended that the pinniped maximum theoretical net productivity rate (R_{MAX}) of 12% be employed for this stock (NMFS in prep.).

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 1.0 (NMFS in prep.), as population levels have remained stable with a known human take (Pitcher 1990, J. Lewis unpubl. data, Alaska Dep. Fish and Game, 333 Raspberry Rd., Anchorage, AK 995 18). Thus, for this stock of harbor seals, PBR = (32,746 x 0.06 x 1.0), or 1,965 animals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

NMFS observers have not been assigned to fisheries in Southeast Alaska: thus, no mortalities of harbor seals incidental to commercial fisheries has been observed. The only source of information on the number of harbor seals killed or injured incidental to commercial fishery operations is the logbook reports maintained by boat operators as required by the Marine Mammal Protection Act (MMPA) interim exemption program. During the 3-year period between 1990-92, logbook reports, where observer data were not available, included an annual mean of 8 injured and 6 mortalities from interactions with fishing operations, with an additional 32 injured and 28 mortalities due to legal deterrence. However, because logbook records are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. These data are from the Southeast Alaska salmon drift gillnet and Yakutat salmon set gillnet fisheries. Injuries and mortalities due to gear interaction were 2-3 times greater in the set gillnet fishery. The majority (82%) of the injuries and mortalities from legal deterrence occurred in 1990.

The estimated annual mortality rate incidental to commercial fisheries recently monitored is 6, based entirely on logbook data because no observer data were available. At present, annual mortality levels less than 196 animals per year (i.e., 10% of PBR) can be considered insignificant. However, a reliable estimate of the mortality rate incidental to commercial fisheries is currently unavailable because of the absence of observer placements in the gillnet fisheries mentioned above. Therefore, it is unknown whether the kill rate is insignificant.

Subsistence/Native Harvest Information

The 1992 and 1993 subsistence harvest of harbor seals in Alaska was estimated by the Alaska Department of Fish and Game, under contract with the NMFS (Wolfe and Mishler 1993, Wolfe and Mishler 1994). In both years, data were collected through systematic interviews with hunters and users of marine mammals in approximately 2,100 households in about 60 coastal communities within the geographic range of the harbor seal in Alaska: interviews were conducted in 18 communities in Southeast Alaska. The subsistence take for the entire state of Alaska was similar for 1992 and 1993: total take, 2,867 (95% CI 2,317-3,677) and 2,729 (95% CI 2,513-3,464); struck and lost, 342 (11.9%) and 369 (13.5%). In both years, the majority of the seals were taken in Southeast Alaska: 1,671(58.3%) and 1,615 (59.2%), with a mean annual take of 1,643. In 1992, the number of seals harvested (i.e., landed) from this stock was 1,481, while 190 were struck and lost.

In 1993, the number of seals harvested was 1,425, while 190 were struck and lost. The age-specific kill of the harvest for this stock during 1992 and 1993 was approximately 81.3% adults, 7.8% juveniles, 0.7% pups, and 10.2% of unknown age: sex-specific kill was approximately 46.9% males, 21.0% females, and 32.1% of unknown sex.

Other Mortality

Illegal intentional killing of harbor seals by commercial fishers, sport fishers, and others may occur, but the magnitude of this mortality is unknown.

STATUS OF STOCK

A reliable estimate of the annual rate of mortality incidental to commercial fisheries is unavailable. Therefore, it is unknown if the estimated annual level of total human-caused mortality and serious injury exceeds the PBR (1,965) for this stock. Until additional information on mortality incidental to commercial fisheries becomes available, the Southeast Alaska stock of harbor seals is not classified as strategic based on stable population levels recently observed. This classification is consistent with the recommendations of the Alaska Scientific Review Group (DeMaster 1995: pp. 14).

REFERENCES

Bigg, M. A. 1969. The harbour seal in British Columbia. Fish. Res. Bd. Can. Bull. 172.33 pp.

Bigg, M. A. 1981. Harbour seal, Phoca vitulina, Linnaeus, 1758 and Phoca Zargha, Pallas, 1811. Pp. 1-27 In S.H. Ridgway and R. J. Harrison (eds.), Handbook of Marine Mammals, vol.2: Seals. Academic Press, New York.

Calambokiclis, J., B. L. Taylor, S. D. Carter, G. H. Steiger, P. K. Dawson, and L. D. Antrim. 1987. Distribution and haul out behavior of harbor seals in Glacier Bay, Alaska. Can. J. Zool. 65:1391-1396.

Credle, V. R., D. P. DeMaster, M. M. Merklein, M. B. Hanson, W. A. Karp, and S. M. Fitzgerald (eds.). 1994. NMFS observer programs: minutes and recommendations from a workshop held in Galveston, Texas, November 10-11, 1993. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-94-1, 96 pp.

DeMaster, D.P. 1995. Minutes from the 4-5 and 11 January 1995 meeting of the Alaska Scientific Review Group, Anchorage, Alaska. 27 pp + appendices. (available upon request- D.P. DeMaster, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98115).

Dizon, A. E., C. Lockyer, W. F. Perrin, D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 6:24-36.

Fisher, I-I. D. 1952. The status of the harbour seal in British Columbia, with particular reference to the Skeena River. Fish. Res. Bd. Can. Bull. 93.58 pp.

Harvey, J. T. 1987. Population dynamics, annual food consumption, movements, and diving behavior of harbor seals, Phoca vitulina, in Oregon. Ph.D. dissertation, Oregon State Univ., Corvallis, OR. 177 pp.

Hoover, A. A. 1988. Harbor seal. Pp. 125-157 In J. W. Lentfer (ed.), Selected marine mammals of Alaska: Species accounts with research and management recommendations. Marine Mammal Commission, Washington, D. C.

Hoover-Miller, A. A. 1994. Harbor seal (Phoca vitulina) biology and management in Alaska. Marine Mammal Commission, Washington D.C., Contract #T75134749.

Kelly, B. P. 1981. Pelage polymorphism in Pacific harbor seals. Can. J. Zool. 59:1212-1219.

Loughlin, T. R. 1994. Abundance and distribution of harbor seals (Phoca vitulina richardsi) in Southeastern Alaska during 1993. Annual report to the MMPA Assessment Program, Office of Protected Resources, NMFS, NOAA, 1335 East-West Highway, Silver Spring, MD 20910.

National Marine Fisheries Service. In prep. Guidelines for Estimating Potential Biological Removals. U.S. Dep. Commer., NOAA Tech. Rep.

Olesiuk, P. F., M. A. Bigg, and G. M. Ellis. 1990. Recent trends in the abundance of harbour seals, Phoca vitulina, in British Columbia. Can. J. Fish. Aquat. Sci. 47:992-1003.

Pitcher, K. W. 1990. Major decline in number of harbor seals, Phoca vitulina richardsi, on Tugidak Island, Gulf of Alaska. Mar. Mammal Sci. 6:121-134.

Pitcher, K. W., and D. G. Calkins. 1979. Biology of the harbor seal (Phoca vitulina richardsi) in the Gulf of Alaska. U.S. Dep. Commer., NOAA, OCSEAP Final Rep. 19(1983):231-310.

Pitcher, K. W., and D. C. McAllister. 1981. Movements and haul out behavior of radio-tagged harbor seals, Phoca vitulina. Can. Field Nat. 95:292-297.

Scheffer, V. B., and J. W. Slipp. 1944. The harbor seal in Washington state. Amer. Midl. Nat. 32:373-416.

Shaughnessy, P. D., and F. H. Fay. 1977. A review of the taxonomy and nomenclature of North Pacific harbour seals. J. Zool. (Lond.) 182:385-419.

Westlake, R. L. G. M. O'Corry-Crowe, A. Sean Costa, C. A. Lux, and A. E. Dizon. Unpubl. rep. Progress in the genetic definition of Alaskan harbor seal populations. U.S. Dep. Commer., NOAA, Southwest Fisheries Science Center, 4 pp. (available upon request- SWFSC, P.O. Box 271, La Jolla, CA 92038).

Wolfe, R. J., and C. Mischler. 1993. The subsistence harvest of harbor seal and sea lion by Alaska natives in 1992. Final report for year one, subsistence study and monitor system (no. 50ABNF20055). Prepared for the NMFS by Alaska Dep. Fish and Game, Juneau, Alaska. 94 pp. + appendices.

Wolfe, R. J., and C. Mischler. 1994. The subsistence harvest of harbor seal and sea lion by Alaska natives in 1993. Draft final report for year two, subsistence study and monitor system (no. 50ABNF20055). Prepared for the NMFS by Alaska Dep. Fish and Game, Juneau, Alaska, 60 pp. + appendices.

HARBOR SEAL (*Phoca vitulina richardsi*): Gulf of Alaska Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Harbor seals inhabit coastal and estuarine waters off Baja California, north along the western coasts of the U.S., British Columbia, and Southeast Alaska, and west through the Gulf of Alaska and Aleutian Islands, and in the Bering Sea north to Cape Newenham and the Pribilof Islands. They haul out on rocks, reefs, beaches, and drifting glacial ice, and feed in marine, estuarine, and occasionally fresh waters. Harbor seals generally are non-migratory, with local movements associated with such factors as tides, weather, season, food availability, and reproduction (Scheffer and Slipp 1944; Fisher 1952; Bigg 1969,1981), although some long-distance movement (174 km) of tagged animals in Alaska has been recorded (Pitcher and McAllister 1981). Strong fidelity of individuals for haul out sites also has been recorded (Pitcher and Catkins 1979, Pitcher and McAllister 1981).

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: (1) Distributional data: geographic distribution continuous, natal dispersal characteristics unknown breeding dispersal very limited, year-round site fidelity observed, seasonal movements greater than 300 km rare (Harvey 1987) except in western Alaska (Hoover-Miller 1994); (2) Population response data: substantial differences in population dynamics between Southeast Alaska Gulf of Alaska, and Bering Sea (Hoover-Miller 1994); (3) Phenotypic data: clinal variation in body size and color phase (Shaughnessy and Fay 1977, Kelly 1981); (4) Genotypic data: undetermined for Alaska, mitochondrial DNA analyses currently underway. Based on this information, harbor seal stock structure is equivocal. Preliminary mtDNA results show no evidence of geographical separation of populations; however, until additional samples are analyzed (projected for June 1995) preliminary conclusions regarding Alaskan harbor seal stock structure based on genetic analyses are premature (Westlake et al. unpubl. report). Specifically, the small number of samples analyzed to date (31) does not provide sufficient statistical power to accept the conclusion of a single stock. Therefore, based primarily on the significant population decline of seals in the Gulf of Alaska versus the stable population in Southeast Alaska and the apparent stability of the population in the Bering Sea, three separate stocks are recognized in Alaskan waters: Southeast Alaska, Gulf of Alaska, and Bering Sea. The Alaska Scientific Review Group concluded that the scientific data available to determine stock structure were equivocal, and thus stock structure of harbor seals could not be defined.

POPULATION SIZE

Extensive photographic aerial surveys of harbor seals in the Gulf of Alaska were conducted during the autumn molt in 1991 (23 August - 29 August): Prince William Sound and the Copper River Delta; and 1992 (25 August - 9 September): south side of the Alaska Peninsula, Cook Inlet, Kenai Peninsula, the Kodiak Archipelago, and Prince William Sound. All known harbor seal haul out sites in each area were surveyed, and reconnaissance surveys were flown prior to photographic surveys to establish the location of additional sites. Aerial surveys were flown within 2 hours on either side of low tide, based on the assumption that at locations affected by tides, harbor seals haul out in greatest numbers at and around the time of low tide (Pitcher and Calkins 1979, Calambokidis et al. 1987). Glacial haul-outs were flown as close to noon as possible because haul out behavior is thought to be mostly diurnal rather than affected by tide (Hoover 1988). At least four repetitive photographic counts were obtained for each major rookery and haul out site within each study area. Coefficients of variation (CV) were determined for multiple surveys and found to be <0.19 in all cases. This method of estimating abundance and its CV assumes that during the survey period no migration occurs between sites and that there was no trend in the number of animals ashore. The number of seals moving between areas was assumed to be small considering each area's large geographic size, though a small number of seals may have been counted twice.

The total count for the 1991 and 1992 surveys was 12,232 (CV=0.030) harbor seals, with the following mean counts for the major survey areas: Copper River Delta 3,491; Prince William Sound 2,394: Kenai Peninsula 695; Cook Inlet 1,105; Kodiak Archipelago 2,422: south side of the Alaska Peninsula 2,125 (Loughlin 1992, 1993). A correction factor for this stock is currently unavailable: yet, a correction factor study was performed during autumn 1994 in Southeast Alaska and analyses are nearly complete. Instead, the correction factor developed for harbor seals in the state of Washington (1.61, CV=0.062; Huber et al. 1993) was utilized. This correction factor is based on the proportion of seals hauled during the pupping season, which in Alaska is higher than the proportion hauled during the molt; consequently, the correction factor is considered conservative. Thus, the estimated abundance for the Gulf of Alaska stock of harbor seals is 19,694 (12,232 x 1.61; CV=0.0689).

Minimum Population Estimate

Not determined, see "Status of Stock" section below.

Current Population Trend

In Prince William Sound, harbor seal numbers have declined by as much as 57% from 1984 to 1992 (Pitcher 1989, Frost and Lowry 1993); the decline appears to have begun before the 1989 Exxon Valdez oil spill, yet may have accelerated thereafter. A steady decrease in numbers of harbor seals has been reported throughout the Kodiak Archipelago since 1976. On southwestern Tugidak Island, formally one of the largest concentrations of harbor seals in the world, counts declined 85% from 1976 (6,919) to 1988 (1,014) (Pitcher 1990); the 1994 count (678) represents a 33% decline since 1988. Overall counts for Kodiak Island, based on an aerial photographic route established in 1992, increased slightly (11%) from 1993 (1,424) to 1994 (1,604) (J. Lewis unpubl. data, Alaska Dep. Fish and Game, 333 Raspberry Rd., Anchorage, AK 99518); however, the overall population remains low compared to the 1970s and 1980s.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Reliable rates of maximum net productivity have not been estimated for the Gulf of Alaska and Bering Sea stock of harbor seal. Population growth rates were estimated at 6% and 8% between 1991 and 1992 in Oregon and Washington, respectively (Huber et al. 1994). Harbor seals have been protected in British Columbia since 1970, and the population has responded with an annual rate of increase of approximately 12.5% since 1973 (Olesiuk et al. 1990). However, until additional data become available from which more reliable estimates of population growth can be determined, it is recommended that the pinniped maximum theoretical net productivity rate (R_{MAX}) of 12% be employed for this stock (NMFS in prep.).

POTENTIAL BIOLOGICAL REMOVAL

Not determined, see "Status of Stock" section below.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

NMFS observers monitored incidental take on 3 different fisheries within the range of the Gulf of Alaska stock of harbor seals during 1990-93: Gulf of Alaska groundfish trawl, longline, and pot fisheries. The only fishery for which observed incidental mortality occurred was the Gulf of Alaska groundfish trawl, with a mean annual (total) mortality of 1 (CV=0.54). Fishing effort (based on total metric tons of fish caught) was 212,000 tons, observer coverage (defined as the percentage of effort observed) was 42%, and the incidental catch rate (defined as the number of observed dead in the catch divided by the observed effort (tons) multiplied by 10^{-4}) was 0.0563 (CV=0.54).

In the Prince William Sound driftnet fishery, observers recorded 2 incidental mortalities of harbor seals in 1990 (Wynne et al. 1991), and 1 in 1991 (Wynne et al. 1992). The extrapolated kill estimates were 36 (95% CI 2-74) in 1990 and 12 (95% CI 1-44) in 1991, resulting in an extrapolated mean kill of 24 animals per year for this fishery. Combining the estimate from the Gulf of Alaska groundfish trawl fishery presented above (1) with the estimate from the Prince William Sound driftnet fishery (24) results in an estimated annual observed incidental kill rate of 25 harbor seals per year. In 1990, observers boarded 300 (57.3%) of the 524 vessels that fished in the Prince William Sound driftnet fishery, monitoring a total of 3,090 sets, or 3.9% of the estimated number of sets made by the fleet after 1 July when observers were fully deployed. The South Unimak driftnet fishery was monitored in 1990 (but not 1991), and observers boarded 59 (38.3%) of 154 vessels, monitoring a total of 373 or 4.1% of the sets. In 1991, 116,674 or 5.04% of the sets were observed in Prince William Sound districts. The estimated mortality rate of harbor seals based on me 1990 and 1991 observed mortalities is 0.0002 kills per set.

An additional source of information on the number of harbor seals killed or injured incidental to commercial fishery operations is the logbook reports maintained by boat operators as required by the Marine Mammal Protection Act (MMPA) interim exemption program. During the 3-year period between 1990-92, logbook reports, where observer data were not available, from the Gulf of Alaska indicated an annual mean of 10 injuries and 10 mortalities from interactions with fishing operations, with an additional 7 injuries and 7 mortalities due to legal deterrence. However, because logbook records are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. These estimates are based on all available logbook reports for Gulf of Alaska fisheries, except the groundfish fisheries, for which observer data were presented above. The fishery for which the majority of the incidental take occurred was the Copper River and Bering River salmon drift gillnet fishery.

The estimated annual mortality rate incidental to commercial fisheries is 35, based on observer data (25) and logbook reports (10) where observer data were not available. However, a reliable estimate of the mortality rate incidental to commercial fisheries is currently unavailable because of the absence of observer placements in the fisheries mentioned above. Further, at present, a protocol for estimating a PBR for this stock has not been developed. Therefore, it is unknown whether the kill rate due to commercial fishing is insignificant.

Subsistence/Native Harvest Information

The 1992 and 1993 subsistence harvest of harbor seals in Alaska was estimated by the Alaska Department of Fish and Game, under contract with the NMFS (Wolfe and Mishler 1993, Wolfe and Mishler 1994). In both years, data were collected through systematic interviews with hunters and users of marine mammals in approximately 2,100 households in about 60 coastal communities within the geographic range of the harbor seal in Alaska; interviews were conducted in 27 communities in the Gulf of Alaska. The subsistence take for the entire state of Alaska was similar for 1992 and 1993: total take, 2,867 (95% CI 2,317-3,677) and 2,729 (95% CI 2,513-3,464); struck and lost, 342 (11.9%) and 369 (13.5%). For 1992 and 1993, the number of seals taken in the Gulf of Alaska was 852 (29.7%) and 814 (29.8%), respectively, with a mean annual take of 833. The number of seals harvested for this stock was 790 and 728, whereas the number struck and lost was 62 (7.8%) and 86 (11.8%) for 1992 and 1993, respectively. The age-specific kill of the harvest for this stock during 1992 and 1993 was approximately 62.6% adults, 20.6% juveniles, 1.9% pups, and 14.9% of unknown age: sex-specific kill was approximately 40.6% males, 15.6% females, and 43.8% of unknown sex.

Other Mortality

Illegal intentional killing of harbor seals by commercial fishers, sport fishers, and others may occur, but the magnitude of this mortality is unknown.

STATUS OF STOCK

Estimates of Potential Biological Removal and status under the Marine Mammal Protection Act (MMPA) have not been determined because this marine mammal stock is (1) not listed under the Endangered Species Act or MMPA, (2) subject to Alaska Native subsistence harvests, and (3) fisheries-related mortality and serious injury incidental to commercial fishing is absent or is a relatively minor contribution to total human-related mortality and injury. Sustainable harvest levels and status determination for this stock will be determined from the analysis of information gathered through the co-management process, and will reflect me degree of uncertainty associated with the information obtained for this stock.

REFERENCES

Bigg, M. A. 1969. The harbour seal in British Columbia. Fish. Res. Bd. Can. Bull. 172.33 pp.

Bigg, M. A. 1981. Harbour seal, Phoca vitulina, Linnaeus, 1758 and Phoca largha, Pallas, 1811. Pp. 1-27, In S.H. Ridgway and R. J. Harrison (eds.), Handbook of Marine Mammals, vol.2: Seals. Academic Press, New York.

Calambokidis, J., B. L. Taylor, S. D. Carter, G. H. Steiger, P. K. Dawson, and L. D. Antrim. 1987. Distribution and haul out behavior of harbor seals in Glacier Bay, Alaska. Can. J. Zool. 65:1391-1396.

Credle, V. R., D. P. DeMaster, M. M. Merklein, M. B. Hanson, W. A. Karp, and S. M. Fitzgerald (eds.). 1994. NMFS observer programs: minutes and recommendations from a workshop held in Galveston, Texas, November 10-11, 1993. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-94-1, 96 pp.

Dizon, A. E., C. Lockyer, W. F. Perrin, D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 6:24-36.

Fisher, H. D. 1952. The status of the harbour seal in British Columbia, with particular reference to the Skeena River. Fish. Res. Bd. Can. Bull. 93.58 pp.

Frost, K. F., and L. F. Lowry. 1993. Assessment of injury to harbor seals in Prince William Sound, Alaska, and adjacent areas following the Exxon Valdez oil spill. State-Federal Natural Resource Damage Assessment, Marine Mammals Study No.5. 95 pp.

Harvey, J. T. 1987. Population dynamics, annual food consumption, movements, and diving behavior of harbor seals, Phoca vitulina, in Oregon. Ph.D. dissertation, Oregon State Univ., Corvallis, OR. 177 pp.

Hoover, A. A. 1988. Harbor seal. Pp. 125-157, In J. W. Lentfer (ed.), Selected marine mammals of Alaska: Species accounts with research and management recommendations. Marine Mammal Commission, Washington, D.C.

Hoover-Miller, A. A. 1994. Harbor seal (Phoca vitulina) biology and management in Alaska. Marine Mammal Commission, Washington D.C., Contract #T75134749.

Huber, H., S. Jeffries, R. Brown, and R. DeLong. 1993 Abundance of harbor seals (Phoca vitulina richardsi) in Washington and Oregon, 1992. Annual report to the MMPA Assessment Program, Office of Protected Resources, NMFS, NOAA, 1335 East-West Highway, Silver Spring, MD 20910.

Huber, H., S. Jeffries, R. Brown, and R. DeLong. 1994. Harbor Seal Stock Assessment in Washington and Oregon 1993. Annual report to the MMPA Assessment Program, Office of Protected Resources, NMFS, NOAA, 1335 East-West Highway, Silver Spring, MD 20910.

Kelly, B. P. 1981. Pelage polymorphism in Pacific harbor seals. Can. J. Zool. 59:1212-1219.

Ioughlin, T. R. 1992. Abundance and distribution of harbor seals (Phoca vitulina richardsi) in Bristol Bay, Prince William Sound, and Copper River Delta during 1991. Annual report to the MMPA Assessment Program, Office of Protected Resources, NMFS, NOAA, 1335 East-West Highway, Silver Spring, MD 20910.

Loughhn, T. R. 1993. Abundance and distribution of harbor seals (Phoca vitulina richardsi) in the Gulf of Alaska and Prince William Sound in 1992. Annual report to the MMPA Assessment Program, Office of Protected Resources, NMFS, NOAA, 1335 East-West Highway, Silver Spring, MD 20910.

National Marine Fisheries Service. In prep. Guidelines for Estimating Potential Biological Removals. U.S. Dep. Commer., NOAA Tech. Rep.

Olesiuk, P.F., M. A. Bigg, and G. M. Ellis. 1990. Recent trends in the abundance of harbour seals, Phoca vitulina, in British Columbia. Can. J. Fish. and Aquat. Sci. 47:992-1003.

Pitcher, K W. 1989. Harbor seal trend count surveys in southern Alaska, 1988. Final report Contract MM4465852-1 to U.S. Marine Mammal Commission, Washington, D.C. 15 pp.

Pitcher, K. W. 1990. Major decline in number of harbor seals, Phoca vitulina richardsi, on Tugidak Island, Gulf of Alaska. Mar. Mammal Sci. 6:121-134.

Pitcher, K W., and D. G. Calkins. 1979. Biology of the harbor seal (Phoca vitulina richardsi) in the Gulf of Alaska. U.S. Dep. Commer., NOAA, OCSEAP Final Rep. 19(1983):231-310.

Pitcher, K. W., and D. C. McAllister. 1981. Movements and haul out behavior of radio-tagged harbor seals, Phoca vitulina. Can. Field Nat. 95:292-297.

Scheffer, V. B., and J. W. Slipp. 1944. The harbor seal in Washington state, Amer. Midl. Nat. 32:373-416.

Shaughnessy, P. D., and F. H. Fay. 1977. A review of the taxonomy and nomenclature of North Pacific harbour seals. J. Zool. (Lond.) 182:385-419.

Westlake, R. L. G. M. O'Corry-Crowe, A. Sean Costa, C. A. Lux, and A. E. Dizon. Unpubl. rep. Progress in the genetic definition of Alaskan harbor seal populations. U.S. Dep. Commer., NOAA, NFMS, Southwest Fisheries Science Center, 4pp. (available upon request- SWFSC, P.O. Box 271, La Jolla, CA 92038).

Wolfe, R. J., and C. Mischler. 1993. The subsistence harvest of harbor seal and sea lion by Alaska natives in 1992. Final report for year one, subsistence study and monitor system (no. 50ABNF20055). Prepared for the NMFS by Alaska Dep. Fish and Game, Juneau, Alaska, 94 pp. + appendices.

Wolfe, R. J., and C. Mischler. 1994. The subsistence harvest of harbor seal and sea lion by Alaska natives in 1993. Draft final report for year two, subsistence study and monitor system (no. 50ABNF20055). Prepared for the NMFS by Alaska Dep. Fish and Game, Juneau, Alaska, 60 pp. + appendices.

Wynne, K M., D. Hicks, and N. Munro. 1991. 1990 salmon gillnet fisheries observer programs in Prince William Sound and South Unimak Alaska. Annual Rept. NMFS/NOAA Contract 50ABNF000036. 65 pp. NMFS, Alaska Region, Office of Marine Mammals, P.O. Box 21668, Juneau, AK 99802.

Wynne, K M., D. Hicks, and N. Munro. 1992. 1991 Marine mammal observer program for the salmon driftnet fishery of Prince William Sound Alaska. Annual Rept. NMFS/NOAA Contract 50ABNF000036. 53 pp. NMFS, Alaska Region, Office of Marine Mammals, P.O. Box 21668, Juneau, AK 99802.

HARBOR SEAL (*Phoca vitulina richardsi*): Bering Sea Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Harbor seals inhabit coastal and estuarine waters off Baja California, norm along the western coasts of me U.S., British Columbia, and Southeast Alaska, and west through me Gulf of Alaska and Aleutian Islands, and in me Bering Sea norm to Cape Newenham and the Pribilof Islands. They haul out on rocks, reefs, beaches, and drifting glacial ice, and feed in marine, estuarine, and occasionally fresh waters. Harbor seals generally are non-migratory, with local movements associated with such factors as tides, weather, season, food availability, and reproduction (Scheffer and Slipp 1944; Fisher 1952; Bigg 1969,1981), although some long-distance movement (174 km) of tagged animals in Alaska has been recorded (Pitcher and McAllister 1981). Strong fidelity of individuals for haul out sites also has been recorded (Pitcher and Calkins 1979, Pitcher and McAllister 1981).

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: (1) Distributional data: geographic distribution continuous, natal dispersal characteristics unknown breeding dispersal very limited, year-round site fidelity observed, seasonal movements greater than 300 km rare (Harvey 1987) except in western Alaska (Hoover-Miller 1994); (2) Population response data: substantial differences in population dynamics between Southeast Alaska, Gulf of Alaska, and Bering Sea (Hoover-Miller 1994); (3) Phenotypic data: clinal variation in body size and color phase (Shaughnessy and Fay 1977, Kelly 1981); (4) Genotypic data: undetermined for Alaska, mitochondrial DNA analyses currently underway. Based on this information, harbor seal stock structure is equivocal. Preliminary mtDNA results show no evidence of geographical separation of populations: however, until additional samples are analyzed (projected for June 1995) preliminary conclusions regarding Alaskan harbor seal stock structure based on genetic analyses are premature (Westlake et al. unpubl. report). Specifically, the small number of samples analyzed to date (31) does not provide sufficient statistical power to accept the conclusion of a single stock. Therefore, based primarily on the significant population decline of seals in the Gulf of Alaska versus the stable population in Southeast Alaska and the apparent stability of the population in the Bering Sea, three separate stocks are recognized in Alaskan waters: Southeast Alaska, Gulf of Alaska, and Bering Sea. The Alaska Scientific Review Group concluded that the scientific data available to determine stock structure were equivocal, and thus stock structure of harbor seals could not be defined.

POPULATION SIZE

Extensive photographic aerial surveys of harbor seals in the Bering Sea were conducted during the autumn molt in 1991(26 August - 5 September): Eastern Bristol Bay and the north side of the Alaska Peninsula: and 1994 (29 August - 8 September): Aleutian Islands. All known harbor seal haul out sites in each area were surveyed, and reconnaissance surveys were flown prior to photographic surveys to establish the location of additional sites. Aerial surveys were flown within 2 hours on either side of low tide, based on the assumption that at locations affected by tides, harbor seals haul out in greatest numbers at and around the time of low tide (Pitcher and Calkins 1979, Calambokidis et al. 1987). At least four repetitive photographic counts were obtained for each major rookery and haul out site within each study area. Coefficients of variation were determined for multiple surveys and found to be 4.19 in all cases. This method of estimating abundance and its CV assumes that during the survey period no migration occurs between sites and that there was no trend in the number of animals ashore. The number of seals moving between areas was assumed to be small considering each area's large geographic size, though a small number of seals may have been counted twice.

The total mean count for the 1991 survey was 9,324 harbor seals, with mean counts of 797 for Bristol Bay and 8,527 for the north side of the Alaska Peninsula (Loughlin 1992), whereas the sum of mean counts from the 1994 Aleutian Islands surveywas 2,056 (NMFS unpubl. data, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98115). A reliable estimate of the number of seals on Otter Island (Pribilof Islands) is currently not available; a minimum count in July 1978 was 707 (Kelly unpubl. report). Thus, the population estimate for the Bering Sea stock of harbor seals is 11,380 (9,324 + 2,056; CV=0.057). A correction factor for this stock is currently unavailable: although a correction factor study was performed during autumn 1994 in Southeast Alaska, and analyses are nearly complete. Instead, the correction factor developed for harbor seals in the state of Washington (1.61, CV=0.062; Huber et al. 1993) was utilized. This correction factor is based on the proportion of seals hauled during the pupping season, which in Alaska is higher than the proportion hauled during the molt; consequently, the correction factor is considered conservative. Thus, the estimated abundance for the Bering Sea stock of harbor seals is 18,322 (11,380 x 1.61; CV=0.0722).

Minimum Population Estimate

The minimum population estimate (N,) for this stock is calculated from equation 1 from the PBR Guidelines (NMFS in prep.): $N_{MIN} = N/exp(0.842*[ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 18,322 and a CV of 0.0722, N_{MIN} for this stock of harbor seals is 17,243.

Current Population Trend

The population on the north side of the Alaska Peninsula appears to have remained relatively stable from 1975 to 1991, fluctuating around 9,000 animals. However, an increase of about 5,600 seals was observed from 1975 to 1976, an increase which Loughlin (1992) considered unlikely to be due from an addition of new pups. During 1975 to 1991 the combined counts at Bristol Bay sites declined: however, Loughlin (1992) stated that if the high count in 1976 was excluded as anomalous, the decline becomes equivocal.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Reliable rates of maximum net productivity have not been estimated for the Gulf of Alaska and Bering Sea stock of harbor seal. Population growth rates were estimated at 6% and 8% between 1991 and 1992 in Oregon and Washington, respectively (Huber et al. 1994). Harbor seals have been protected in British Columbia since 1970, and the population has responded with an annual rate of increase of approximately 12.5% since 1973 (Olesiuk et al. 1990). However, until additional data become available from which more reliable estimates of population growth can be determined, it is recommended that the pinniped maximum theoretical net productivity rate (R,) of 12% be employed for this stock (NMFS in prep.).

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), me 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 pinniped stocks with stable population status (NMFS in prep,). Thus, for this stock of harbor seals, PBR = (17,243 x 0.06 x 1.0), or 1,035 animals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

NMFS observers monitored incidental take on 3 different fisheries within the range of the Bering Sea stock of harbor seals during 1990-93: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries. The mean annual (total) mortality was 1 (CV=0.35) for the Bering Sea groundfish trawl fishery, and 1 (CV=0.75) for the Bering Sea groundfish longline fishery. No harbor seal mortality was observed by NMFS observers in the pot fishery. Fishing effort (based on total metric tons of fish caught), observer coverage (defined as the percentage of effort observed), and incidental catch rate (defined as the number of observed dead in the catch divided by the observed effort (tons) multiplied by 10') was also estimated for the 2 fisheries where incidental mortality occurred: Bering Sea groundfish trawl, effort=l.84 million tons, observer coverage=64%, and catch rate=0.0064 (CV=0.34); and Bering Sea groundfish longline: effort=95,000 tons, observer coverag=44%, and catch rate=0.0598 (CV=0.75).

An additional source of information on the number of harbor seals killed or injured incidental to commercial fishery operations is the logbook reports maintained by boat operators as required by the Marine Mammal Protection Act (MMPA) interim exemption program. During the 3-year period between 1990-92, logbook reports, where observer data were not available, from the Bering Sea indicated an annual mean of 12 injuries and 10 mortalities from interactions with fishing operations, with an additional 12 injuries and 24 mortalities due to legal deterrence. However, because logbook records are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. These estimates are based on all available logbook reports for the Bering Sea fisheries, except those fisheries for which observer data were presented above. The fisheries for which the majority of the incidental take occurred in the Bering Sea was the Bristol Bay salmon set and drift gillnet fisheries.

The estimated annual mortality rate incidental to commercial fisheries (12; based on observer data (2) and logbook reports (10) where observer data were not available) is less than 10% of the PBR (110). However, a reliable estimate of the mortalityrate incidental to commercial fisheries is currently unavailable because of the absence of observer placements in the gillnet fisheries mentioned above. Therefore, it is unknown whether the kill rate is insignificant.

Subsistence/Native Harvest Information

The 1992 and 1993 subsistence harvest of harbor seals in Alaska was estimated by the Alaska Department of Fish and Game, under contract with me NMFS (Wolfe and Mishler 1993, Wolfe and Mishler 1994). In both years, data were collected through systematic interviews with hunters and users of marine mammals in approximately 2,100 households in about 60 coastal communities within me geographic range of me harbor seal in Alaska; interviews were conducted in 15 communities in the Bering Sea and Aleutian Islands. The subsistence take for the entire state of Alaska was similar for 1992 and 1993: total take, 2,867 (95% CI 2,317-3,677) and 2,729 (95% CI 2,513-3,464); struck and lost, 342 (11.9%) and 369 (13.5%). For 1992 and 1993, the number of seals taken from the Bering Sea stock was 344 (12.1%) and 300 (11.0%), respectively, with a mean annual take of 322. The number of seals harvested was 253 and 207, whereas the number struck and lost was 91 (36.0%) and 93 (44.9%) for 1992 and 1993, respectively. The age-specific kill of the harvest for this stock during 1992 and 1993 was approximately 60.3% adults, 25.4% juveniles, 4.7% pups, and 9.6% of unknown age; sex-specific kill was approximately 29.8% males, 16.5% females, and 53.7% of unknown sex.

Other Mortality

Illegal intentional killing of harbor seals by commercial fishers, sport fishers, and others may occur, but the magnitude of this mortality is unknown.

STATUS OF STOCK

The estimated annual rate of human-caused mortality and serious injury (12 + 322=334) does not exceed the PBR (1,035), thus the Bering Sea stock of harbor seals is not classified as a strategic stock.

REFERENCES

Bigg, M. A. 1969. The harbour seal in British Columbia. Fish. Res. Bd. Can. Bull. 172.33 pp.

Bigg, M. A. 1981. Harbour seal, Phoca vitulina, Linnaeus, 1758 and Phoca largha, Pallas, 1811. Pp. 1-27, In S.H. Ridgway and R. J. Harrison (eds.), Handbook of Marine Mammals, vol.2: Seals. Academic Press, New York.

Calambokidis, J., B. L. Taylor, S. D. Carter, G. H. Steiger, P. K. Dawson, and L. D. Antrim. 1987. Distribution and haul out behavior of harbor seals in Glacier Bay, Alaska. Can. J. Zool. 65:1391-1396.

Credle, V. R., D. P. DeMaster, M. M. Merklein, M. B. Hanson, W. A. Karp, and S. M. Fitzgerald (eds.). 1994. NMFS observer programs: minutes and recommendations from a workshop held in Galveston, Texas, November 10-11, 1993. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-94-1, 96 pp.

Dizon, A.E., C. Lockyer, W.F. Perrin, D.P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 6:24-36.

Fisher, H.D. 1952. The status of the harbour seal in British Columbia, with particular reference to the Skeena River. Fish. Res. Bd. Can. Bull. 93. 58 pp.

Harvey, J.T. 1987. Population dynamics, annual food consumption, movements, and diving behavior of harbor seals, Phoca vitulina, in Oregon. Ph.D. dissertation, Oregon State Univ., Corvallis, OR. 177 pp.

Hoover-Miller, A.A. 1994. Harbor seal (Phoca vitulina) biology and management in Alaska. Marine Mammal Commission, Washington D.C., Contract #T75134749.

Huber, H., S. Jeffries, R. Brown, and R. DeLong. 1993 Abundance of harbor seals (Phoca vitulina richardsi) in Washington and Oregon, 1992. Annual report to the MMPA Assessment Program Office of Protected Resources, NMFS, NOAA, 1335 East-West Highway, Silver Spring, MD 20910.

Huber, H., S. Jeffries, R. Brown and R. DeLong. 1994. Harbor Seal Stock Assessment in Washington and Oregon 1993. Annual report to the MMPA Assessment Program, Office of Protected Resources, NMFS, NOAA, 1335 East-West Highway, Silver Spring, MD 20910.

Kelly, B. P. Unpubl. rep. Biological observations on Otter Island, Pribilof Islands, July 1978 - a report to the National Marine Fisheries Service. Biological Sciences Program, Univ. Alaska, Fairbanks, AK. 10 pp.

Kelly, B. P. 1981. Pelage polymorphism in Pacific harbor seals. Can. J. Zool. 59: 1212-1219.

Loughlin, T. R. 1992. Abundance and distribution of harbor seals (Phoca vitulina richardsi) in Bristol Bay, Prince William Sound, and Copper River Delta during 1991. Annual report to the MMPA Assessment Program, Office of Protected Resources, NMFS, NOAA, 1335 East-West Highway, Silver Spring, MD 20910.

National Marine Fisheries Service. In prep. Guidelines for Estimating Potential Biological Removals. U.S. Dep. Commer., NOAA Tech. Rep.

Olesiuk, P.F., M. A. Bigg, and G. M. Ellis. 1990. Recent trends in the abundance of harbour seals, Phoca vitulina, in British Columbia. Can. J. Fish. Aquat. Sci. 47:992-1003.

Pitcher, K. W., and D. G. Calkins. 1979. Biology of the harbor seal (Phoca vitulina richadsi) in the Gulf of Alaska. U.S. Dep. Commer., NOAA, OCSEAP Final Rep. 19(1983):231-310.

Pitcher, K. W., and D. C. McAllister. 1981. Movements and haul out behavior of radio-tagged harbor seals, Phoca vitulina. Can. Field Nat. 95:292-297.

Scheffer, V. B., and J. W. Slipp. 1944. The harbor seal in Washington state. Amer. Midl. Nat. 32:373-416.

Shaughnessy, P. D., and F. H. Fay. 1977. A review of the taxonomy and nomenclature of North Pacific harbour seals. J. Zool. (Lond.) 182:385419.

Westlake, R. L. G. M. O'Corry-Crowe, A. Sean Costa, C. A. Lux, and A. E. Dizon. Unpubl. rep. Progress in the genetic definition of Alaskan harbor seal populations. U.S. Dep. Commer., NOAA, Southwest Fisheries Science Center, 4 pp. (available upon request- SWFSC, P.O. Box 271, La Jolla, CA 92038).

Wolfe, R. J., and C. Mischler. 1993. The subsistence harvest of harbor seal and sea lion by Alaska natives in 1992. Final report for year one, subsistence study and monitor system (no. 50ABNF20055). Prepared for the NMFS by Alaska Dep. Fish and Game, Juneau, Alaska, 94 pp. + appendices.

Wolfe, R. J., and C. Mischler. 1994. The subsistence harvest of harbor seal and sea lion by Alaska natives in 1993. Draft final report for year two, subsistence study and monitor system (no. 50ABNF20055). Prepared for the NMFS by Alaska Dep. Fish and Game, Juneau, Alaska, 60 pp. + appendices.

SPOTTED SEAL (*Phoca largha*): Alaska Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Spotted seals are distributed along me continental shelf of me Beaufort, Chukchi, Bering, and Okhotsk Seas south to the northern Yellow Sea and western Sea of Japan (Shaughnessy and Fay 1977). Little is known of their winter distribution and migration routes. During spring they inhabit mainly the southern margin of the ice, with movement to coastal habitats after me retreat of the sea ice (Fay 1974, Shaughnessy and Fay 1977). In summer, spotted seals may be found as far north as 69-72°N in the Chukchi and Beaufort Seas (Shaughnessy and Fay 1977, Porsild 1945). To the south, along the west coast of Alaska, spotted seals are known to occur around the Pribilof Islands, Bristol Bay, and the eastern Aleutian Islands. Of 8 known breeding areas, 3 occur in the Bering Sea, the remaining 5 are in the Okhotsk Sea and Sea of Japan. There is little morphological difference between seals from these areas. Spotted seals are closely related to and often mistaken for North Pacific harbor seals (Phoca vitulina). The two species are often seen together and are partially sympatric, as their ranges overlap in the southern part of the Bering Sea (Quakenbush 1988). Yet, spotted seals breed earlier and are less social during the breeding season, and only spotted seals are regularly associated with pack ice (Shaughnessy and Fay 1977). These and other ecological, behavioral, and morphological differences support their recognition as two separate species (Quakenbush 1988).

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: (1) Distributional data: geographic distribution continuous, (2) Population response data: unknown: (3) Phenotypic data: unknown; (4) Genotypic data: unknown. Based on this limited information, and the absence of any significant fishery interactions, there is currently no strong evidence to suggest splitting the distribution of spotted seals into more than one stock, therefore only the Alaska stock is recognized in U.S. waters.

POPULATION SIZE

A reliable estimate of spotted seal population abundance is currently not available. However, early estimates of the world population were in the range of 335,000-450,000 animals (Bums 1973). The population of the Bering Sea, including Russian waters, was estimated to be 200,000-250,000 based on the distribution of family groups on ice during the mating season (Bums 1973). Fedoseev (1971) estimated 168,000 seals in the Okhotsk Sea. Aerial surveys were flown in 1992 and 1993 to examine the distribution and abundance of spotted seals in Alaska. In 1992, survey methods were tested and distributional studies were conducted over the Bering Sea pack ice in spring and along the western Alaskan coast during summer (Rugh et al. 1993). In 1993, the survey effort concentrated on known haul sites in autumn (Rugh et al. 1994). The sum of maximum counts of hauled out animals were 4,145 and 2,951 in 1992 and 1993, respectively.

Studies to determine a correction factor for the number of spotted seals at sea missed during surveys have been initiated, but only preliminary results are currently available. The Alaska Department of Fish and Game placed satellite radio transmitters on 4 spotted seals in Kasegaluk Lagoon to estimate the ratio of time hauled out vs. time at sea. Preliminary results indicate that the proportion hauled out averages about 6.8% (CV=0.85) (Lowry et al. 1994). Using this correction factor with the maximum count of 4,145 from 1992 results in an estimate of 59,214. However, the count is from a survey that covered only the eastern portion of the spotted seal's geographic range and may have included harbor seals, and therefore must be considered equivocal. In addition, the correction factor data have not been stratified by season, tide, and time of day.

Minimum Population Estimate

A reliable minimum population estimate (N_{MIN}) for this stock can not presently be determined because current reliable estimates of abundance are not available.

Current Population Trend

At present, reliable data on trends in population abundance for the Alaska stock of spotted seals are unavailable. However, Frost et al. (1993) report that counts of spotted seals have been relatively stable at Kasegaluk Lagoon since the late 1970s.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for the Alaska stock of spotted seals. Hence, until additional data become available, it is recommended that the pinniped maximum theoretical net productivity rate (R_{MAX}) of 12% be employed for this stock (NMFS in prep.).

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 pinniped stocks with unknown population status (NMFS in prep.). However, because a reliable estimate of N_{MIN} is currently not available, the PBR for this stock is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

NMFS observers monitored incidental take on 3 different fisheries that could have interacted with spotted seals during 1990-93: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries. Observers did not report anymortality or serious injury of spotted seals incidental to these groundfish fisheries. An additional source of information on the number of spotted seals killed or injured incidental to commercial fishery operations is the logbook reports maintained by boat operators required by the Marine Mammal Protection Act (MMPA) interim exemption program. During the 3-year period between 1990-92, logbook reports, where observer data were not available, indicated an annual mean of 1 injury and 1 mortality from gear interactions, and 1 injury and 0.7 mortalities from legal deterrence. However, because logbook records are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. The fisheries involved were the Alaska Peninsula salmon drift gillnet and the Bristol Bay salmon set and drift gillnet fisheries.

The estimated mortality rate incidental to commercial fisheries recently monitored is 1 animal per year, based on logbook data. Yet, it should be noted that most interactions with these fisheries are likely to be harbor seals rather than spotted seals, and that due to the difficulty of distinguishing between spotted and harbor seals, the reliability of such data is questionable. Because the PBR for this stock is unknown, it is currently not possible to determine what annual mortality level is insignificant. However, if there were 50,000 spotted seals the PBR would equal 1,500 (50,000 x 0.06 x 0.5 = 1,500, and annual mortality levels less than 150 animals (i.e., 10% of PBR) would be considered insignificant. Currently, there is no reason to believe there are less than 50,000 spotted seals in U.S. waters.

Subsistence/Native Harvest Information

Spotted seals are an important species for Alaskan subsistence hunters with estimated annual harvests of 850-3,600 seals taken during 1966-76 (Quakenbush 1988), primarily in the Bering Strait and Yukon-Kuskokwim regions (Lowry 1984). From September 1985 to June 1986 the combined harvest from 5 villages was 986. Wolfe and Mischler (1993) estimated the 1992 subsistence harvest of spotted seals at 437, all of which were killed in the northern part of Bristol Bay: an estimate of variance for the harvest was not available. Reliable information on subsistence harvests from the remainder of Alaska during 1992 is not available, thus 437 should be considered an underestimate of unknown magnitude.

STATUS OF STOCK

Reliable estimates of the minimum population, PBR, and human-caused mortality and serious injury are currently not available. Due to a lack of information suggesting subsistence hunting is adversely affecting this stock and because of the minimal interactions between spotted seals and any U.S. fishery, the Alaska stock of spotted seals is not classified as a strategic stock. This classification is consistent with the recommendations of the Alaska Scientific Review Group (DeMaster 1995: pp. 26).

REFERENCES

Bums, J. J. 1973. Marine mammal report. Alaska Dep. Fish and Game, Pittman-Robertson Proj. Rep. W-17-3, W-174, and W-17-5.

Credle, V. R., D. P. DeMaster, M. M. Merklein, M. B. Hanson, W. A. Karp, and S. M. Fitzgerald (eds.). 1994. NMFS observer programs: minutes and recommendations from a workshop held in Galveston, Texas, November 10-11, 1993. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-94-1, 96 pp.

Dizon, A. E., C. Lockyer, W. F. Perrin, D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 6:24-36.

DeMaster, D.P. 1995. Minutes from the 4-5 and 11 January 1995 meeting of the Alaska Scientific Review Group, Anchorage, Alaska. 27 pp + appendices. (available upon request- D.P. DeMaster, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98115).

Fay, F. H. 1974. The role of ice in the ecology of marine mammals of the Bering Sea. Pp. 383-389, In D. W. Hood and E. J. Kelley (eds.), Oceanography of the Bering Sea. Univ. Alaska, Fairbanks, Inst. Mar. Sci. Occas. Publ. 2.

Fedoseev, G. A. 1971. The distribution and numbers of seals on whelping and moulting patches in the Sea of Okhotsk. Pp. 135-158, In K K Chapskii and E. S. Mil'chenko (eds.), Research on marine mammals. Nauchno-issled. Inst. Rybn. Khoz. Okeanogr. 39:1-344. (Transl. From Russian by Can. Fish. Mar. Serv., 1974, Transl. Ser. 3185)

Frost, K. J., L. F. Lowry, and G. Carroll. 1993. Beluga whale and spotted seal use of a coastal lagoon system in the northeastern Chukchi Sea. Arctic 46:8-16.

Lowry, L. F. 1984. The spotted seal (Phoca largha). Pp. 1-11, In Alaska Dep. Fish and Game marine mammal species accounts. Vol. 1. Juneau, Alaska.

Lowry, L F., K. J. Frost, R. Davis, R. S. Suydam, and D. P. DeMaster. 1994. Movements and behavior of satellite-tagged spotted seals (Phoca largha) in the Bering and Chukchi Seas. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-38. 71 pp.

National Marine Fisheries Service. In prep. Guidelines for Estimating Potential Biological Removals. U.S. Dep. Commer., NOAA Tech. Rep.

Porsild, A. E. 1945. Mammals of the Mackenzie Delta. Can. Field-Nat. 59:4-22.

Quakenbush, L. T. 1988. Spotted seal, Phocu largh. Pp. 107-124, In J.W. Lentfer (ed.), Selected marine mammals of Alaska. Species accounts with research and management recommendations. Marine Mammal Commission, Washington, D.C.

Rugh, D. J., K. E. W. Shelden, D. E. Withrow, H. W. Braham, and R. P. Angliss. 1993. Spotted seal (Phocu largha) distribution and abundance in Alaska, 1992. Annual report to the MMPA Assessment Program, Office of Protected Resources, NMFS, NOAA, 1335 East-West Highway, Silver Spring, MD 20910.

Rugh, D. J., K. E. W. Shelden, and D. E. Withrow. 1994. Spotted seals in Alaska, 1993 annual report. Annual report to the MMPA Assessment Program, Office of Protected Resources, NMFS, NOAA, 1335 East-West Highway, Silver Spring, MD 20910.

Shaughnessy, P. D., and F. H. Fay. 1977. A review of the taxonomy and nomenclature of North Pacific harbour seals. J. Zool. (Lond.) 182:385-419.

Wolfe, R. J., and C. Mischler. 1993. The subsistence harvest of harbor seal and sea lion by Alaska natives in 1992. Final report for year one, subsistence study and monitor system (no. 50ABNF20055). Juneau, Alaska. 94 pp. + appendices.

BEARDED SEAL (*Erignathus barbatus*): Alaska Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bearded seals are circumpolar in their distribution, extending from the Arctic Ocean (85°N) south to Hokkaido (45°N) in the Pacific. They generally inhabit areas of shallow water (less than 200 m) that are at least seasonally ice covered. During winter they are most common in broken pack ice (Burns 1967) and in some areas also inhabit shorefast ice (Smith and Hammill 1981). In Alaskan waters, bearded seals are distributed over the continental shelves of the Bering, Chukchi, and Beaufort Seas (Ognev 1935, Johnson et al. 1966, Burns 1981). They are evidently most concentrated from January to April over the northern part of the Bering Sea shelf (Burns 1981, Braham et al. 1984). Many of the seals that winter in the Bering Sea migrate north through the Bering Strait from late April through June, and spend the summer along the ice edge in the Chukchi Sea (Burns 1967 and 1981). The overall summer distribution is quite broad, with seals rarely hauled out on land, and some seals do not migrate but remain in open-water areas of the Bering and Chukchi Seas (Burns 1981, Nelson 1981, Smith and Hammill 1981). An unknown proportion of the population migrates southward from the Chukchi Sea in late fall and winter, and Burns (1967) noted a movement of bearded seals away from shore at that season as well.

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: (1) Distributional data: geographic distribution continuous, (2) Population response data: unknown; (3) Phenotypic data: unknown; (4) Genotypic data: unknown. Based on this limited information, and the absence of any significant fishery interactions, there is currently no strong evidence to suggest splitting the distribution of bearded seals into more than one stock: therefore, only the Alaska stock is recognized in U.S. waters.

POPULATION SIZE

Early estimates of the Bering-Chukchi Seapopulation range from 250,000 to 300,000 (Popov 1976, Burns 1981). Until additional surveys are conducted, reliable estimates of abundance for the Alaskan stock of bearded seals are considered unavailable.

Minimum Population Estimate

A reliable minimum population estimate (N_{MIN}) for this stock can not presently be determined because current reliable estimates of abundance are not available.

Current Population Trend

At present, reliable data on trends in population abundance for the Alaska stock of bearded seals are unavailable, though there is no evidence that population levels are declining.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for the Alaska stock of bearded seals. Hence, until additional data become available, it is recommended that the pinniped maximum theoretical net productivity rate (R_{MAX}) of 12% be employed for this stock (NMFS in prep.).

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,. The recovery factor (F_R) for this stock is 0.5, the value for pinniped stocks with unknown population status (NMFS in prep.). However, because a reliable estimate of minimum abundance N_{MIN} is currently not available, the PBR for this stock is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS IN JURY

Fisheries Information

NMFS observers monitored incidental take on 3 different fisheries that could have interacted with bearded seals during 1990-93: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries. The only fishery for which incidental kill was observed was the Bering Sea groundfish fishery, with reports of 3 mortalities in 1991, although one of these observed kills was later identified as a juvenile elephant seal (K. Wynne, pers. comm., Univ. AK, 900 Trident Way, Kodiak, AK 99615). These mortalities resulted in a mean annual (total) mortality of 1.2 (CV=0.35). Fishing effort (based on total metric tons of fish caught) was 1.84 million tons, observer coverage (defined as the percentage of effort observed) was 64%, and incidental catch rate (defined as the number of observed dead in the catch divided by the observed effort [tons] multiplied by 10^{-4}) was 0.0064 (CV=0.34).

An additional source of information on the number of bearded seats killed or injured incidental to commercial fishery operations is the logbook reports maintained by boat operators required by the Marine Mammal Protection Act (MMPA) interim exemption program. During the 3-year period between 1990-92, logbook reports, where observer data were not available, indicated an annual mean of 10 injuries and 5 mortalities from gear interactions, and 13 injuries and 6 mortalities from legal deterrence. However, because logbook records are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. The only fishery involved was the Bristol Bay salmon drift gillnet. Anecdotal reports indicate small numbers are taken in bottom trawl fisheries.

The estimated mortality rate incidental to commercial fisheries recently monitored is 6.2 animals per year, based on observer data (1.2) and logbook data (5) where observer data were not available. Because the PBR for this stock is unknown it is currently not possible to determine what annual mortality level is insignificant. However, if there were 50,000 bearded seals the PBR would equal 1,500 (50,000 x 0.06 x 0.5 = 1,500), and annual mortality levels less than 150 animals (i.e., 10% of PBR) would be considered insignificant. Currently, there is no reason to believe there are less than 50,000 bearded seals in U.S. waters.

Subsistence/Native Harvest Information

Bearded seals are an important species for Alaskan subsistence hunters, with estimated annual harvests of 1,784 (SD=941) from 1966 to 1977 (Burns 1981). Between August 1985 and June 1986,791 bearded seals were harvested in 5 villages based on reports from the Eskimo Walrus Commission (Kelly 1988). A current reliable estimate of the annual number of bearded seals taken by Alaskan Natives for subsistence is currently unavailable.

STATUS OF STOCK

Reliable estimates of the minimum population, PBR, and human-caused mortality and serious injury are currently not available. Due to a lack of information suggesting subsistence hunting is adversely affecting this stock and because of the minimal interactions between bearded seals and any U.S. fishery, the Alaska stock of bearded seals is not classified as a strategic stock. This classification is consistent with the recommendations of the Alaska Scientific Review Group (DeMaster 1995: pp. 26).

REFERENCES

Braham, H. W., J. J. Burns, G. A. Fedoseev, and B. D. Krogman. 1984. Habitat partitioning by ice-associated pinnipeds: distribution and density of seals and walruses in the Bering Sea, April 1976. Pp. 25-47, In F.H. Fay and G. A. Fedoseev (eds.), Soviet-American cooperative research on marine mammals. vol. 1. Pinnipeds. U.S. Dep. Commer., NOAA Tech. Rep. NMFS 12.

Burns, J. J. 1967. The Pacific bearded seal. Alaska Dep. Fish and Game, Pittman-Robertson Proj. Rep. W-6-R and W-14-R. 66 pp.

Burns, J. J. 1981. Bearded seal-Erignathus barbatus Erxleben, 1777. Pp. 145-170, In S.H. Ridgway and RJ. Harrison (eds.), Handbook of Marine Mammals. vol. 2. Seals. Academic Press, New York.

Credle, V. R., D. P. DeMaster, M. M. Merklein, M. B. Hanson, W. A. Karp, and S. M. Fitzgerald (eds.). 1994. NMFS observer programs: minutes and recommendations from a workshop held in Galveston, Texas, November 10-11, 1993. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-94-1, 96 pp.

DeMaster, D.P. 1995. Minutes from the 4-5 and 11 January 1995 meeting of the Alaska Scientific Review Group, Anchorage, Alaska. 27 pp. + appendices. (available upon request- D.P. DeMaster, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98115).

Dizon, A. E., C. Lockyer, W. F. Perrin, D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 6:24-36.

Johnson, M. L., C. H. Fiscus, B. T. Ostenson, and M. L. Barbour. 1966. Marine mammals. Pp. 877-924, In N.J. Wilimovsky and J.N. Wolfe (eds.), Environment of the Cape Thompson region, Alaska. U.S. Atomic Energy Comm., Oak Ridge, TN.

Kelly, B. P. 1988. Bearded seal, Erignathus barbatus. Pp. 77-94, In J.W. Lentfer (ed.), Selected marine mammals of Alaska. Species accounts with research and management recommendations. Marine Mammal Commission, Washington, D.C.

National Marine Fisheries Service. In prep. Guidelines for Estimating Potential Biological Removals. U.S. Dep. Commer., NOAA Tech. Rep.

Nelson, R. K 1981. Harvest of the sex coastal subsistence in modem Wainwright. North Slope Borough, Barrow, Alaska. 125 pp.

Ognev, S. I. 1935. Mammals of the U.S.S.R. and adjacent countries. vol. 3. Carivora (Fissipedia and Pinnipedia). Gosudarst. Izdat. Biol. Med. Lit., Moscow. (Transl. from Russian by Israel Prog. Sci. Transl., 1962,741 pp.).

Popov, L A. 1976. Status of main ice forms of seals inhabiting waters of the U.S.S.R. and adjacent to the country marine areas. FAO ACMRR/MM/SC/51. 17 pp.

Smith, T. G., and M. O. Hammill. 1981. Ecology of the ringed seal, Phoca hispida, in its fast-ice breeding habitat. Can. J. Zool. 59:966-981.

RINGED SEAL (*Phoca hispida*): Alaska Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Ringed seals have a circumpolar distribution from approximately 35°N to the North Pole, occurring in all seas of the Arctic Ocean (King 1983). In the eastern North Pacific, they are found in the southern Bering Sea and range as far south as the Seas of Okhotsk and Japan. Throughout their range, ringed seats have an affinity for ice-covered waters and are well adapted to occupying seasonal and permanent ice. They remain in contact with ice most of the year and pup on the ice in late winter-early spring. Ringed seals are found throughout the Beaufort, Chukchi, and Bering Seas, as far south as Bristol Bay in years of extensive ice coverage. During late April through June, ringed seals are distributed throughout their range from the southern ice edge northward (Bums and Harbo 1972, Burns et al. 1981, Braham et al. 1984). The overall winter distribution is probably similar, and it is believed there is a net movement of seals northward with the ice edge in late spring and summer (Burns 1970). Thus, ringed seals occupying the Bering and southern Chukchi Seas in winter apparently are migratory, but details of their movements are unknown. The seasonal migrations of seals wintering in the northern Chukchi and Beaufort Seas presumably are less extensive.

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: (1) Distributional data: geographic distribution continuous, (2) Population response data: unknown; (3) Phenotypic data: unknown; (4) Genotypic data: unknown. Based on this limited information, and the absence of any significant fishery interactions, there is currently no strong evidence to suggest splitting the distribution of ringed seals into more than one stock, therefore only the Alaska stock is recognized in U.S. waters.

POPULATION SIZE

A reliable abundance estimate for the Alaska stock of ringed seals is currently not available. Crude estimates of the world population have ranged from 2.3 to 7 million, with 1 to 1.5 million in Alaskan waters (Kelly 1988). The most recent abundance estimates of ringed seals are based on aerial surveys conducted in 1985,1986, and 1987 by Frost et al. (1988). Survey effort was directed towards shorefast ice, though some areas of adjacent pack ice were also surveyed, in the Chukchi and Beaufort Seas from southern Kotzebue Sound north and east to the U.S.-Canada border. The abundance estimate from 1987 was 44,360 ± 9,130 (95% CI); however, it represents only a portion of the geographic range of the stock, as many seals occur in the pack ice and along the Russian coast.

Minimum Population Estimate

A reliable minimum population estimate N_{MIN} for this stock can not presently be determined because current reliable estimates of abundance are not available.

Current Population Trend

At present, reliable data on trends in population abundance for the Alaska stock of ringed seals are unavailable, though there is no evidence population levels are declining..

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for the Alaska stock of ringed seals. Hence, until additional data become available, it is recommended that the pinniped maximum theoretical net productivity rate (R_{MAX}) of 12% be employed for this stock (NMFS in prep.).

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 pinniped stocks with unknown population status (NMFS in prep.). However, because a reliable estimate of minimum abundance N_{MIN} is currently not available, the PBR for this stock is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

NMFS observers monitored incidental take on 3 different fisheries that could have interacted with ringed seals during 1990-93: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries. The only fishery for which incidental kill was observed was the Bering Sea groundfish fishery, with 2 mortalities in 1992. These mortalities resulted in an estimated annual mortality of 0.8. Fishing effort (based on total metric tons of fish caught) was 1.84 million tons, observer coverage (defined as the percentage of effort observed) was 64%, and incidental catch rate (defined as the number of observed dead in the catch divided by the observed effort (tons) multiplied by 10") was 0.0043 (CV=0.42). An additional source of information on the number of ringed seals killed or injured incidental to commercial fishery operations is the logbook reports maintained by boat operators required by the Marine Mammal Protection Act (MMPA) interim exemption program. During the 3-year period between 1990-92, logbook reports, where observer data were not available, indicated no injuries or mortalities from either gear interactions or legal deterrence.

The estimated average mortality rate incidental to commercial fisheries recently monitored is 0.8 animals per year, based on observer data (0.8) and logbook data (0) where observer data were not available. Because the PBR for this stock is unknown, it is currently not possible to determine what annual mortality level is insignificant. However, if there were 50,000 ringed seals the PBR would equal 1,500 (50,000 x 0.06 x 0.5 = 1,500), and annual mortality levels less than 150 animals (i.e., 10% of PBR) would be considered insignificant. Currently, there is no reason to believe there are less than 50,000 ringed seals in U.S. waters.

Subsistence/Native Harvest Information

Ringed seals are an important species for Alaskan subsistence hunters. The annual subsistence harvest in Alaska dropped from 7,000-15,000 in 1962-72 to an estimated 2,000-3,000 in 1979 (Frost unpubl. report). Based on data from St. Lawrence Island, the current total annual take in Alaska likely exceeds 3,000 seals (Kelly 1988), but reliable estimates are currently not available.

STATUS OF STOCK

Reliable estimates of the minimum population, PBR, and human-caused mortality and serious injury are currently not available. Due to a lack of information suggesting subsistence hunting is adversely affecting this stock and because of the minimal interactions between ringed seals and any U.S. fishery, the Alaska stock of ringed seals is not classified as a strategic stock. This classification is consistent with the recommendations of the Alaska Scientific Review Group (DeMaster 1995: pp. 26).

REFERENCES

Braharn, H. W., J. J. Burns, G. A. Fedoseev, and B. D. Krogman. 1984. Habitat partitioning by ice-associated pinnipeds: distribution and density of seals and walruses in the Bering Sea, April 1976. Pp. 25-47, In F.H. Fay and G. A. Fedoseev (eds.), Soviet-American cooperative research on marine mammals. vol. 1. Pinnipeds. U.S. Dep. Comer., NOAA Tech. Rep. NMFS 12.

Bums, J. J. 1970. Remarks on the distribution and natural history of pagophilic pinnipeds in the Bering and Chulchi Seas. J. Mammal. 51:445-454.

Burns, J. J., and S. J. Harbo. 1972. An aerial census of ringed seals, northern coast of Alaska. Arctic 25:279-290.

Bums, J. J., L. H. Shapiro, and F. H. Fay. 1981. Ice as marine mammal habitat in the Bering Sea. Pp. 781-797, in D.W. Hood and J.A. Calder (eds.), The eastern Bering Sea shelf: oceanography and resources. vol. 2. U.S. Dep. Commer., NOAA, Off. Mar. Pollut. Assess., Juneau, Alaska.

DeMaster, D.P. 1995. Minutes from the 4-5 and 11 January 1995 meeting of the Alaska Scientific Review Group, Anchorage, Alaska. 27 pp + appendices. (available upon request- D.P. DeMaster, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98115).

Dizon, A. E., C. Lockyer, W. F. Perrin, D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 6:24-36.

Frost, K. J. Unpubl. rep. The ringed seal. Alaska Dep. Fish and Game, Fairbanks. 14 pp (1985).

Frost, K. J., L. F. Lowry, J. R. Gilbert, and J. J. Burns. 1988. Ringed seals monitoring: relationships of distribution and abundance to habitat attributes and industrial activities. Final Rep. contract no. 84-ABC-00210 submitted to U.S. Dep. Interior, Minerals Management Service, Anchorage, AK. 101 pp.

Kelly, B. P. 1988. Ringed seal, Phocu hispida. Pp. 57-75, In J.W. Lentfer (ed.), Selected marine mammals of Alaska. Species accounts with research and management recommendations. Marine Mammal Commission, Washington, D.C.

King, J. E. 1983. Seals of the world. 2nd ed. Br. Mus. (Nat. Hist.), London. 240 pp.

National Marine Fisheries Service. In prep. Guidelines for Estimating Potential Biological Removals. U.S. Dep. Commer., NOAA Tech. Rep.

RIBBON SEAL (*Phoca fasciata*): Alaska Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Ribbon seals inhabit the North Pacific Ocean and adjacent fringes of the Arctic Ocean. In Alaskan waters, ribbon seals are found in the open sea, on the pack ice, and only rarely on shorefast ice (Kelly 1988). They range northward from Bristol Bay in the Bering Sea into the Chukchi and western Beaufort Seas. From late March to early May, ribbon seals inhabit the Bering Sea ice front (Burns 1970,1981; Braham et al. 1984). They are most abundant in the northern part of the ice front in the central and western parts of the Bering Sea (Burns 1970, Burns et al. 1981). As the ice recedes in May to mid-July the seals move farther to the north in the Bering Sea, where they haul out on the receding ice edge and remnant ice (Bums 1970, 1981; Burns et al. 1981). There has been little agreement on the range of ribbon seals during the rest of the par. Recent sightings and a review of the literature suggest that many ribbon seals migrate into the Chukchi Sea for the summer (Kelly 1988).

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: (1) Distributional data: geographic distribution continuous, (2) Population response data: unknown: (3) Phenotypic data: unknown: (4) Genotypic data: unknown. Based on this limited information, and the absence of any significant fishery interactions, there is currently no strong evidence to suggest splitting the distribution of ribbon seals into more than one stock, therefore only the Alaska stock is recognized in U.S. waters.

POPULATION SIZE

A reliable abundance estimate for the Alaska stock of ribbon seals is currently not available. Burns (1981) estimated the worldwide population of ribbon seals at 240,000 in the mid-1970s with au estimate for the Bering Sea at 90,000-100,000.

Minimum Population Estimate

A reliable minimum population estimate (N_{MIN}) for this stock can not presently be determined because current reliable estimates of abundance are not available.

Current Population Trend

At present, reliable data on trends in population abundance for the Alaska stock of ribbon seals are unavailable, though there is no evidence population levels are declining.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for the Alaska stock of ribbon seals. Hence, until additional data become available, it is recommended that the pinniped maximum theoretical net productivity rate (R_{MAX}) of 12% be employed for this stock (NMFS in prep.).

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_{MAX} The recovery factor (F_R) for this stock is 0.5, the value for pinniped stocks with unknown population status (NMFS in prep.). However, because a reliable estimate of minimum abundance N_{MIN} is currently not available, the PBR for this stock is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

NMFS observers monitored incidental take on 3 different fisheries that could have interacted with ribbon seals during 1990-93: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries. The only fishery for which incidental kill was observed was the Bering Sea groundfish fishery, with 1 mortality in 1990. This mortality resulted in a mean annual mortality rate of 0.4. Fishing effort (based on total metric tons of fish caught) was 1.84 million tons, observer coverage (defined as the percentage of effort observed) was 64%, and incidental catch rate (defined as the number of observed dead in the catch divided by the observed effort (tons) multiplied by 10") was 0.0021 (CV=0.62). An additional source of information on the number of ribbon seals killed or injured incidental to commercial fishery operations is the logbook reports maintained by boat operators required by the Marine Mammal Protection Act (MMPA) interim exemption program. During the 3-year period between 1990-92, logbook reports, where observer data were not available, indicated no injuries or mortalities from either gear interactions or legal deterrence.

The estimated mortality rate incidental to commercial fisheries recently monitored is 0.4 animals per year, based on observer data (0.4) and logbook data (0) where observer data were not available. Because the PBR for this stock is unknown, it is currently not possible to determine what annual mortality level is insignificant. However, if there were 50,000 ribbon seals the PBR would equal 1,500 (50,000 x 0.06 x 0.5 = 1,500), and annual mortality levels less than 150 animals (i.e., 10% of PBR) would be considered insignificant. Currently, there is no reason to believe there are less than 50,000 ribbon seals in U.S. waters.

Subsistence/Native Harvest Information

Ribbon seals are an important species for Alaskan subsistence hunters. The annual subsistence harvest was estimated to be less than 100 seals annually from 1968 to 1980 (Burns 1981). Currently, the Eskimo Walrus Commission estimates the subsistence take is less than 100 seals annually (Kelly 1988), yet reliable estimates are not available.

STATUS OF STOCK

Reliable estimates of the minimum population, PBR, and human-caused mortality and serious injury are currently not available. Due to a lack of information suggesting subsistence hunting is adversely affecting this stock and because of the minimal interactions between ribbon seals and any U.S. fishery, the Alaska stock of ribbon seals is not classified as a strategic stock. This classification is consistent with the recommendations of the Alaska Scientific Review Group (DeMaster 1995: pp. 26).

REFERENCES

Braham, I-I. W., J. J. Burns, G. A. Fedoseev, and B. D. Krogman. 1984. Habitat partitioning by ice-associated pinnipeds: distribution and density of seals and walruses in the Bering Sea, April 1976. Pp. 25-47, In F.H. Fay and GA. Fedoseev (eds.), Soviet-American cooperative research on marine mammals. vol. 1. Pinnipeds. U.S. Dep. Commer., NOAA Tech. Rep. NMFS 12.

Burns, J. J. 1970. Remarks on the distribution and natural history of pagophilic pinnipeds in the Bering and Chukchi Seas. J. Mammal. 51:445-454.

Burns, J. J. 1981. Ribbon seal-Phoca fasciata. Pp 89-109, In S.H. Ridgway and R.J. Harrison (eds.), Handbook of Marine Mammals. vol. 2. Seals. Academic Press, New York.

Burns, J. J., L. H. Shapiro, and F. H. Fay. 1981. Ice as marine mammal habitat in the Bering Sea. Pp. 781-797, In D.W. Hood and J.A. Calder (eds.), The eastern Bering Sea shelf: oceanography and resources. vol. 2. U.S. Dep. Commer., NOAA, Off. Mar. Pollut. Assess., Juneau, Alaska.

DeMaster, D.P. 1995. Minutes from the 4-5 and 11 January 1995 meeting of the Alaska Scientific Review Group, Anchorage, Alaska. 27 pp + appendices. (available upon request- D.P. DeMaster, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98115).

Dizon, A. E., C. Lockyer, W. F. Pen-in, D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 6:24-36.

Kelly, B. P. 1988. Ribbon seal, Phocafusciara. Pp. 96-106. In J.W. Lentfer (ed.), Selected marine mammals of Alaska. Species accounts with research and management recommendations. Marine Mammal Commission, Washington, D.C.

National Marine Fisheries Service. In prep. Guidelines for Estimating Potential Biological Removals. U.S. Dep. Commer., NOAA Tech. Rep.

BELUGA WHALE (*Delphinapterus leucas*): Beaufort Sea Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Beluga whales are distributed throughout seasonally ice-covered arctic and subarctic waters of the Northern Hemisphere (Gurevich 1980), and are closely associated with open leads and polynya in ice-covered regions (Hazard 1988). Depending on season and region, beluga whales may occur in both offshore and coastal waters, with concentrations in Cook Inlet, Bristol Bay, Norton Sound Kasegaluk Lagoon, and the Mackenzie Delta (Hazard 1988). It is assumed that most beluga whales from these summering areas overwinter in the Bering Sea, excluding those found in the northern Gulf of Alaska (Shelden 1994). Seasonal distribution is affected by ice cover, tidal conditions, access to prey, temperature, and human interaction (Lowry 1985). During the winter, beluga whales occur in offshore waters associated with pack ice. In the spring, they migrate to warmer coastal estuaries, bays, and rivers for molting (Finley 1982) and calving (Sergeant and Brodie 1969). Annual migrations may cover thousands of kilometers (Reeves 1990).

The following information was considered in classifying beluga whale stock structure based on the Dizon et al. (1992) phylogeographic approach: (1) Distributional data: geographic distribution discontinuous in summer (Frost and Lowry 1990), distribution unknown outside of summer: (2) Population response data: possible extirpation of local populations; distinct population trends between regions occupied in summer; (3) Phenotypic data: unknown; and (4) Genotypic data: preliminary mitochondrial DNA analyses indicate distinct differences among summering areas, except between Norton Sound and Bristol Bay (G. O'Corry-Crowe, unpubl. data, Southwest Fisheries Science Center, P.O. Box 271, La Jolla, CA 92038); however, the number of samples collected from Bristol Bay was too small (n=5) to provide sufficient statistical power to delineate between these two areas. Based on this information, 5 putative stocks of beluga whales are recognized within U.S. waters: 1) Cook Inlet, 2) Bristol Bay, 3) Norton Sound, 4) Eastern-Chukchi Sea, and 5) Beaufort Sea. The Alaska Scientific Review Group concluded that the scientific data available to determine stock structure in Bristol Bay and Norton Sound were equivocal, and thus stock structure of beluga whales could not be defined for these areas (DeMaster 1995a: pp. 4).

POPULATION SIZE

The sources of information to estimate abundance for belugas in the waters of northern Alaska and western Canada have included both opportunistic and systematic observations. Duval(l993) reported an estimate of 21,000 for the Beaufort Sea stock, similar to that reported by Seaman et al. (1985). The most recent survey was conducted in 1992, when approximately 20,805 CV=0.102) belugas were counted (Dep. Fisheries and Oceans, unpub. data, 501 University Crescent, Winnipeg, Canada R3T 2N6). A correction factor of 2 has been recommended for the Beaufort Sea stock (Duval 1993), resulting in a population estimate of 41,610 (20,805 x 2).

Minimum Population Estimate

For the Beaufort Sea stock of belugas, the minimum population estimate (N_{MIN}) is calculated from equation 1 from the PBR Guidelines (NMFS in prep.). Thus, $N_{MIN} = N/\exp(0.842*[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 41,610 and an associated CV of 0.102, N_{MIN} for this stock is 38,194. The Alaska Scientific Review Group considered this estimate of abundance to be conservative because not all of the range of this stock was surveyed and because the applied correction factor is likely to be negatively biased.

Current Population Trend

The Beaufort Sea stock of beluga whales is considered to be stable or increasing (DeMaster 1995b: pp. 16).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for the Beaufort Sea stock of beluga whales. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate (R_{MAX}) of 4% be employed for this stock (NMFS in prep.).

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 m-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: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$ As this stock is stable or increasing (DeMaster 1995b: pp. 16), the recovery factor (F_R) for this stock is 1.0 (NMFS in prep.). Thus, for the Beaufort Sea stock of beluga whales, PBR = (38,194 x 0.02 x 1.0), or 764 animals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

There are no reports of mortality incidental to commercial fisheries for this stock in recent years. At present, annual mortality levels less than 76 animals per year (i.e., 10% of PBR) are considered insignificant.

Subsistence/Native Harvest Information

The subsistence take of beluga whales within U.S. waters of the Beaufort Sea is reported by the Alaska Beluga Whale Committee (ABWC), who repotted that the number of whales harvested for subsistence has averaged approximately 47 during the 5-year period from 1990-94 (Frost and Suydam 1995); the 1994 estimate is not currently available. Estimates from the Canadian harvest for this stock over the same 5-year period have averaged 113 whales. Thus, the mean estimated subsistence kill for the Beaufort Sea stock is 160 (47 + 113). This estimate is based on household surveys and on-site harvest monitoring, but is negatively biased because it has not been corrected for hunters that did not respond, and there is not a reliable estimate for the percent struck and lost.

STATUS OF STOCK

The level of human-caused mortality and serious injury (160) does not exceed the PBR (764), thus the Beaufort Sea stock of beluga whales is not classified as a strategic stock.

REFERENCES

DeMaster, D.P. 1995a. Minutes from the 16-17 February 1995 meeting of the Alaska Scientific Review Group. Anchorage, Alaska. 22 pp. (available upon request- D.P. DeMaster, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98115).

DeMaster, D.P. 1995b. Minutes from the 4-5 and 11 January 1995 meeting of the Alaska Scientific Review Group. Anchorage, Alaska. 27 pp. + appendices. (available upon request- D.P. DeMaster, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98115).

Dizon, A. E., C. Lockyer, W. F. Perrin, D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 6:24-36.

Duval, W. S. 1993. Proceedings of a workshop on Beaufort Sea beluga: February 3-6,1992. Vancouver, B.C. Env. Studies Res. Found. Rep. No 123. Calgary. 33 pp. + appendices.

Finley, K. J. 1982. The estuarine habitat of the beluga or white whale, Delphinapterus leucas. Cetus 4:4-5.

Frost, K. J., and L. F. Lowry. 1990. Distribution, abundance, and movements of beluga whales, Delphinapterus leucas, in coastal waters of western Alaska. Pp. 39-57, In T.G. Smith, DJ. St. Aubin, and J.R. Geraci (eds.), Advances in research on the beluga whale, Delphinapterus leucas. Can. Bull. Fish. Aquat. Sci. 224.

Frost, K. J., and R. Suydam. 1995. Harvests of beluga whales, Delphinapterus leucas, in Alaska, 1987-1994. Working paper for Alaska Beluga Whale Committee Scientific Workshop, Anchorage, AK, 5-7 April 1995. 14 pp.

Gurevich, V. S. 1980. Worldwide distribution and migration patterns of the white whale (beluga), Delphinapterus leucas. Rep. Int. Whaling Commn. 30:465-480.

Hazard K. 1988. Beluga whale, Delphinapterus leucas. Pp. 195-235, In J. W. Lentfer (ed.), Selected marine mammals of Alaska. Species accounts with research and management recommendations. Marine Mammal Commission, Washington, D.C.

Lowry, L F. 1985. The belukha whale (Delphinapterus leucus). Pp. 3-13, In JJ. Burns, KJ. Frost, and L.F. Lowry (eds.), Marine mammal species accounts. Alaska Dep. Fish and Game, Game Tech. Bull. 7.

National Marine Fisheries Service. In prep. Guidelines for Estimating Potential Biological Removals. U.S. Dep. Commer., NOAA Tech. Rep.

Reeves, R. R. 1990. An overview of the distribution, exploitation and conservation status of belugas, worldwide. Pp. 47-58, In J. Prescott and M. Gauquelin (eds.), For the future of the beluga: Proceedings of the International Forum for the Future of the Beluga. Univ. Quebec Press, Canada.

Seaman, G. A., K. J. Frost, and L. F. Lowry. 1985. Investigations of belukha whales in coastal waters of western and northern Alaska. Part I. Distribution, abundance and movements. U.S. Dep. Commer., NOAA, OCSEAP Final Rep. 56:153-220. (available from NOAA-OMA-OAD, Alaska Office, 701 C. Street, P.O. Box 56, Anchorage, AK 99513).

Sergeant, D. E., and P. F. Brodie. 1969. Body size in white whales, Delphinapterus leucas. J. Fish. Res. Bd. Can. 26:2561-2580.

Shelden, K. E. W. 1994. Beluga whales (Delphinapterus leucas) in Cook Inlet - A review. Appendix In Withrow, D. E., K. E. W. Shelden, and D. J. Rugh. Beluga whale (Delphinapterus leucus) distribution and abundance in Cook Inlet, summer 1993. Annual report to the MMPA Assessment Program, Office of Protected Resources, NMFS, NOAA, 1335 East-West Highway, Silver Spring, MD 20910.

BELUGA WHALE (*Delphinapterus leucas*): Eastern Chukchi Sea Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Beluga whales are distributed throughout seasonally ice-covered arctic and subarctic waters of the Northern Hemisphere (Gurevich 1980), and are closely associated with open leads and polynya in ice-covered regions (Hazard 1988). Depending on season and region, beluga whales may occur in both offshore and coastal waters, with concentrations in Cook Inlet, Bristol Bay, Norton Sound, Kasegaluk Lagoon, and the Mackenzie Delta (Hazard 1988). It is assumed that most beluga whales from these summering areas overwinter in the Bering Sea, excluding those found in the northern Gulf of Alaska (Shelden 1994). Seasonal distribution is affected by ice cover, tidal conditions, access to prey, temperature, and human interaction (Lowry 1985). During the winter, beluga whales occur in offshore waters associated with pack ice. In the spring, they migrate to warmer coastal estuaries, bays, and rivers for molting (Finley 1982) and calving (Sergeant and Brodie 1969). Annual migrations may cover thousands of kilometers (Reeves 1990).

The following information was considered in classifying beluga whale stock structure based on the Dizon et al. (1992) phylogeographic approach: (1) Distributional data: geographic distribution discontinuous in summer (Frost and Lowry 1990), distribution unknown outside of summer: (2) Population response data: possible extirpation of local populations; distinct population trends between regions occupied in summer; (3) Phenotypic data: unknown: and (4) Genotypic data: preliminary mitochondrial DNA analyses indicate distinct differences among summering areas, except between Norton Sound and Bristol Bay (G. O'Corry-Crowe, unpubl. data, Southwest Fisheries Science Center, P.O. Box 271, La Jolla, CA 92038); however, the number of samples collected from Bristol Bay was too small (n=5) to provide sufficient statistical power to delineate between these two areas. Based on this information, 5 putative stocks of beluga whales are recognized within U.S. waters: 1) Cook Inlet, 2) Bristol Bay, 3) Norton Sound, 4) Eastern Chukchi Sea, and 5) Beaufort Sea. The Alaska Scientific Review Group concluded that the scientific data available to determine stock structure in Bristol Bay and Norton Sound were equivocal, and thus stock structure of beluga whales could not be defined for these areas (DeMaster 1995a: pp. 4).

POPULATION SIZE

Frost et al. (1993) estimated the minimum size of the eastern Chukchi stock of belugas at 1,200, based on counts of animals from aerial surveys conducted during 1989-91. Survey effort was concentrated on the 170 km long Kasegaluk Lagoon, an area known to be regularly used by belugas during the open-water season. Other areas belugas are known to frequent (e.g., Kotezbue Sound) were not surveyed, thus the survey effort resulted in a minimum count. If this count is corrected for the proportion of animals that were diving and thus not visible at the surface (2.62, Frost and Lowry 1995), and for the proportion of newborns and yearlings not observed due to small size and dark coloration (1.18; Brodie 1971), the total corrected abundance estimate for the eastern Chukchi stock is 3,710 (1,200 x 2.62 x 1.18).

Minimum Population Estimate

The survey technique utilized for estimating the abundance of beluga whales is a direct count which incorporates correction factors. Although CVs of the correction factors are not available, the Alaska Scientific Review Group concluded that the population estimate of 3,710 can serve as an estimate of minimum population size because the survey did not include areas where beluga are known to occur.

Current Population Trend

Based on similar counts of belugas in Kasegaluk Lagoon since 1978, the Eastern Chukchi Sea stock of beluga whales should be considered stable (Frost et al. 1993).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for this stock of beluga whales. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate (R_{MAX}) of 4% be employed for this stock (NMFS in prep.).

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. This stock is relatively stable and not declining in the presence of known take, thus the recovery factor (F_R) for this stock is 1.0, (DeMaster 1995b: pp. 17, NMFS in prep.). Thus, for the eastern Chukchi Sea stock of beluga whale PBR = (3,7 10 x 0.02 x 1.0), or 74 animals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

NMFS observers monitored incidental take on 3 different fisheries that could have interacted with beluga whales in the Chukchi Sea during 1990-93: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries. Observers did not report any mortality or serious injury of beluga whales incidental to these groundfish fisheries. An additional source of information on the number of beluga whales killed or injured incidental to commercial fishery operations is the logbook reports maintained by boat operators required by the Marine Mammal Protection Act (MMPA) interim exemption program. During the 3-year period between 1990-92, logbook reports, where observer data were not available, did not include any mortality or injury to beluga whales from this stock.

The estimated annual mortality rate incidental to commercial fisheries (0) is less than 10% of the PBR (7) and, therefore, is considered insignificant and approaching a zero mortality and serious injury rate.

Subsistence/Native Harvest Information

The subsistence take of beluga whales within the eastern Chukchi Sea is reported by the Alaska Beluga Whale Committee (ABWC), who reported that the number of whales harvested for subsistence has averaged approximately 65 during the 5-year period from 1990-94 (Frost and Suydam 1995). This estimate is based on household surveys and on-site monitoring, but is negatively biased because there is not a reliable estimate for the percent struck and lost.

STATUS OF STOCK

The estimated annual rate of human-caused mortality and serious injury (65) does not exceed the PBR (74), thus the Eastern Chukchi Sea stock of beluga whales is not classified as a strategic stock.

REFERENCES

Brodie, P. F. 1971. A reconsideration of aspects of growth, reproduction, and behavior of the white whale with reference to the Cumberland Sound, Baffin Island, population. J. Fish. Res. Bd. Can. 28:1309-1318.

DeMaster, D.P. 1995a. Minutes from the 16-17 February 1995 meeting of the Alaska Scientific Review Group. Anchorage, Alaska. 22 pp. (available upon request- D.P. DeMaster, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98 115).

DeMaster, D.P. 1995b. Minutes from the 4-5 and 11 January 1995 meeting of the Alaska Scientific Review Group, Anchorage, Alaska. 27 pp. + appendices. (available upon request- D.P. DeMaster, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98 115).

Dizon, A. E., C. Lockyer, W. F. Perrin D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 6:24-36.

Finley, K. J. 1982. The estuarine habitat of the beluga or white whale, Delphinapterus leucus. Cetus 4:4-5.

Frost, K. J., and L. F. Lowry. 1990. Distribution, abundance, and movements of beluga whales, Delphinapterus leucus, in coastal waters of western Alaska. Pp. 39-57, In T.G. Smith, D.J. St. Aubin, and J.R. Geraci (eds.), Advances in research on the beluga whale, Delphinapterus leucas. Can. Bull. Fish. Aquat. Sci. 224.

Frost, K. J., L. F. Lowry, and G. Carroll. 1993. Beluga whale and spotted seal use of a coastal lagoon system in the northeastern Chukchi Sea. Arctic 46:8-16.

Frost, K. J., and L. F. Lowry. 1995. Radio tag based correction factors for use in beluga whale population estimates. Working paper for Alaska Beluga Whale Committee Scientific Workshop, Anchorage, AK, 5-7 April 1995. 12 pp. (available upon request- Alaska Dep. Fish and Game, 1300 College Rd., Fairbanks, AK 99701).

Frost, K. J., and R. Suydam. 1995. Harvests of beluga whales, Delphinapterus leucus, in Alaska, 1987-1994. Working paper for Alaska Beluga Whale Committee Scientific Workshop, Anchorage, AK, 5-7 April 1995. 14 pp.

Gurevich, V. S. 1980. Worldwide distribution and migration patterns of the white whale (beluga), Delphinapterus leucus. Rep. Int. Whaling Commn. 30:465-480.

Hazard, K. 1988. Beluga whale, Delphinapterus leucas. Pp. 195-235, In J.W. Lentfer (ed.), Selected marine mammals of Alaska. Species accounts with research and management recommendations. Marine Mammal Commission, Washington, D.C.

Lowry, L. F. 1985. The belukha whale (Delphinapterus leucas). Pp. 3-13, In J.J. Burns, KJ. Frost, and L.F. Lowry (eds.), Marine mammals species accounts. Alaska Dep. Fish and Game, Game Tech. Bull. 7.

National Marine Fisheries Service. In prep. Guidelines for Estimating Potential Biological Removals. U.S. Dep. Commer., NOAA Tech. Rep.

Reeves, R. R. 1990. An overview of the distribution, exploitation and conservation status of belugas, worldwide. Pp. 47-58, In J. Prescott and M. Gauquelin (eds.), For the future of the beluga: Proceedings of the International Forum for the Future of the Beluga. Univ. Quebec Press, Canada.

Seaman, G. A., K. J. Frost, and L. F. Lowry. 1985. Investigations of belikha whales in coastal waters of western and northern Alaska. Part I. Distribution, abundance and movements. U.S. Dep. Commer., NOAA, OCSEAP Final Rep. 56:153-220. (available from NOAA-OMA-OAD, Alaska Office, 701 C. Street, P.O. Box 56, Anchorage, AK 99513).

Sergeant, D. E., and P. F. Brodie. 1969. Body size in white whales, Delphinapterus leucas. J. Fish. Res. Bd. Can. 26:2561-2580.

Shelden, K. E. W., 1994. Beluga whales (Delphinapterus leucas) in Cook Inlet - A review. Appendix In Withrow, D. E., K E. W. Shelden, and D. J. Rugh. Beluga whale (Delphinapterus leucas) distribution and abundance in Cook Inlet, summer 1993. Annual report to the MMPA Assessment Program, Office of Protected Resources, NMFS, NOAA, 1335 East-West Highway, Silver Spring, MD 20910.

BELUGA WHALE (*Delphinapterus leucas*): Norton Sound Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Beluga whales are distributed throughout seasonally ice-covered arctic and subarctic waters of the Northern Hemisphere (Gurevich 1980), and are closely associated with open leads and polynya in ice-covered regions (Hazard 1988). Depending on season and region, beluga whales may occur in both offshore and coastal waters, with concentrations in Cook Inlet, Bristol Bay, Norton Sound, Kasegaluk Lagoon, and the Mackenzie Delta (Hazard 1988). It is assumed that most beluga whales from these summering areas overwinter in the Bering Sea, excluding those found in the northern Gulf of Alaska (Shelden 1994). Seasonal distribution is affected by ice cover, tidal conditions, access to prey, temperature, and human interaction (Lowry 1985). During the winter, beluga whales occur in offshore waters associated with pack ice. In the spring, they migrate to warmer coastal estuaries, bays, and rivers for molting (Finley 1982) and calving (Sergeant and Brodie 1969). Annual migrations may cover thousands of kilometers (Reeves 1990).

The following information was considered in classifying beluga whale stock structure based on the Dizon et al. (1992) phylogeographic approach: (1) Distributional data: geographic distribution discontinuous in summer (Frost and Lowry 1990), distribution unknown outside of summer; (2) Population response data: possible extirpation of local populations; distinct population trends between regions occupied in summer; (3) Phenotypic data: unknown: and (4) Genotypic data: preliminary mitochondrial DNA analyses indicate distinct differences among summering areas, except between Norton Sound and Bristol Bay (G. O'Corry-Crowe, unpubl. data, Southwest Fisheries Science Center, P.O. Box 271, La Jolla, CA 92038); however, the number of samples collected from Bristol Bay was too small (n=5) to provide sufficient statistical power to delineate between these two areas. Based on this information, 5 putative stocks of beluga whales are recognized within U.S. waters: 1) Cook Inlet, 2) Bristol Bay, 3) Norton Sound, 4) Eastern Chukchi Sea, and 5) Beaufort Sea. The Alaska Scientific Review Group concluded that the scientific data available to determine stock structure in Bristol Bay and Norton Sound were equivocal, and thus stock structure of beluga whales could not be defined for these areas (DeMaster 1995: pp. 4).

POPULATION SIZE

A reliable abundance estimate for this stock is currently unavailable (DeMaster 1995: pp. 4). DeMaster et al. (1994) estimated the minimum abundance of belugas from aerial surveys over Norton Sound in 1992,1993, and 1994 at 2,095,620, and 695, respectively (see also Lowry et al. 1995). The variation between years was due, in part, to variability in the timing of the migration and movement of animals into the sound, and thus the 1993 and 1994 estimates were considered to be negatively biased. Correction factors recommended from studies of belugas range from 2 to 3.27. For Norton Sound, the correction factor of 2.98 (CV[CF] not available) has been recommended for the proportion of animals that were diving and thus not visible at the surface (DeMaster et al. 1994, based on methods of Frost and Lowry 1995). If this correction factor is applied to the 1992 count (2,095, CW=0.32) along with the additional correction factor for the proportion of newborns and yearlings not observed due to small size and dark coloration (1.18; Brodie 1971), the total corrected abundance estimate for Norton Sound is 7,367 (2,095 x 2.98 x 1.18). A CV(N) that incorporates variance due to all of the correction factors is currently not available.

Minimum Population Estimate

Not determined, see "Status of Stock" section below.

Current Population Trend

Surveys to estimate population abundance in Norton Sound were not conducted prior to 1992-94. Thus, reliable information on population trends is currently not available (Frost and Lowry 1990).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for the Norton Sound stock of beluga whales. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate (R_{MAX}) of 4% be employed for this stock (NMFS in prep.).

POTENTIAL BIOLOGICAL REMOVAL

Not determined, see "Status of Stock" section below.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

NMFS observers monitored incidental take on 3 different fisheries that could have interacted with beluga whales in Norton Sound during 1990-93: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries. Observers did not report any mortality or serious injury of beluga whales incidental to these groundfish fisheries. An additional source of information on the number of beluga whales killed or injured incidental to commercial fishery operations is the logbook reports maintained by boat operators as required by the Marine Mammal Protection Act (MMPA) interim exemption program. During the 3-year period between 1990-92, logbook reports, where observer data were not available, did not include any mortality or injury to beluga whales from this stock.

The estimated annual mortality rate incidental to commercial fisheries recently monitored is zero, and although the PBR for this stock is currently unknown this mortality rate is considered to be insignificant and approaching a zero mortality and serious injury rate.

Subsistence/Native Harvest Information

The subsistence take of beluga whales within Norton Sound is reported by the Alaska Beluga Whale Committee (ABWC), who reported that the number of whales harvested for subsistence has averaged approximately 147 during the 5-year period from 1990-94 (Frost and Suydam 1995). This estimate is based on household surveys, but is negatively biased because it has not been corrected for hunters that did not respond, and there is not a reliable estimate for the percent struck and lost. In addition, an unknown proportion of the animals harvested each year may belong to other beluga stocks migrating through Norton Sound in both the fall and spring.

STATUS OF STOCK

Estimates of PBR and status under the MMPA have not been determined because this marine mammal stock is (1) not listed under the ESA or MMPA, (2) subject to Alaska Native subsistence harvests, and (3) fisheries-related mortality and serious injury incidental to commercial fishing is absent or is a relatively minor contribution to total human-related mortality and injury. Sustainable harvest levels and status determination for this stock will be determined from the analysis of information gathered through the co-management process, and will reflect the degree of uncertainty associated with the information obtained for this stock.

REFERENCES

Brodie, P. F. 1971. A reconsideration of aspects of growth, reproduction, and behavior of the white whale with reference to the Cumberland Sound, Baffin Island, population. J. Fish. Res. Bd. Can. 28:1309-1318.

DeMaster, D. P., K. Frost, L Lowry, and T. Pierce. 1994. Abundance estimate for beluga whales (Delphinapterus leucas) in Norton Sound: June 1992, 1993, and 1994. Alaska Beluga Whale Committee Report No. 94-1, November 1994,13 pp.

DeMaster, D.P. 1995. Minutes from the 16-17 February 1995 meeting of the Alaska Scientific Review Group. Anchorage, Alaska. 22 pp. (available upon request- D.P. DeMaster, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98115).

Dizon, A. E., C. Lockyer, W. F. Perrin, D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 6:24-36.

Finley, K. J. 1982. The estuarine habitat of the beluga or white whale, Delphinapterus leucas. Cetus 4:4-5.

Frost, K. J., and L. F. Lowry. 1990. Distribution, abundance, and movements of beluga whales, Delphinapterus leucas, in coastal waters of western Alaska. Pp. 39-57, In T.G. Smith, DJ. St. Aubin, and J.R. Geraci (eds.), Advances in research on the beluga whale, Delphinapterus leucas. Can. Bull. Fish. Aquat. Sci. 224.

Frost, KJ., and L.F. Lowry. 1995. Radio tag based correction factors for use in beluga whale population estimates. Working paper for Alaska Beluga Whale Committee Scientific Workshop, Anchorage, AK, 5-7 April 1995. 12 pp.

Frost, K. J., and R. Suydam. 1995. Harvests of beluga whales, Delphinapterus leucas, in Alaska, 1987-1994. Working paper for Alaska Beluga Whale Committee Scientific Workshop, Anchorage, AK, 5-7 April 1995. 14 pp.

Gurevich, V. S. 1980. Worldwide distribution and migration patterns of the white whale (beluga), Delphinapterus leucas. Rep. Int. Whaling Commn. 30:465480.

Hazard, K. 1988. Beluga whale, Delphinapterus leucas. Pp. 195-235, In J.W. Lentfer (ed.), Selected marine mammals of Alaska. Species accounts with research and management recommendations. Marine Mammal Commission, Washington, D.C.

Lowry, L. F. 1985. The belukha whale (Delphinapterus leucas). Pp. 3-13, In JJ. Burns, KJ. Frost, and L.F. Lowry (eds.), Marine mammals species accounts. Alaska Dep. Fish and Game, Game Tech. Bull. 7.

Lowry, L. F., K. J. Frost, D. P. DeMaster, and R. R. Nelson. 1995. Distribution and abundance of beluga whales in the Norton Sound/Yukon Delta region, 1992-1994. Working paper for Alaska Beluga Whale Committee Scientific Workshop, Anchorage, AK, 5-7 April 1995. 13 pp.

National Marine Fisheries Service. In prep. Guidelines for Estimating Potential Biological Removals. U.S. Dep. Commer., NOAA Tech. Rep.

Reeves, R. R. 1990. An overview of the distribution, exploitation and conservation status of belugas, worldwide. Pp. 47-58, In J. Prescott and M. Gauquelin (eds.), For the future of the beluga: Proceedings of the International Forum for the Future of the Beluga. Univ. Quebec Press, Canada.

Seaman, G. A., K J. Frost, and L. F. Lowry. 1985. Investigations of belukha whales in coastal waters of western and northern Alaska. Part I. Distribution, abundance and movements. U.S. Dep. Commer., NOAA, OCSEAP Final Rep. 56:153-220. (available from NOAA-OMA-OAD, Alaska Office, 701 C. Street, P.O. Box 56, Anchorage, AK 99513).

Sergeant, D. E., and P. F. Brodie. 1969. Body size in white whales, Delphinapterus leucas. J. Fish. Res. Bd. Can. 26:2561-2580.

Shelden, K. E. W. 1994. Beluga whales (Delphinapterus leucas) in Cook Inlet - A review. Appendix In D. E. Withrow, K E. W. Shelden, and D. J. Rugh. Beluga whale (Delphinapterus leucas) distribution and abundance in Cook Inlet, summer 1993. Annual report to the MMPA Assessment Program, Office of Protected Resources, NMFS, NOAA, 1335 East-West Highway, Silver Spring, MD 20910.

BELUGA WHALE (*Delphinapterus leucas*): Bristol Bay Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Beluga whales are distributed throughout seasonally ice-covered arctic and subarctic waters of the Northern Hemisphere (Gurevich 1980), and are closely associated with open leads and polynya in ice-covered regions (Hazard 1988). Depending on season and region, beluga whales may occur in both offshore and coastal waters, with concentrations in Cook Inlet, Bristol Bay, Norton Sound, Kasegaluk Lagoon, and the Mackenzie Delta (Hazard 1988). It is assumed that most beluga whales from these summering areas over-winter in the Bering Sea, excluding those found in the northern Gulf of Alaska (Shelden 1994). Seasonal distribution is affected by ice cover, tidal conditions, access to prey, temperature, and human interaction (Lowry 1985). During the winter, beluga whales occur in offshore waters associated with pack ice. In the spring, they migrate to warmer coastal estuaries, bays, and rivers for molting (Finley 1982) and calving (Sergeant and Brodie 1969). Annual migrations may cover thousands of kilometers (Reeves 1990).

The following information was considered in classifying beluga whale stock structure based on the Dizon et al. (1992) phylogeographic approach: (1)Distributional data: geographic distribution discontinuous in summer (Frost and Lowry 1990), distribution unknown outside of summer: (2) Population response data: possible extirpation of local populations; distinct population trends between regions occupied in summer; (3) Phenotypic data: unknown; and (4) Genotypic data: preliminary mitochondrial DNA analyses indicate distinct differences among summering areas, except between Norton Sound and Bristol Bay (G. O'Corry-Crowe, unpubl. report, Southwest Fisheries Science Center, P.O. Box 271, La Jolla, CA 92038); however, the number of samples collected from Bristol Bay was too small (n=5) to provide sufficient statistical power to delineate between these two areas. Based on this information, 5 putative stocks of beluga whales are recognized within U.S. waters: 1) Cook Inlet, 2) Bristol Bay, 3) Norton Sound, 4) Eastern Chukchi Sea, and 5) Beaufort Sea. The Alaska Scientific Review Group concluded that the scientific data available to determine stock structure in Bristol Bay and Norton Sound were equivocal, and thus stock structure of beluga whales could not be defined for these areas (DeMaster 1995: pp. 4).

POPULATION SIZE

The sources of information to estimate abundance for belugas in the waters of western and northern Alaska have included both opportunistic and systematic observations. Frost and Lowry (1990) compiled data collected from aerial surveys conducted between 1978 and 1987 that were designed to specifically estimate the number of beluga whales. Surveys did not cover the entire habitat of belugas, but were directed to specific areas at the times of year when belugas were expected to concentrate. Frost and Lowry (1990) reported an estimate of 1,000-1,500 for Bristol Bay, similar to that reported by Seaman et al. (1985). Most recently, the number of beluga whales in Bristol Bay was estimated at 1,555 in 1994 (Frost and Lowry 1995a), based on a count of 503 animals, which was corrected for the proportion of animals that were diving and thus not visible at the surface (2.62, Frost and Lowry 1995b), and for the proportion of newborns and yearlings not observed due to small size and dark coloration (1.18; Brodie 1971).

Minimum Population Estimate

The survey technique utilized for estimating the abundance of beluga whales in this stock is a direct count which incorporates correction factors. For the Bristol Bay stock of belugas, the minimum population estimate (N_{MIN}) is 1526, which is from Frost and Lowry (1995a). Equation 1 from the PBR Guidelines (NMFS in prep.) was not used because of the unavailability of a CV(N). Because an estimate of the variance of abundance is currently not available, the estimate of N_{MIN} should be considered preliminary. This approach is consistent with the recommendations of the Alaska Scientific Review Group.

Current Population Trend

Abundance estimates from surveys conducted in 1983, 1993, and 1994 are similar to estimates from the 1950s, suggesting this stock of beluga whales should be considered stable (Frost and Lowry 1990).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for the Bristol Bay stock of beluga whales. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate (R_{MAX}) of 4% be employed for this stock (NMFS in prep.).

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. As this stock is considered stable (Frost and Lowry 1990), the recovery factor (F_R) for this stock is 1.0 (NMFS in prep.). Thus, for the Bristol Bay stock of beluga whales, PBR = (1,529 x 0.02 x LO), or 31 animals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

NMFS observers monitored incidental take on 3 different fisheries that could have interacted with beluga whales in Bristol Bay during 1990-93: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries. Observers have not monitored the Bristol Bay salmon set and drift gillnet fisheries, the largest commercial fishing fleet affecting belugas in western Alaska. Observers did not report any mortality or serious injury of beluga whales incidental to the groundfish fisheries. An additional source of information on the number of beluga whales killed or injured incidental to commercial fishery operations is the logbook reports maintained by boat operators as required by the MMPA interim exemption program. During the 3-year period between 1990-92, logbook reports, where observer data were not available, included 1 mortality and 1 injury due to gear interaction in the Bristol Bay salmon set and drift gillnet fishery. Thus, logbook records indicate an annual mean of 0.3 injuries and 0.3 mortalities from interactions with fishing operations, with no additional injuries or mortalities due to illegal deterrence. However, because logbook records are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. In 1983, the Alaska Department of Fish and Game documented 12 beluga whale mortalities in Bristol Bay related to fishing.

The current estimated mortality rate incidental to commercial fisheries is 0.3 animals per year, based entirely on logbook data. It should be noted that no observers have been assigned to those fisheries that are known to interact with this stock of belugas. Therefore, it is unknown whether the kill rate can be considered insignificant and approaching a zero mortality and serious injury rate.

Subsistence/Native Harvest Information

The subsistence take of beluga whales within Bristol Bay is reported by the Alaska Beluga Whale Committee (ABWC), who reported that the number of whales harvested for subsistence has averaged approximately 13 during the 5-year period from 1990-94 (Frost and Suydam 1995); estimates are not available for 1992. This estimate is based on household surveys, but is negatively biased because it has not been corrected for hunters that did not respond, and there is not a reliable estimate for the percent struck and lost. A study conducted by the Alaska Department of Fish and Game, in cooperation with the ABWC and the Indigenous People’s Council for Marine Mammals, estimated the subsistence take in 1993 at 39 whales based on surveys of 42 hunters from 10 different communities in Bristol Bay (Chythlook and Coiley 1994). Replacing this 1993 estimate with the estimate from Frost and Suydam (1995) and using the other 3-years of data from the ABWC results in an estimated subsistence take of 22 belugas each year.

STATUS OF STOCK

The estimated annual rate of human-caused mortality and serious injury (22) that can be estimated does not exceed the PBR (31), thus the Bristol Bay stock of beluga whales is not classified as a strategic stock. However, as noted, fisheries-related mortality is undetermined and, therefore, may be underestimated.

REFERENCES

Brodie, P. F. 1971. A reconsideration of aspects of growth, reproduction, and behavior of the white whale with reference to the Cumberland Sound, Baffin Island, population. J. Fish. Res. Bd. Can. 28:1309-1318.

Chythlook, M. and P. A. Coiley. 1994. The subsistence use of beluga whale in Bristol Bay by Alaska natives, 1993. Draft final report for year two, subsistence study and monitor system, No. 50ABNF200055. Prepared for NMFS by the Alaska Department of Fish and Game, Juneau, AK 99802.

Credle, V. R., D. P. DeMaster, M. M. Merklein, M. B. Hanson, W. A. Karp, and S. M. Fitzgerald (eds.). 1994. NMFS observer programs: minutes and recommendations from a workshop held in Galveston, Texas, November 10-11, 1993. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-94-1, 96 pp.

DeMaster, D.P. 1995. Minutes from the 16-17 February 1995 meeting of the Alaska Scientific Review Group. Anchorage, Alaska. 22 pp. (available upon request- DP. DeMaster, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98115).

Dizon, A. E., C. Lockyer, W. F. Pen-in, D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 6:24-36.

Finley, K. J. 1982. The estuarine habitat of the beluga or white whale, Delphinapterus leucas. Cetus 4:4-5.

Frost, K. J., and L. F. Lowry. 1990. Distribution, abundance, and movements of beluga whales, Delphinapterus leucas, in coastal waters of western Alaska. Pp. 39-57, In T.G. Smith, DJ. St. Aubin, and J.R. Geraci (eds.), Advances in research on the beluga whale, Delphinapterus leucas. Can. Bull. Fish. Aquat. Sci. 224.

Frost, K. J., and L. F. Lowry. 1995a. Distribution and abundance of beluga whales in Bristol Bay, Alaska, 1993-1994. Alaska Beluga Whale Committee Rep. 95-114 pp.

Frost, K. J., and L. F. Lowry. 1995b. Radio tag based correction factors for use in beluga whale population estimates. Working paper for Alaska Beluga Whale Committee Scientific Workshop, Anchorage, AK, 5-7 April 1995. 12 pp.

Frost, K. J., and R. Suydam. 1995. Harvests of beluga whales, Delphinapterus leucas, in Alaska, 1987-1994. Working paper for Alaska Beluga Whale Committee Scientific Workshop, Anchorage, AK, 5-7 April 1995. 14 pp.

Gurevich, V. S. 1980. Worldwide distribution and migration patterns of the white whale (beluga), Delphinapterus leucas. Rep. Int. Whaling Commn. 30:465480.

Hazard, K. 1988. Beluga whale, Delphinapterus leucas. Pp. 195-235, In J.W. Lentfer (ed.), Selected marine mammals of Alaska. Species accounts with research and management recommendations. Marine Mammal Commission, Washington, D.C.

Lowry, L. F. 1985. The belukha whale (Delphinapterus leucas). Pp. 3-13, In JJ. Burns, KJ. Frost, and L.F. Lowry (eds.), Marine mammal species accounts. Alaska Dep. Fish and Game, Game Tech. Bull. 7.

National Marine Fisheries Service. In prep. Guidelines for Estimating Potential Biological Removals. U.S. Dep. Commer., NOAA Tech. Rep.

Reeves, R. R. 1990. An overview of the distribution, exploitation and conservation status of belugas, worldwide. Pp. 47-58, In J. Prescott and M. Gauquelin (eds.), For the future of the beluga: Proceedings of the International Forum for the Future of the Beluga. Univ. Quebec Press, Canada.

Seaman, G. A., K. J. Frost, and L. F. Lowry. 1985. Investigations of belukha whales in coastal waters of western and northern Alaska. Part I. Distribution, abundance and movements. U.S. Dep. Commer., NOAA, OCSEAP Final Rep. 56:153-220. Available from NOAA-OMA-OAD, Alaska Office, 701 C. Street, P.O. Box 56, Anchorage, AK 99513.

Sergeant, D. E., and P. F. Brodie. 1969. Body size in white whales, Delphinapterus leucas. J. Fish. Res. Bd. Can. 26:2561-2580.

Shelden, K. E. W. 1994. Beluga whales (Delphinapterus leucas) in Cook Inlet - A review. Appendix In Withrow, D. E., K. E. W. Shelden, and D. J. Rugh. Beluga whale (Delphinapterus leucas) distribution and abundance in Cook Inlet, summer 1993. Annual report to the MMPA Assessment Program, Office of Protected Resources, NMFS, NOAA, 1335 East-West Highway, Silver Spring, MD 20910.

BELUGA WHALE (*Delphinapterus leucas*): Cook Inlet Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Beluga whales are distributed throughout seasonally ice-covered arctic and subarctic waters of the Northern Hemisphere (Gurevich 1980), and are closely associated with open leads and polynya in ice-covered regions (Hazard 1988). Depending on season and region, beluga whales may occur in both offshore and coastal waters, with concentrations in Cook Inlet, Bristol Bay, Norton Sound, Kasegaluk Lagoon, and the Mackenzie Delta (Hazard 1988). It is assumed that most beluga whales from these summering areas overwinter in the Bering Sea, excluding those found in the northern Gulf of Alaska (Shelden 1994). Seasonal distribution is affected by ice cover, tidal conditions, access to prey, temperature, and human interaction (Lowry 1985). During the winter, beluga whales occur in offshore waters associated with pack ice. In the spring, they migrate to warmer coastal estuaries, bays, and rivers for molting (Finley 1982) and calving (Sergeant and Brodie 1969). Annual migrations may cover thousands of kilometers (Reeves 1990).

The following information was considered in classifying beluga whale stock structure based on the Dizon et al. (1992) phylogeographic approach: (1) Distributional data: geographic distribution discontinuous in summer (Frost and Lowry 1990), distribution unknown outside of summer: (2) Population response data: possible extirpation of local populations; distinct population trends between regions occupied in summer; (3) Phenotypic data: unknown: and (4) Genotypic data: preliminary mitochondrial DNA analyses indicate distinct differences among summering areas, except between Norton Sound and Bristol Bay (G. O'Corry-Crowe, unpubl. report, Southwest Fisheries Science Center, P.O. Box 271, La Jolla, CA 92038); however, the number of samples collected from Bristol Bay was too small (n=5) to provide sufficient statistical power to delineate between these two areas. Based on this information, 5 putative stocks of beluga whales arerecognized within U.S. waters: 1) Cook Inlet, 2) Bristol Bay, 3) Norton Sound, 4) Eastern Chukchi Sea, and 5) Beaufort Sea The Alaska Scientific Review Group concluded that the scientific data available to determine stock structure in Bristol Bay and Norton Sound were equivocal, and thus stock structure of beluga whales could not be defined for these areas (DeMaster 1995: pp. 4).

POPULATION SIZE

Aerial surveys for beluga whales in Cook Inlet were conducted in June 1994 using an 'approach' survey technique that involves repeated circling of observed groups, and videotape recording. The approach technique differs from 'passing mode' surveys performed for belugas in other stocks, in that during passing surveys the aircraft maintains a straight flight path. The approach technique allows each group of whales observed and recorded on video to be corrected for 1) animals that were under the surface, and 2) animals missed by observers yet recorded on video. The sum of corrected counts for all groups observed in the 1994 survey has not yet been determined. The maximum single day count from the 1994 survey was 431 (CV=0.14) belugas. Based on information collected during the 1994 survey on mean surface time and mean time between surfacings, and the methodology of Frost and Lowry (1995), a correction factor of 2.46 (CV not available) was estimated for this stock. As recommended by the Alaska Scientific Review Group (DeMaster 1995: pp. 5), if this correction factor is applied to the 1994 count along with the additional correction factor for the proportion of newborns and yearlings not observed due to small size and dark coloration (1.18; Brodie 1971), the total corrected abundance estimate for Cook Inlet Sound is 1,251 (431 x 2.46 x 1.18). A CV(N) that incorporates variance associated with the correction factors is currently not available.

Minimum Population Estimate

Not determined, see "Status of Stock" section below.

Current Population Trend

In general, population estimates have ranged from 300 to 500 beluga whales (uncorrected counts) within Cook Inlet since the early 1960s. Based on these surveys, this population is considered to be stable (Shelden 1994).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently not available for the Cook Inlet stock of beluga whales. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate (R_{MAX}) of 4% be employed for this stock (NMFS in prep.).

POTENTIAL BIOLOGICAL REMOVAL

Not determined, see "Status of Stock" section below.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS IN JURY

Fisheries Information

Three types of fishing gear occur in Cook Inlet: purse seine, drift-net, and set-net, which are used to catch each of the five species of Pacific salmon as well as Pacific herring. NMFS observers have not monitored any of these fisheries within Cook Inlet. An additional source of information on the number of beluga whales killed or injured incidental to commercial fishery operations is the logbook reports maintained by boat operators through the Marine Mammal Protection Act (MMPA) interim exemption program. During the 3-year period between 1990-92, logbook reports, where observer data were not available, indicated no injuries or mortalities from either interactions with fishing operations or illegal deterrence. Unsubstantiated information obtained by the NMFS Anchorage Field Office includes net entanglement, which occurred when fisheries were active between May and August.

'The estimated mortality rate incidental to commercial fisheries recently monitored is zero. At present, a PBR for this stock can not be determined (see "Status of Stock" section below). Further, a reliable estimate of the mortality rate incidental to commercial fisheries is currently unavailable because of the absence of observer placements in the fisheries mentioned above. Therefore, it is unknown whether the kill rate is insignificant.

Subsistence/Native Harvest Information

The only documented human-caused mortality of beluga whales within the Cook Inlet stock is that reported by the Alaska Beluga Whale Committee (ABWC), who reported that the number of whales harvested for subsistence has averaged approximately 13 during the 5-year period from 1990-94 (Frost and Suydam 1995); estimates are not available for 1991. This estimate is based on household surveys, and has been corrected for hunters that did not respond. However, this estimate is negatively biased because there is not a reliable estimate for the percent struck and lost, and it does not include the number of animals killed by residents from outside Cook Inlet. A study conducted by the Alaska Department of Fish and Game, in cooperation with the ABWC and the Indigenous People's Council for Marine Mammals, estimated the subsistence take in 1993 at 17 whales based on surveys of 16 of 19 households known to have hunted in 1993 Stanek (1994). This was considered a minimum estimate, and was increased by adding the estimated number of whales taken from households not surveyed (3) and by hunters from areas outside of Cook Inlet (10) resulting in an estimated total take of 30 (17 + 3 + 10) whales. Using this 1993 estimate of 30 belugas from Stanek (1994), because it was a more comprehensive survey, and the estimates from 1990, 1992, and 1994 from the ABWC results in an estimated average subsistence take of 17 belugas per year. However, in consultation with native elders from the Cook Inlet region, the Cook Inlet Marine Mammal Council has estimated the number of belugas taken by subsistence hunters to be significantly greater than 17. Thus, the estimate of 17 belugas taken each year is considered to be an underestimate, and until additional comprehensive surveys are conducted, a reliable estimate of the annual subsistence take of belugas in this stock is considered unavailable.

STATUS OF STOCK

Estimates of PBR and status under the MMPA have not been determined because this marine mammal stock is (1) not listed under the ESA or MMPA, (2) subject to Alaska Native subsistence harvests, and (3) fisheries-related mortality and serious injury incidental to commercial fishing is absent or is a relatively minor contribution to total human-related mortality and injury. Sustainable harvest levels and status determination for this stock will be determined from the analysis of information gathered through the co-management process, and will reflect the degree of uncertainty associated with the information obtained for this stock.

REFERENCES

Brodie, P. F. 1971. A reconsideration of aspects of growth, reproduction, and behavior of the white whale with reference to the Cumberland Sound, Baffin Island, population. J. Fish. Res. Bd. Can. 28:1309-1318.

DeMaster, D.P. 1995. Minutes from the 16-17 February 1995 meeting of the Alaska Scientific Review Group. Anchorage, Alaska. 22 pp. (available upon request- D.P. DeMaster, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98115).

Dizon, A. E., C. Lockyer, W. F. Perrin, D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 6:24-36.

Finley, K. J. 1982. The estuarine habitat of the beluga or white whale, Delphinapterus leucas. Cetus 4:4-5.

Frost, K. J., and L. F. Lowry. 1990. Distribution, abundance, and movements of beluga whales, Delphinapterus leucas, in coastal waters of western Alaska. Pp. 39-57, In T.G. Smith, DJ. St. Aubin, and J.R. Geraci (eds.), Advances in research on the beluga whale, Delphinapterus leucas. Can. Bull. Fish. Aquat. Sci. 224.

Frost, K. J., and L. F. Lowry. 1995. Radio tag based correction factors for use in beluga whale population estimates. Working paper for Alaska Beluga Whale Committee Scientific Workshop, Anchorage, AK, 5-7 April 1995. 12 pp.

Frost, K. J., and R. Suydam. 1995. Harvests of beluga whales, Delphinapterus leucas, in Alaska, 1987-1994. Working paper for Alaska Beluga Whale Committee Scientific Workshop, Anchorage, AK, 5-7 April 1995. 14 pp.

Gurevich, V. S. 1980. Worldwide distribution and migration patters of the white whale (beluga), Delphinapterus leucas. Rep. Int. Whaling Commn. 30:465-480.

Hazard, K. 1988. Beluga whale, Delphinapterus leucas. Pp. 195-235, In J.W. Lentfer (ed.), Selected marine mammals of Alaska. Species accounts with research and management recommendations. Marine Mammal Commission, Washington, D.C.

Lowry, L. F. 1985. The belukha whale (Delphinapterus leucas). Pp. 3-13, In JJ. Burns, KJ. Frost, and LF. Lowry (eds.), Marine mammals species accounts. Alaska Dep. Fish and Game, Game Tech. Bull. 7.

National Marine Fisheries Service. In prep. Guidelines for Estimating Potential Biological Removals. U.S. Dep. Commer., NOAA Tech. Rep.

Reeves, R. R. 1990. An overview of the distribution, exploitation and conservation status of belugas, worldwide. Pp. 47-58, In J. Prescott and M. Gauquelin (eds.), For the future of the beluga: Proceedings of the International Forum for the Future of the Beluga. Univ. Quebec Press, Canada.

Sergeant, D. E., and P. F. Brodie. 1969. Body size in white whales, Delphinapterus leucas. J. Fish. Res. Bd. Can. 26:2561-2580.

Shelden, K. E. W. 1994. Beluga whales (Delphinapterus leucas) in Cook Inlet - A review. Appendix In Withrow, D. E., K. E. W. Shelden, and D. J. Rugh. Beluga whale (Delphinapterus leucas) distribution and abundance in Cook Inlet, summer 1993. Annual report to the MMPA Assessment Program, Office of Protected Resources, NMFS, NOAA, 1335 East-West Highway, Silver Spring, MD 20910.

Stanek, R. T. 1994. The subsistence use of beluga whale in Cook Inlet by Alaska Natives, 1993. Draft Final Rep. Study No. 50ABNF200055, submitted to NMFS by Alaska Dep. Fish and Game, Juneau, AK. 24 pp.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Killer whales have been observed in all oceans and seas of the world (Leatherwood and Dahlheim 1978). Although reported from tropical and offshore waters, killer whales prefer the colder waters of both hemispheres, with greatest abundances found within 800 km of major continents (Mitchell 1975). In Alaskan waters, killer whales occur along the entire Alaskan coast from the Chukchi Sea, into the Bering Sea, along the Aleutian Islands, Gulf of Alaska, and into Southeast Alaska (Braham and Dahlheim 1982). Their occurrence has been well documented in British Columbia and inland waterways of Washington State (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) and in the intracoastal waterways of British Columbia and Washington State (Bigg et al. 1990). Through examination of photographs of recognizable individuals and pods, movements of whales between geographical areas have been documented. For example, whales identified in Prince William Sound have been observed near Kodiak Island (Heise et al. 1991, Dahlheim et al. in prep. a); whales identified in Southeast Alaska have been observed in Prince William Sound, British Columbia, and Puget Sound (Leatherwood et al. 1990; Dahlheim et al. in prep.a; Dahlheim et al. in prep. b). Movements of killer whales between Southeast Alaska and off central California have also been documented (Goley and Straley 1994).

Killer whales along British Columbia and Washington State have been labeled as resident and transient (Bigg et al. 1990). Although less is known about killer whales in Alaska, it appears from a preliminary examination of data that both forms also exist in these waters. The two sympatric forms are believed to differ in several aspects of morphology, ecology, and behavior; that is, dorsal fm shape, saddle patch shape, pod size, home range size, diet, travel routes, dive duration, social integrity of pods. For example, in Pacific Northwest waters, significant differences occur in call repertoires (Ford and Fisher 1982), saddle patch pigmentation (Baird and Stacey 1988), and diet (Baird et al. 1992). Studies on mtDNA restriction patterns provide evidence that the resident and transient pods are genetically distinct (Stevens et al. 1989; Hoelzel 1991; Hoelzel and Dover 1991). Using such information, Matkin and Saulitis (1994) proposed 8 provisional killer whale stocks in the eastern North Pacific. However, in reviewing the discreteness of all the characteristics proposed to separate the two forms, Heyning and Dahlheim (1993) concluded that other than saddle patch pigmentation and genetic studies, most information is preliminary, lacks critical statistical evaluation, and is thus equivocal. Following the phylogeographic approach to classify stock structure (Dizon et al. 1992), killer whales occurring from Alaska to the inland waters of Washington State (east of Cape Flattery) represent 2 separate stocks, resident and transient, based primarily on genetic differences. Because the stock area is defined as waters of Alaska to the inland waters of Washington, resident whales in Canada are considered part of the resident stock. Killer whales in waters south of Cape Flattery along the U.S. West Coast are considered a separate stock (see Assessment Reports for the Pacific Region, available upon request from J. Barlow, Southwest Fisheries Science Center, P.O. Box 271, LaJolla, CA 92038).

POPULATION SIZE

In the late 1970s, researchers began collecting identification photographs of killer whales in Prince William Sound, Alaska (Hall 1981). The whales were assigned to pods in 1984 (Leatherwood et al. 1984) which resulted in the first catalogue of Prince William Sound killer whales being produced (Ellis 1984). The catalogue was updated in 1987 (Ellis 1987) and again in 1991 (Heise et al. 1991). In 1984, photographic studies on killer whales were also initiated in Southeast Alaska (Leatherwood et al. 1984) with photographs of individual killer whales from Southeast Alaska also included in Ellis (1984,1987). Although opportunistic photographs of killer whales were collected between the years 1985 through 1988 (Prince William Sound and Southeast Alaska), photo-identification research was limited in both areas. Beginning in 1989, dedicated killer whale photo-identification studies were initiated by the National Marine Mammal Laboratory, primarily in Southeast Alaska.

Preliminary analysis of photographic data resulted in the following minimum counts for Alaskan killer whales (Note: individual whales have been matched between geographical regions and missing animals likely to be dead have been subtracted). Based on data collected from Seward, Alaska, west to Kodiak Island, then westward along the Alaskan Peninsula into the southeastern Bering Sea to include the eastern Aleutian Islands (Dahlheim and Waite 1993, Dahlheim 1994, Dahlheim in prep., Dahlheim et al. in prep. a), 277 individual whales have been identified. In Prince William Sound, 310 whales have been identified (Leatherwood et al. 1990; Heise et al. 1991; Dahlheim et al. in prep. a). For Southeast

Alaska, 259 whales have been identified (Dahlheim and Waite 1993, Dahlheim 1994, and Dahlheim et al. in prep b). Combining these counts gives a total for Alaskan waters of 846 (277 + 310 + 259) whales. For the inland waters, only, of Washington State, 158 killer whales have been documented (Ford et al. 1994). Minor adjustments to counts will be made based on final analysis: for example, a relatively small number of internal matches between Washington State and Alaska (<10 whales) could decrease counts. Thus, the estimated abundance of killer whales in Alaska and the inland waters of Washington State is 1,004 (846 + 158) (Dahlheim et al. a in prep), with approximately 759 (75.6%) identified as residents. The distinction between resident and transient whales was based primarily on genetics and saddle patch shape, and the morphological, ecological, and behavioral characteristics presented above. Additionally, 250 resident whales that have only been observed in Canadian waters. Therefore, the best estimate of abundance for this stock, including resident animals found off the coast of British Columbia, is 1,009 (759 + 250).

Minimum Population Estimate

The survey technique utilized for obtaining the abundance estimate of killer whales is a direct count, and a correction factor is currently unavailable. Given that researchers continue to identify new whales, the estimate of abundance based on the number of uniquely identified individuals known to be alive is likely conservative. Other estimates of the overall population size (i.e., N,,) and associated CV are not currently available. Thus, the minimum population estimate (N_{MIN}) for the resident stock of killer whales is 759, which does not include animals found in Canadian waters (see PBR Guidelines regarding the status of non-migratory stocks, NMFS in prep.). This approach is consistent with the recommendations of the Alaska Scientific Review Group.

Current Population Trend

At present, reliable data on trends in population abundance for this stock of killer whales are unavailable.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for this stock of killer whales. Olesiuk et al. 1990, studied a resident population of killer whales in the coastal waters of British Columbia and Washington State, and estimated the population was below carrying capacity and grew at 2.92% from 1973-87. However, a population increases at the maximum growth rate (R_{MAX}) when the population is at extremely low levels; thus, the estimate of 2.92% is not an estimate of R_{MAX}. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate (R_{MAX}) of 4% be employed for this stock (NMFS in prep.).

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 cetacean stocks with unknown population status (NMFS in prep.). Thus, for this stock PBR = (759 x 0.02 x 0.5), or 7.6 animals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

NMFS observers monitored incidental take on 6 different fisheries that could have interacted with killer whales during 1990-93: The Bering Sea (and Aleutian Islands) and Gulf of Alaska groundfish trawl, longline, and pot fisheries. The only fishery for which incidental kill was observed was the Bering Sea/Gulf of Alaska groundfish fishery, with 2 mortalities observed in 4 years. This mortality resulted in an estimated mean annual mortality of 0.8. Fishing effort (based on total metric tons of fish caught) was 1.84 million tons, observer coverage (defined as the percentage of effort observed) was 64%, and incidental catch rate (defined as the number of observed dead in the catch divided by the observed effort (tons) multiplied by 10^4) was 0.0043 (CV=0.42). Observers did not report any mortality of killer whales incidental to commercial fisheries in Washington State during the same 1990-93 time period.

An additional source of information on the number of killer whales killed or injured incidental to commercial fishery operations is the logbook reports maintained by boat operators required by the MMPA interim exemption program. During the 3-year period between 1990-92, logbook reports, where observer data were not available, indicated no injuries or mortalities from gear interactions: no injuries or mortalities due to illegal deterrence were reported.

The estimated mortality rate incidental to commercial fisheries recently monitored is 0.8 animals per year, based on observer data (0.8) and logbook data (0.0) where observer data were not available. Mortalities incidental to commercial fisheries have not been identified as either resident or transient killer whales. At present, the estimated annual mortality level (0.8) is approximately equal to 10% of the PBR (i.e., 0.8); therefore mortality incidental to commercial fishing is not considered insignificant for this stock.

Other Mortality

Since 1986, research efforts have been made to assess the nature and magnitude of killer whale/blackcod (sablefish; Anoplopoma fimbria) interactions (Dahlheim 1988; Yano and Dahlheim 1994). Fishery interactions have occurred each year in the Bering Sea and Prince William Sound, with the number of annual reports varying considerably. Data collected from the Japan/U.S. cooperative longline research surveys operating in the Bering Sea indicate that interactions may be increasing and expanding into the Aleutian Island region (Yano and Dahlheim 1994). During 1991 surveys conducted in the Bering Sea and near Kodiak Island, 5 of 12 (42%) pods encountered had evidence of bullet wounds (Dahlheim and Waite 1993). The relationship between wounding due to shooting and survival is unknown. In Prince William Sound, the pod responsible for most of the fishery interactions has experienced a high level of mortality: between 1986-91,22 whales out of a pod of 37 (59%) are missing and considered dead (Matkin et al. 1994). The cause of death for these whales is unknown, but it is likely related to gunshot wounds or effects of the Exxon Valdez oil spill (Dahlheim and Matkin 1994).

STATUS OF STOCK

The estimated annual level of human-caused mortality and serious injury of 0.8 animals per year does not exceed the PBR (7.6), thus the resident stock of killer whales is not classified as a strategic stock.

REFERENCES

Baird, R. W., and P. J. Stacey. 1988. Variation in saddle patch pigmentation in populations of killer whales (Orcinus orca) from British Columbia, Alaska, and Washington State. Can. J. Zool. 66 (11):2582-2585.

Baird, R. W., Abrams, P. A., and L. M. Dill. 1992. Possible indirect interactions between transient and resident killer whales: implications for the evolution of foraging specializations in the genus Orcinus. Oecologia 89:125-132.

Barlow, J. 1995. The abundance of cetaceans in California waters. Part I: Ship surveys in summer and fall of 1991. Fish. Bull., U.S. 93:1-14.

Bigg, M. A., P. F. Olesiuk, G. M. Ellis, J. K. B. Ford, and K. C. Balcomb III. 1990. Social organization and genealogy of resident killer whales (Orcinus orca) in the coastal waters of British Columbia and Washington State. Pp. 386-406, In P.S. Hammond S.A. Mizroch, and G. P. Donovan (eds.), Individual recognition of cetaceans: use of photo-identification and other techniques to estimate population parameters. Rep. Int. Whal. Commn. (Special Issue) 12.

Braham, H. W., and M. E. Dahlheim. 1982. Killer whales in Alaska documented in the Platforms of Opportunity Program. Rep. Int. Whal. Commn. 32:643-646.

Dahlheim, M. E. 1988. Killer whale (Orcinus orca) depredation on longline catches of sablefish (Anoplopoma fimbria) in Alaskan waters. NWAFC Processed Report 88-14, 31 pp. (available upon request- Alaska Fisheries Science Center, 7600 Sand Point Way, NE, Seattle, WA 98115).

Dahlheim, M. E. 1994. Abundance and distribution of killer whales (Orcinus orca) in Alaska in 1993. Annual report to the MMPA Assessment Program, Office of Protected Resources, NMFS, NOAA, 1335 East-West Highway, Silver Spring, MD 20910.

Dahlheim, M. E. In prep. A photographic catalogue of killer whales observed from the Central Gulf of Alaska to the southeastern Bering Sea. U.S. Dep. Commer., NOAA Tech. Rep.

Dahlheim, M. E., and J. M. Waite. 1993. Abundance and distribution of killer whales (Orcinus orca) in Alaska in 1992. Annual report to the MMPA Assessment Program, Office of Protected Resources, NMFS, NOAA, 1335 East-West Highway, Silver Spring, MD 20910.

Dahlheim, ME., and C.O. Matkin. 1994. Assessment of injuries to Prince William Sound killer whales. Pp. 163-171, In T. R. Loughlin (ed.), Marine Mammals and the Exxon Valdez. Academic Press, Inc., San Diego, CA.

Dahlheim, ME., J. Laake, and A. York. In prep a. Killer whales of Alaska: Abundance and distribution. (available upon request- Alaska Fisheries Science Center, 7600 Sand Point Way, NE, Seattle, WA 98115).

Dahlheim, M.E., D. Ellifrit, and J. Swenson. In prep b. A catalogue of Southeast Alaskan killer whales. University of Washington Press, Seattle, WA (available upon request- Alaska Fisheries Science Center, 7600 Sand Point Way, NE, Seattle, WA 98115).

Dizon, A. E., C. Lockyer, W. F. Perrin, D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 6:24-36.

Ellis, G. M. 1984. Killer whales of southern Alaska a catalogue of individuals photo-identified in 1984. San Diego. Hubbs Sea World Research Institute Tech. Rep. No. 84-176. 73 pp.

Ellis, G. M. 1987. Killer whales of Prince William Sound and Southeast Alaska: a catalogue of individuals photo-identified, 1976-1986. San Diego. Hubbs Sea World Research Institute Tech. Rep. No. 87-200. 76 pp.

Ford, J. K. B., and H. D. Fisher. 1982. Killer whale (Orcinus orca) dialects as an indicator of stocks in British Columbia. Rep. Int. Whal. Commn. 32:671-679.

Ford, J. K. B., G. Ellis, and K. C. Balcomb. 1994. Killer whales: the natural history and genealogy of Orcinus orca in British Columbia and Washington State. University of British Columbia Press and University of Washington Press. 102 PP.

Forney, K. A., J. Barlow, and J. V. Carretta 1995. The abundance of cetaceans in California waters. Part II: Aerial surveys in winter and spring of 1991 and 1992. Fish. Bull., U.S. 93:15-26.

Goley, P. D, and J. M. Straley. 1994. Attack on gray whales (Eschrichtius robustus) in Monterey Bay, California, by killer whales (Orcinus orca) previously identified in Glacier Bay, Alaska. Can. J. Zool. 72:1528-1530.

Green, G. A. J. J. Brueggeman, R. A. Grotefendt, C. E. Bowlby, M. L. Bonnel, and K. C. Balcomb. 1992. Cetacean distribution and abundance of Oregon and Washington, 1989-1990. Pp. 1-100, In Brueggeman (ed.), Oregon and Washington Marine Mammal and Seabird Surveys. Final Rep. OCS Study MMS 91-0093.

Hall, J. D. 1981. Aspects of the natural history of cetaceans of Prince William Sound, Alaska. Ph.D. dissertation. University of California Santa Cruz. 101 pp.

Heise, K., G. Ellis, and C. Matkin. 1991. A catalogue of Prince William Sound killer whales. North Gulf Oceanic Society, Homer, AK. Published for the National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115.

Heyning, J. E., and M. E. Dahlheim, 1993. How distinct are resident and transient whales? Abstract presented at the Tenth Biennial conference on the Biology of Marine Mammals, Galveston, Texas, 11-15 November, 1993.

Hoelzel, A. R. 1991. Analysis of regional mitochondrial DNA variation in the killer whale: implications for cetacean conservation. Rep. Int. Whal. Commn. (Special Issue 13): 225-233.

Hoelzel, A. R., and G. A. Dover. 1991. Genetic differentiation between sympatric killer whale populations. Heredity 66: 191-195.

Leatherwood, J. S., and M. E. Dahlheim. 1978. Worldwide distribution of pilot whales and killer whales. Naval Ocean Systems Center, Tech. Rep. 443:1-39.

Leatherwood, S., K. C. Balcomb III, C. O. Matkin, and G. Ellis. 1984. Killer whales (Orcinus orca) in southern Alaska. Hubbs Seaworld Research Institute Technical Report No.84-175. 54 pp.

Leatherwood, S., C. O. Matkin, J. D. Hall, and G. M. Ellis. 1990. Killer whales, Orcinus orca, photo-identified in Prince William Sound, Alaska 1976 to 1987. Can. Field Naturalist., 104: 362-371.

Matkin, C. O., G. M. Ellis, M. E. Dahlheim, and J. Zeh. 1994. Status of killer whales in Prince William Sound, 1985-1992. Pp. 141-162, In T. R. Loughlin (ed.), Marine Mammals and the Exxon Valdez. Academic Press, Inc., San Diego, CA.

Matkin, C. O., and E. L Saulitis. 1994. Killer whale (Orcinus orca) biology and management in Alaska. Marine Mammal Commission, Washington D.C., Contract #T75135023.

Mitchell, E. D. 1975. Report on the meeting on small cetaceans, Montreal, April 1-11,1974. J. Fish. Res. Bd. Can. 32:914-916.

National Marine Fisheries Service. In prep. Guidelines for Estimating Potential Biological Removals. U.S. Dep. Commer., NOAA Tech. Rep.

Olesiuk, P. F., M. A. Bigg, and G. M. Ellis. 1990. Life history and population dynamics of resident killer whales (Orcinus orca) in the coastal waters of British Columbia and Washington State. Report of the International Whaling Commn. (Special Issue 12):209-242.

Stevens, T. A., D. Duffield, E. Asper, K. Hewlett, A. Bolz, L. Gage, and G. Bossart. 1989. Preliminary findings of restriction fragment differences in mitochondrial DNA among killer whales (Orcinus orca). Can. J. Zool. 67:2592-2595.

Yano, K., and M. E. Dahlheim. 1994. Killer whale, Orcinus orca, depredation on longline catches of bottomfish in the southeastern Bering Sea and adjacent waters. Fish. Bull., U.S. 92:451463.

KILLER WHALE (Orcinus orca): Eastern North Pacific Transient Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Killer whales have been observed in all oceans and seas of the world (Leatherwood and Dahlheim 1978). Although reported from tropical and offshore waters, killer whales prefer the colder waters of both hemispheres, with greatest abundances found within 800 km of major continents (Mitchell 1975). In Alaskan waters, killer whales occur along the entire Alaskan coast from the Chukchi Sea, into the Bering Sea, along the Aleutian Islands, Gulf of Alaska, and into Southeast Alaska (Braham and Dahlheim 1982). Their occurrence has been well documented in British Columbia and inland waterways of Washington State (Bigg et al. 1990), and along the outer coasts of Washington, Oregon, and California (Barlow 1995, Forney et al. 1995). Seasonal and year-round occurrence has been noted for killer whales throughout Alaska (Braham and Dahlheim 1982) and in the intracoastal waterways of British Columbia and Washington State (Bigg et al. 1990). Through examination of photographs of recognizable individuals and pods, movements of whales between geographical areas have been documented. For example, whales identified in Prince William Sound have been observed near Kodiak Island (Heise et al. 1991, Dahlheim et al. in prep. a): whales identified in Southeast Alaska have been observed in Prince William Sound, British Columbia, and Puget Sound (Leatherwood et al. 1990, Dahlheim et al. in prep. a, Dahlheim et al. in prep. b). Movements of killer whales between Southeast Alaska and off central California have also been documented (Goley and Straley 1994).

Killer whales along British Columbia and Washington State have been labeled as resident and transient (Bigg et al. 1990). Although less is known about killer whales in Alaska, it appears from a preliminary examination of data that both forms also exist in these waters. The two sympatric forms are believed to differ in several aspects of morphology, ecology, and behavior; that is, dorsal fin shape, saddle patch shape, pod size, home range size, diet, travel routes, dive duration, social integrity of pods. For example, in Pacific Northwest waters, significant differences occur in call repertoires (Ford and Fisher 1982), saddle patch pigmentation (Baird and Stacey 1988), and diet (Baird et al. 1992). Studies on mtDNA restriction patterns provide evidence that the resident and transient pods are genetically distinct (Stevens et al. 1989, Hoelzel 1991, Hoelzel and Dover 1991). Using such information, Matkin and Saulitis (1994) proposed 8 provisional killer whale stocks in the eastern North Pacific. However, in reviewing the discreetness of all the characteristics proposed to separate the two forms, Heyning and Dahlheim (1993) concluded that other than saddle patch pigmentation and genetic studies, most information is preliminary, lacks critical statistical evaluation, and is thus equivocal. Following the phylogeographic approach to classify stock structure (Dizon et al. 1992), killer whales occurring from Alaska to the inland waters of Washington State (east of Cape Flattery) represent 2 separate stocks, resident and transient, based primarily on genetic differences. Killer whales in waters south of Cape Flattery along the U.S. West Coast are considered a separate stock (see Assessment Reports for the Pacific Region, available upon request from J. Barlow, Southwest Fisheries Science Center, P.O. Box 271, LaJolla, CA 92038).

POPULATION SIZE

In the late 1970s, researchers began collecting identification photographs of killer whales in Prince William Sound, Alaska (Hall 1981). The whales were assigned to pods in 1984 (Leatherwood et al. 1984) which resulted in the first catalogue of Prince William Sound killer whales being produced (Ellis 1984). The catalogue was updated in 1987 (Ellis 1987) and again in 1991 (Heise et al. 1991). In 1984, photographic studies on killer whales were also initiated in Southeast Alaska (Leatherwood et al. 1984) with photographs of individual killer whales from Southeast Alaska also included in Ellis (1984, 1987). Although opportunistic photographs of killer whales were collected between the years 1985 through 1988 (Prince William Sound and Southeast Alaska), photo-identification research was limited in both areas. Beginning in 1989, dedicated killer whale photo-identification studies were initiated by the National Marine Mammal Laboratory, primarily in Southeast Alaska.

Preliminary analysis of photographic data have resulted in the following minimum counts for Alaskan killer whales (Note: individual whales have been matched between geographical regions and missing animals likely to be dead have been subtracted). Based on data collected from Seward, Alaska, west to Kodiak Island, then westward along the Alaska Peninsula into the southeastern Bering Sea to include the eastern Aleutian Islands (Dahlheim and Waite 1993, Dahlheim 1994, Dahlheim in prep., Dahlheim in prep. a), 277 individual whales have been identified. In Prince William Sound, 310 whales have been identified (Leatherwood et al. 1990, Heise et al. 1991, Dahlheim in prep. a). For Southeast Alaska, 259 whales have been identified (Dahlheim and Waite 1993, Dahlheim 1994, and Dahlheim in prep. b). Combining these counts gives a total for Alaskan waters of 846 (277 + 310 + 259) whales. For the inland waters, only, of Washington State, 158 killer whales have been documented (Ford et al. 1994). Minor adjustments to counts will be made based on final analysis: for example, a relatively small number of internal matches between Washington State and Alaska (<10 whales) could decrease counts. Thus, the estimated abundance of killer whales in Alaska and the inland waters of Washington State is 1,004 (846 + 158) (Dahlheim in prep. a), with approximately 245 (24.4%) identified as transients. The distinction between resident and transient whales was based primarily on genetics and saddle patch shape, and the morphological, ecological, and behavioral characteristics presented above. An estimate of the abundance of transient whales that have only been observed in Canada is not currently available.

Minimum Population Estimate

The survey technique utilized for obtaining the abundance estimate of killer whales is a direct count, and a correction factor is currently unavailable. Given that researchers continue to identify new whales, the estimate of abundance based on the number of uniquely identified individuals known to be alive is likely conservative. Additional estimates of the overall population size (i.e., N,,) and associated coefficient of variation (CV) are not currently available. Thus, the minimum population estimate (N_{MIN}) for the transient stock of killer whales is 245.

Current Population Trend

At present, reliable data on trends in population abundance for this stock of killer whales are unavailable.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currenty unavailable for this stock of killer whales. Olesiuk et al. 1990, studied a resident population of killer whales in the coastal waters of British Columbia and Washington State, and estimated the population was below carrying capacity and grew at 2.92% from 1973-87. However, a population increases at the maximum growth rate (R_{MAX}) when the population is at extremely low levels; thus, the estimate of 2.92% is not an estimate of R,. In addition, no reliable estimates of R_{MAX} are currently available for transient killer whales. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate (R_{MAX}) of 4% be employed for this stock (NMFS in prep.).

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 cetacean stocks with unknown population status (NMFS in prep.). Thus, for this stock PBR = (245 x 0.02 x 0.5), or 2.4 animals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

NMFS observers monitored incidental take on 6 different fisheries that could have interacted with killer whales during 1990-93: The Bering Sea (and Aleutian Islands) and Gulf of Alaska groundfish trawl, longline, and pot fisheries. The only fishery for which incidental kill was observed was the Bering Sea/Gulf of Alaska groundfish fishery, with 2 mortalities observed in 4 gears. This mortalityresulted in a mean annual mortality rate of 0.8. Fishing effort (based on total tons of fish caught) was 1.84 million tons, observer coverage (defined as the percentage of effort observed) was 64%, and incidental catch rate (defined as the number of observed dead in the catch divided by the observed effort (tons) multiplied by 10^{-4}) was 0.0043 (CV=0.42). Observers did not report any mortality of killer whales incidental to commercial fisheries in Washington State during the same 1990-93 time period.

An additional source of information on the number of killer whales killed or injured incidental to commercial fishery operations is the logbook reports maintained by boat operators required by the MMPA interim exemption program. During the 3-year period between 1990-92, logbook reports, where observer data were not available, indicated no injuries or mortalities from gear interactions; no injuries or mortalities due to illegal deterrence were reported.

The estimated mortality rate incidental to commercial fisheries recently monitored is approximately 0.8 animals per year, based on observer data (0.8) and logbook data (0) where observer data were not available. Mortalities incidental to commercial fisheries have not been identified as either resident or transient killer whales. At present the estimated annual mortality level (0.8) is greater than 10% of the PBR (i.e., 0.2; therefore, mortality incidental to commercial fishing in not considered insignificant for this stock.

Other Mortality

Since 1986, research efforts have been made to assess the nature and magnitude of killer whale/blackcod (sablefish; Anoplopoma fimbria) interactions (Dahlheim 1988, Yano and Dahlheim 1994). Fishery interactions have occurred each year in the Bering Sea and Prince William Sound, with the number of annual reports varying considerably. Data collected from the Japan/U.S. cooperative longline research surveys operating in the Bering Sea indicate that interactions may be increasing and expanding into the Aleutian Island region (Yano and Dahlheim 1994). During 1991 surveys conducted in the Bering Sea and near Kodiak Island, 5 of 12 (42%) pods encountered had evidence of bullet wounds (Dahlheim and Waite 1993). The relationship between wounding due to shooting and survival is unknown. In Prince William Sound, the pod responsible for most of the fishery interactions has experienced a high level of mortality: between 1986-91,22 whales out of a pod of 37 (59%) are missing and considered dead (Matkin et al. 1994). The cause of death for these whales is unknown, but likely related to gunshot wounds or effects of the Exxon Valdez oil spill (Dahlheim,and Matkin 1994).

STATUS OF STOCK

The estimated annual level of human-caused mortality and serious injury of 0.8 animals per year does not exceed the PBR (2.4), thus the transient stock of killer whales is not classified as a strategic stock.

REFERENCES

Baird, R. W., and P. J. Stacey. 1988. Variation in saddle patch pigmentation in populations of killer whales (Orcinus orca) from British Columbia, Alaska, and Washington State. Can. J. Zool. 66 (11):2582-2585.

Baird, R. W., Abrams, P. A., and L. M. Dill. 1992. Possible indirect interactions between transient and resident killer whales: implications for the evolution of foraging specializations in the genus Orcinus. Oecologia 89: 125-132.

Barlow, J. 1995. The abundance of cetaceans in California waters. Part I: Ship surveys in summer and fall of 1991. Fish. Bull., U.S. 93:1-14.

Bigg, M. A., P. F. Olesiuk, G. M. Ellis, J. K. B. Ford, and K. C. Balcomb III. 1990. Social organization and genealogy of resident killer whales (Orcinus orca) in the coastal waters of British Columbia and Washington State. Pp. 386-406, In P.S. Hammond, S.A. Mizroch, and G.P. Donovan (eds.), Individual recognition of cetaceans: use of photo-identification and other techniques to estimate population parameters. Rep. Int. Whal. Commn. (Special Issue 12).

Braham, H. W., and M. E. Dahlheim. 1982. Killer whales in Alaska documented in the Platforms of Opportunity Program. Rep. Int. Whal. Commn. 32:643-646.

Dahlheim, M. E. 1988. Killer whale (Orcinus orca) depredation on longline catches of sablefish (Anoplopoma fimbria) in Alaskan waters. NWAFC Processed Rep. 88-14, 31 pp. (available upon request- Alaska Fisheries Science Center, 7600 Sand Point Way, NE, Seattle, WA 98 115).

Dahlheim, M. E. 1994. Abundance and distribution of killer whales (Orcinus orca) in Alaska in 1993. Annual report to the MMPA Assessment Program, Office of Protected Resources, NMFS, NOAA, 1335 East-West Highway, Silver Spring, MD 20910.

Dahlheim, M. E. In press. A photographic catalogue of killer whales observed from the Central Gulf of Alaska to the southeastern Bering Sea. U.S. Dep. Commer., NOAA Tech. Rep.

Dahlheim, M. E., and J. M. Waite. 1993. Abundance and distribution of killer whales (Orcinus orca) in Alaska in 1992. Annual report to the MMPA Assessment Program Office of Protected Resources, NMFS, NOAA, 1335 East-West Highway, Silver Spring, MD 20910.

Dahlheim, M. E., and C. O. Matkin. 1994. Assessment of injuries to Prince William Sound killer whales. Pp. 163-171, In T. R. Loughlin (ed.), Marine Mammals and the Exxon Valdez. Academic Press, Inc., San Diego, CA.

Dahlheim M. E., J. Laake, and A. York. In prep. a. Killer whales of Alaska: Abundance and distribution. (available upon request- Alaska Fisheries Science Center, 7600 Sand Point Way, NE, Seattle, WA 98115).

Dahlheh M. E., D. Ellifiit, and J. Swenson. In prep. b. A catalogue of Southeast Alaskan killer whales. (available upon request- Alaska Fisheries Science Center, 7600 Sand Point Way, NE, Seattle, WA 98115).

Dizon, A. E., C. Lockyer, W. F. Perrin, D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 6:24-36.

Ellis, G. M. 1984. Killer whales of Southern Alaska, a catalogue of individuals photo-identified in 1984. San Diego. Hubbs Sea World Research Institute Tech. Rep. No. 84-176. 73 pp.

Ellis, G. M. 1987. Killer whales of Prince William Sound and Southeast Alaska a catalogue of individuals photo-identified, 1976-1986. San Diego. Hubbs Sea World Research Institute Tech. Rep. No. 87-200. 76 pp.

Ford, J. K. B., and H. D. Fisher. 1982. Killer whale (Orcinus orca) dialects as an indicator of stocks in British Columbia. Rep. Int. Whal. Commn. 32:671-679.

Ford, J. K. B., G. Ellis, and K. C. Balcomb. 1994. Killer whales: the natural history and genealogy of Orcinus orca in British Columbia and Washington State. University of British Columbia Press and University of Washington Press. 102 pp.

Forney, K. A., J. Barlow, and J. V. Carretta. 1995. The abundance of cetaceans in California waters. Part II: Aerial surveys in winter and spring of 1991 and 1992. Fish. Bull., U.S. 93:15-26.

Goley, P. D, and J. M. Straley. 1994. Attack on gray whales (Eschrichtius robustus) in Monterey Bay, California, by killer whales (Orcinus orca) previously identified in Glacier Bay, Alaska. Can. J. Zool. 72:1528-1530.

Hall, J. D. 1981. Aspects of the natural history of cetaceans of Prince William Sound, Alaska. Ph.D. dissertation. University of California Santa Cruz. 101 pp.

Heise, K., G. Ellis, and C. Matkin. 1991. A catalogue of Prince William Sound killer whales. North Gulf Oceanic Society, Homer, AK. Published for the National Marine Mammal Laboratory, 7600 Sand Point Way NE; Seattle, WA 98115.

Heyning, J. E., and M. E. Dahlheim, 1993. How distinct are resident and transient whales? Abstract presented at the Tenth Biennial Conference on the Biology of Marine Mammals, Galveston, Texas, 11-15 November, 1993.

Hoelzel, A. R. 1991. Analysis of regional mitochondrial DNA variation in the killer whale; implications for cetacean conservation. Rep. Int. Whal. Commn. (Special Issue 13): 225-233.

Hoelzel, A. R, and G. A. Dover. 1991. Genetic differentiation between sympatric killer whale populations. Heredity 66: 191-195.

Leatherwood, J. S., and M. E. Dahlheim. 1978. Worldwide distribution of pilot whales and killer whales. Naval Ocean Systems Center, Tech. Rep. 443:1-39.

Ieatherwood, S., K. C. Balcomb III, C. O. Matkin, and G. Ellis. 1984. Killer whales (Orcinus orca) in southern Alaska. Hubbs Seaworld Research Institute Tech. Rep. No.84-175. 54 pp.

Leatherwood, S., C. O. Matkin, J. D. Hall, and G. M. Ellis. 1990. Killer whales, Orcinus orca, photo-identified in Prince William Sound, Alaska 1976 to 1987. Can. Field Naturalist 104: 362-371.

Matkin, C. O., G. M. Ellis, M. E. Dahlheim, and J. Zeh. 1994. Status of Killer Whales in Prince William Sound, 1985-1992. Pp. 141-162, In T.R. Laughlin (ed.), Marine Mammals and the Exxon Valdez. Academic Press, Inc., San Diego, CA.

Matkin, C. O., and E. L. Saulitis. 1994. Killer whale (Orcinus orca) biology and management in Alaska. Marine Mammal Commission, Washington D.C., Contract #T75135023.

Mitchell, E. D. 1975. Report on the meeting on small cetaceans, Montreal, April 1-11, 1974. J. Fish. Res. Bd. Can. 32:914-916.

National Marine Fisheries Service. In prep. Guidelines for Estimating Potential Biological Removals. U.S. Dep. Commer., NOAA Tech. Rep.

Olesiuk, P. F., M. A. Bigg, and G. M. Ellis. 1990. Life history and population dynamics of resident killer whales (Orcinus orca) in the coastal waters of British Columbia and Washington State. Report of the International Whaling Commn. (Special Issue 12):209-242.

Stevens, T. A., D. Duffield, E. Asper, K. Hewlett, A. Bolz, L. Gage, and G. Bossart. 1989. Preliminary findings of restriction fragment differences in mitochondrial DNA among killer whales (Orcinus orca). Can. J. Zool. 67:2592-2595.

Yano, K., and M. E. Dahlheim. 1994. Killer whale, Orcinus orca, depredation on longline catches of bottomfish in the southeastern Bering Sea and adjacent waters. Fish. Bull., U.S. 92:451-463.

PACIFIC WHITE-SIDED DOLPHIN (Lagenorhynchus obliquidens): Central North Pacific Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The Pacific white-sided dolphin is found throughout the temperate North Pacific Ocean north of the coasts of Japan and Baja California, Mexico, and is common both on the high seas and along the continental margins. The following information was considered in classifying Pacific white-sided dolphin stock structure based on the Dizon et al. (1992) phylogeographic approach: (1) Distributional data: geographic distribution discontinuous; (2) Population response data: unknown; (3) Phenotypic data: two morphological forms recognized (Walker et al. 1986, Chivers et al. 1993); and (4) Genotypic data: preliminary genetic analyses underway (NMFS, unpubl. data, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98115). Based on this limited information, stock structure throughout the North Pacific is poorly understood, yet the northern form occurs north of about 33°N from southern California to Alaska, whereas the southern form ranges from about 36°N southward along the coasts of California and Baja California. These two forms can not, however, currently be differentiated for abundance and mortality estimation, and are thus managed together. Because the California drift gillnet fisheries operate between 33°N and 45°N, two stocks are recognized: 1) California/Oregon/Washington stock, and 2) the central North Pacific stock.

POPULATION SIZE

The most recent population abundance estimate for Pacific white-sided dolphins was calculated by Buckland et al. (1993) from line transect analyses applied to the 1987-90 central North Pacific marine mammal sightings survey data. Their abundance estimate was 931,000 (CV=0.900, 95% CI 206,000-4,216,000) animals, after a regression adjustment for size-biased sampling of schools. It should be noted, however, that Buckland et al. (1993) suggested that Pacific white-sided dolphins show strong vessel attraction, based on a high concentration of sightings close to the trackline during sampling. A correction factor has not yet been estimated for such vessel attraction behavior for Pacific white-sided dolphins, yet it may be more extreme than the 0.2 determined for Dall’s porpoise (Phocoenoides dalli); that is,, abundance estimates may be biased upwards by more than five-fold.

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock is calculated from equation 1 from the PBR Guidelines (NMFS in prep.): $N_{MIN} = N/exp(0.S42*[ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 931,000 and its associated CV of 0.900, N_{MIN} for the North Pacific stock of Pacific white-sided dolphin is 486,719.

Current Population Trend

At present, there is no reliable information on trends in abundance for this stock of Pacific white-sided dolphin.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is not currently available for the central North Pacific stock of Pacific white-sided dolphin. Thus, it is recommended that the cetacean maximum net productivity rate (R,) of 4% be employed for this stock at this time (NMFS in prep.).

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 cetacean stocks ofunknown status (NMFS in prep.). Thus, for this stock of Pacific white-sided dolphin PBR = (486,719 x 0.02 x 0.5), or 4.867 animals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS IN JURY

Fisheries Information

Between 1978 and 1991, thousands of Pacific white-sided dolphins were killed annually incidental to high seas fisheries; however, since 1991 these fisheries have not operated in the central north Pacific. NMFS observers monitored incidental take on 6 different fisheries that could have interacted with Pacific white-sided dolphins during 1990-93: The Bering Sea (and Aleutian Islands) and Gulf of Alaska groundfish trawl, longline, and pot fisheries. The only fishery for which incidental kill was observed was the Bering Sea groundfish fishery, with 1 mortality observed in all 4 years. This mortalityresulted in a mean annual (total) mortality <l (CV=0.60). Fishing effort (based on total metric tons of fish caught) was 1.84 million tons, observer coverage (defined as the percentage of effort observed) was 64%, and incidental catch rate (defined as the number of observed dead in the catch divided by the observed effort (tons) multiplied by 103 was 0.0021 (CV=0.62).

An additional source of information on the number of Pacific white-sided dolphins killed or injured incidental to commercial fishery operations is the logbook reports maintained by boat operators required by the MMPA interim exemption program. During the 3-year period between 1990-92, logbook reports, where observer data were not available, indicated 1 injury and 2 mortalities from gear interactions; no injuries or mortalities due to deterrence were reported. However, because logbook records are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. The injury and mortalities occurred in the Copper River and Bering River salmon drift gillnet and the Southeast Alaska salmon drift gillnet.

The estimated annual mortality rate incidental to commercial fisheries (1.1; based on observer data (0.4) and logbook reports (0.7) where observer data were not available) is less than 10% of the PBR (487) and, therefore, is considered insignificant and approaching a zero mortality and serious injury rate.

STATUS OF STOCK

The level of human-caused mortality and serious injury (0.9) does not exceed the PBR (4,867), thus the North Pacific stock of the Pacific white-sided dolphin is not classified as a strategic stock.

REFERENCES

Buckland, S.T., K.L Cattanach, and R.C. Hobbs. 1993. Abundance estimates of Pacific white sided dolphin, northern right whale dolphin Dall's porpoise and northern fur seal in the North Pacific, 1987/90. Pp. 387407, In W. Shaw, R. L. Burgner, and J. Ito (eds.), Biology, Distribution and Stock Assessment of Species Caught in the High Seas Driftnet Fisheries in the North Pacific Ocean. Intl. North Pac. Fish. Comm. Symposium: 4-6 November 1991, Tokyo, Japan.

Chivers, S. J., K. M. Peltier, W. T. Norman, P. A, Akin, and J. Heyning. 1993. Population structure of cetaceans in California coastal waters. Paper SOCCS9 presented at the Status of California Cetacean Stocks Workshop, held in La Jolla, California, March 31-April 2,1993.49 pp.

Credle, V. R., D. P. DeMaster, M. M. Merklein, M. B. Hanson, W. A. Karp, and S. M. Fitzgerald (eds.). 1994. NMFS observer programs: minutes and recommendations from a workshop held in Galveston, Texas, November 10-11, 1993. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-94-1,96 pp.

Dizon, A. E., C. Lockyer, W. F. Perrin, D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 6:24-36.

National Marine Fisheries Service. In prep. Guidelines for Estimating Potential Biological Removals. U.S. Dep. Commer., NOAA Tech. Rep.

Walker, W. A., S. Leatherwood, K. R. Goodrich, W. F. Pen-in, and R. K. Stroud. 1986. Geographical variation and biology of the Pacific white-sided dolphin, Lagenorhynchus obliquidens, in the north-eastern Pacific. Pp. 441-465, In M.M. Bryden and R. Harrison (eds.), Research on Dolphins, Clarendon Press, Oxford.

HARBOR PORPOISE (*Phocoena phocoena*): Alaska Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

In the eastern North Pacific Ocean, the harbor porpoise ranges from Point Barrow, along the Alaskan coast, and down the West Coast of North America to southern California (Gaskin 1984). The harbor porpoise is basically an inshore species, frequenting coastal waters and the mouths of large rivers, harbors, and bays, sometimes ascending freshwater streams. Relatively high densities of harbor porpoise have been recorded along the coasts of Washington, and Northern Oregon and California; yet, distinct seasonal changes in abundance in these areas have been noted, possibly due to a shift in distribution to deeper offshore waters during winter (Barlow 1987, Dohl et al. 1983). Research to examine the genetic structure of harbor porpoise in the northeast Pacific was conducted in 1991-93 using mitochondrial DNA. Preliminary results showed that all 9 samples from Alaska waters fell within one of two major clades found among all northeast Pacific samples (Rosel et al. in press). However, the study was not designed to investigate the genetic structure of harbor porpoise within Alaska, and therefore it is not possible to draw conclusions about stock structure in Alaska from this analysis. Additional Alaska samples are currently being analyzed. For the eastern North Pacific, Gaskin (1984) proposed two putative stocks: Bering Sea and Gulf of Alaska, but this recommendation was based primarily on habitat differences between the two areas, and the Alaska Peninsula as a geographic barrier. Thus, until further research is conducted, a single stock is defined for Alaska waters, which is distinct from the stocks defined along the Pacific coast of the continental U.S.

POPULATION SIZE

The first systematic surveys of harbor porpoise in Alaska were conducted in 1991 (Dahlheim et al. 1992), 1992 (Dahlheim et al. 1993), and 1993 (Dahlheim et al. 1994). Three vessel surveys in the spring, summer, and fall of each year were performed in the inside waters of Southeast Alaska, with abundance estimates relatively similar in each year. Aerial surveys were conducted in different regions outside of Southeast Alaska for each of the 3 years. The abundance estimate from the 1993 vessel survey and all aerial surveys was 10,526 (1,586 + 8,940) harbor porpoise (Table 1).

TABLE 1. Abundance estimates for harbor porpoise in Alaska, based on surveys conducted from 1991-93.

Survey Type and Area	Year Surveyed	Abundance Estimate	CV (%)	Corrected Estimate
Aerial				
Bristol Bay	1991	3,531	23.8	10,946
Cook Inlet	1991	136	63.2	422
Kodiak	1992	740	33.9	2,294
Alaska Peninsula, south side	1992	551	12.2	1,708
Prince William Sound to Dixon Entrance	1993	3,982	18.7	12,344
Total Vessel		8,940	12.9	27,714
Southeast Alaska	1993	1,586	39.2	2,030

Dahlheim et al. in prep). The 1993 vessel survey was used because it was conducted within a few weeks of the Southeast

Alaska aerial survey. Correction factors for aerial surveys of harbor porpoise have been estimated at 3.1 (CV=0.171) (Calambokidis et al. 1993) from Puget Sound, Washington, and 3.2 (Barlow 1988) from the continental West Coast of the U.S. Both estimates are considered conservative for the Alaskan surveys based on differences in survey conditions: the 3.1 estimate was employed. Correction factors for vessel surveys along the continental U.S. was estimated at 1.28 (SE=0.117) by Barlow (1988), and 1.9 (CV=0.142) from vessel surveys in the Gulf of Maine (Palka, pers. comm., Northeast Fisheries Science Center, P.O. Box 314, Woods, Hole, MA 02543). The estimate from the Pacific surveys is more applicable to the Alaskan surveys, and more conservative, thus it was employed. The total corrected abundance estimate from aerial surveys of 27,714 (8,940 x 3.1) (CV=0.215) plus the corrected abundance estimate from vessel surveys of 2,030 (1,586 x 1.28) (CV=0.404) equals a total corrected abundance estimate of 29,744. This should be considered a minimum estimate because survey effort did not include the Aleutian Islands and the Bering Sea. No reliable abundance estimates for British Columbia are currently available.

Minimum Population Estimate

For the Alaska stock of harbor porpoise, the minimum population estimates (N_{MIN}) for the aerial and vessel surveys are calculated separately, using equation 1 from the PBR Guidelines (NMFS in prep.): $N_{MIN} = N/\exp(0.842*[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimates (N) of 27,714 and 2,030 and their associated CVs (0.215 and 0.404, respectively), N_{MIN} for this stock is 24,635.

Current Population Trend

At present, there is no reliable information on trends in abundance for the Alaska stock of harbor porpoise.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

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 cetacean stocks with unknown population status (NMFS in prep.). Thus, for the Alaska stock of harbor porpoise, PBR = (24,635 x 0.02 x 0.5), or 246 animals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

NMFS observers monitored incidental take on 6 different fisheries within the range of the Alaska stock of harbor porpoise during 1990-93: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries, and Gulf of Alaska groundfish trawl, longline, and pot fisheries. No incidental mortality was observed in these fisheries, though 1 mortality and 1 injury was reported in logbook records during 1990 (see below). NMFS fishery observers in the Prince William Sound salmon drift gillnet fishery recorded 1 incidental take in 1990, and 3 incidental kills in 1991. Incidental mortality occurred in fewer than 0.03% of observed sets for both years. Extrapolated to the entire fleet, the estimated annual mortality was 7.5 (95% CI 0-22.1) in 1990 (Wynne et al. 1991), and 32.1(95% CI 3-103) in 1991 (Wynne et al. 1992), for an average annual rate of 20 for both years. NMFS observers have not participated in this fishery since 1991; therefore, no additional data are available.

An additional source of information on the number of harbor porpoise killed or injured incidental to commercial fishery operations is the logbook reports maintained by boat operators as required by the MMPA interim exemption program. During the 3-year period between 1990-92, logbook reports, where observer data were not available, indicated an annual mean of 5 injuries and 12 mortalities from interactions with fishing operations, with an additional 1 injury and 0.7 mortalities due to illegal deterrence. However, because logbook records are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. These estimates are based on all available logbook reports, except the Prince William Sound gillnet fishery for which observer data were presented above. The fisheries for which the majority of the incidental take occurred were the salmon gillnet fisheries in Southeast Alaska, Copper and Bering River district, Kodiak, and Alaska Peninsula.

The estimated annual mortality rate incidental to commercial fisheries (33; based on observer data (20) and logbook reports (13) where observer data were not available) is greater than 10% of the PBR (25) and, therefore, can not be considered insignificant.

Subsistence/Native Harvest Information

There are no reports of subsistence take of harbor porpoise in Alaska.

STATUS OF STOCK

The lack of surveys in a significant portion of this stock's range results in a conservative PBR, and logbook records are most likely negatively biased (Credle et al. 1994) resulting in an underestimate of incidental kill. Yet, based on the best scientific information available, the estimated level of human-caused mortality and serious injury (33) does not exceed the PBR (246), thus the Alaska stock or harbor porpoise is not classified as a strategic stock.

REFERENCES

Barlow, J. 1987. Abundance estimation for harbor porpoise Phocoena phocoena based on ship surveys along the coasts of California, Oregon and Washington. Southwest Fish. Sci. Cent. Admin. Report LJ-86-05. (available upon request- SWFSC, P.O. Box 271, La Jolla, CA 92038).

Barlow, J. 1988. Harbor porpoise, Phocoena phocoena, abundance estimation for California, Oregon, and Washington: I. Ship surveys. Fish. Bull., U.S. 86:417432.

Barlow, J., C. W. Oliver, T. D. Jackson, and B. L. Taylor. 1988. Harbor porpoise, Phocoena phocoena, abundance estimation for California, Oregon, and Washington: II. Aerial surveys. Fish. Bull., U.S. 86:4334l4.

Calambokidis, J., J. R Evenson, J. C. Cubbage, S. D. Osmek, D. Rugh, and J. L. Laake. 1993. Calibration of sighting rates of harbor porpoise from aerial surveys. Final report to the National Marine Mammal Laboratory, AFSC, NMFS, NOAA, 7600 Sand Point Way, NE, Seattle, WA 98115.55 pp.

Credle, V. R., D. P. DeMaster, M. M. Merklein, M. B. Hanson, W. A. Karp, and S. M. Fitzgerald (eds.). 1994. NMFS observer programs: minutes and recommendations from a workshop held in Galveston, Texas, November 10-11, 1993. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-94-1, 96 pp.

Dahlheim, M., A. York, J. Waite, and C. Goebel-Diaz. 1992. Abundance and distribution of harbor porpoise (Phocoena phocoena) in Southeast Alaska, Cook Inlet and Bristol Bay. Annual report to the MMPA Assessment Program, Office of Protected Resources, NMFS, NOAA, 1335 East-West Highway, Silver Spring, MD 20910.

Dahlheim, M., A. York, J. Waite, and R. Towell. 1993. Abundance and distribution of harbor porpoise (Phocoena phocoena) in Southeast Alaska, Kodiak Island, and the south side of the Alaska Peninsula, 1992. Annual report to the MMPA Assessment Program, Office of Protected Resources, NMFS, NOAA, 1335 East-West Highway, Silver Spring, MD 20910.

Dahlheim, M., A. York, J. Waite, and R. Towell. 1994. Abundance and distribution of harbor porpoise (Phocoena phocoena) in Southeast Alaska and the offshore waters of Dixon Entrance to Prince William Sound, 1993. Annual report to the MMPA Assessment Program, Office of Protected Resources, NMFS, NOAA, 1335 East-West Highway, Silver Spring, MD 20910.

Dahlheim, M., A. York, J. Waite, and R. Towell. In prep. Abundance and distribution of harbor porpoise (Phocoena phocoena) in Alaska based on aerial surveys: Bristol Bay to Southeast Alaska. (available upon request- Alaska Fisheries Science Center, 7600 Sand Point Way, NE, Seattle, WA 98115).

Dohl, T. P., R. C. Guess, M. L. Duman, and R. C. Helm. 1983. Cetaceans of central and northern California, 1980-1983: Status, abundance, and distribution. OCS study MMS 84-0045. Pacific OCS Region Minerals Management Service, 1340 Sixth Street, Los Angeles, CA 90014.284 pp.

Gaskin, D. E. 1984. The harbour porpoise (Phocoena phocoena) (L.): Regional populations, status, and information on direct and indirect catches. Rep. Int. Whal. Commn. 34:569-586.

National Marine Fisheries Service. In prep. Guidelines for Estimating Potential Biological Removals. U.S. Dep. Commer., NOAA Tech. Rep.

Rosel, PE., AE. Dizon, and M.G. Haygood. In press. Variability of the mitochondrial control region in populations of the harbour porpoise, Phocoena phocoena, on inter-oceanic and regional scales. Can J. Fish. Aquat Sci.

Wynne, K M., D. Hicks, and N. Munro. 1991. 1990 salmon gillnet fisheries observer programs in Prince William Sound and South Unimak Alaska. Annual Rept. NMFS/NOAA Contract 50ABNF000036. 65 pp. (available upon request- Alaska Region, Office of Marine Mammals, P.O. Box 21668, Juneau, AK 99802).

Wynne, K. M., D. Hicks, and N. Munro. 1992. 1991 Marine mammal observer program for the salmon driftnet fishery of Prince William Sound Alaska. Annual Rept. NMFS/NOAA Contract 50ABNF000036. 53 pp. (available upon request- Alaska Region, Office of Marine Mammals, P.O. Box 21668, Juneau, AK 99802).

DALL'S PORPOISE (*Phocoenoides dalli*): Alaska Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Dali's porpoise are widely distributed across the entire North Pacific Ocean. They are found over the continental shelf adjacent to the slope and over deep (2,500+ m) oceanic waters (Hall 1979). They have been sighted throughout the North Pacific as far north as 65°N (Buckland et al. 1993), and as far south as 28°N in the eastern North Pacific (Leatherwood and Fielding 1974). The only apparent distribution gaps in Alaskan waters are upper Cook Inlet and the shallow eastern flats of the Bering Sea. Throughout most of the eastern North Pacific they are present during all months of the year, although there may be seasonal onshore-offshore movements along the West Coast of the U.S. (Loeb 1972, Leatherwood and Fielding 1974), and winter movements of populations out of Prince William Sound (Hall 1979) and areas in the Gulf of Alaska and Bering Sea (NMFS unpubl. data, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98115).

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: (1) Distributional data: geographic distribution continuous, (2) Population response data: differential tuning of reproduction between the Bering Sea and western North Pacific; (3) Phenotypic data: unknown; and (4) Genotypic data unknown. The stock structure of eastern North Pacific Dall's porpoise is not adequately understood at this time, 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). Based primarily on the population response data, a delineation between Bering Sea and western North Pacific stocks has been recognized (Jones et al. 1986). However, similar data are not available for the eastern North Pacific, thus one stock of Dali's porpoise is recommended for Alaskan waters. Porpoise along the coast of the continental U.S. from California to Washington comprise a separate stock and are reported separately in the Status Assessment Reports for the Pacific Region.

POPULATION SIZE

Data collected from vessel surveys, performed by both U.S. fishery observers and U.S. scientists from 1987-91, were analyzed to provide population estimates of Dali's porpoise throughout the North Pacific and the Bering Sea (Hobbs and Lerczak 1993). The quality of data used in analyses was determined by the procedures recommended by Boucher and Boaz (1989). Survey effort was not well distributed throughout the U.S. Exclusive Economic Zone (EEZ) in Alaska, and as a result, Bristol Bay and the north Bering Sea received little survey effort. only 3 sightings were reported in this area by Hobbs and Lerczak (1993), resulting in an estimate of 9,000 (CV=0.91). In the U.S. EEZ north and south of the Aleutian Islands, Hobbs and Lerczak (1993) reported an estimated abundance of 302,000 (CV=0.11), whereas for the Gulf of Alaska EEZ, they reported 106,000 (CV=0.20). Combining these three estimates results in an abundance estimate of 417,000 (9,000 + 302,000 + 106,000) (CV=0.0970) for the Alaska stock of Dali's porpoise. Turnock and Quinn (1991) estimate that abundance estimates of Dall's porpoise are inflated by as much as 5 times because of vessel attraction behavior. Therefore, a corrected population estimate is 83,400 (417,000 x 0.2) for this stock. No reliable abundance estimates for British Columbia are currently available.

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock is calculated from equation 1 from the PBR Guidelines (NMFS in prep.): $N_{MIN} = N/\exp(0.842*[\ln(l+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 83,400 and its associated CV of 0.0970, N_{MIN} for the Alaska stock of Dall's porpoise is 76,874.

Current Population Trend

At present, there is no reliable information on trends in abundance for the Alaska stock of Dall's porpoise.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate (R_{MAX}) of 4% be employed for the Alaska stock of Dall's porpoise (NMFS in prep.).

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. As this stock is considered to be within optimum sustainable population

(OSP) (Buckland et al. 1993), the recovery factor (F_R) for this stock is 1.00 (NMFS in prep.). Thus, for this stock of Dall's porpoise, PBR = (76,874 x 0.02 x l.00), or 1,537 animals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

NMFS observers monitored incidental take on 6 different fisheries within the range of the Alaska stock of Dall's porpoise during 1990-93: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries, and Gulf of Alaska groundfish trawl, longline, and pot fisheries. The mean annual (total) mortality was 5 (CV=0.18) for the Bering Sea groundfish trawl fishery, and 1 (CV=0.54) for the Gulf of Alaska groundfish trawl fishery. No Dall's porpoise mortality was observed by NMFS observers in the remaining 4 fisheries. Fishing effort (based on total metric tons of fish caught), observer coverage (defined as the percentage of effort observed), and incidental catch rate (defined as the number of observed dead in the catch divided by the observed effort (tons) multiplied by 10") was also estimated for those fisheries where incidental mortality occurred - Bering Sea groundfish trawl: effort=l.84 million tons, observer coverage=64%, and catch rate=0.0279 (CV=0.18); Gulf of Alaska groundfish trawl: effort=212,000 tons, observer coverage=42%, and catch rate=0.0282 (CV=0.76). The Prince William Sound driftnet fishery was monitored by observers during 1990 (Wynne et al. 1991) and 1991 (Wynne et al. 1992), with no incidental kill of Dall's porpoise reported. The Alaska Peninsula salmon driftnet fishery was monitored in 1990, with a reported annual (total) incidental mortality rate of 28 Dall's porpoise (K. Wynne unpubl. data, Univ. AK, 900 Trident Way, Kodiak, AK 99615).

An additional source of information on the number of Dall's porpoise killed or injured incidental to commercial fishery operations is the logbook reports maintained by boat operators as required by the MMPA interim exemption program. During the 3-year period between 1990-92, logbook reports, where observer data were not available, indicated an annual mean of 1 injury and 6 mortalities from interactions with fishing operations, with an additional 0 injuries and 0.7 mortalities due to illegal deterrence. However, because logbook records are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. These estimates are based on all available logbook reports for Alaska fisheries, except for which observer data were presented above. The fishery for which the majority of the incidental take occurred was the Southeast Alaska salmon drift gillnet fishery.

The estimated annual mortalityrate incidental to commercial fisheries (41; based on observer data (34; 5 + 1 + 28) and logbook reports (7) where observer data were not available) is less than 10% of the PBR (154) and, therefore, is considered insignificant and approaching a zero mortality and serious injury rate.

Subsistence/Native Harvest Information

No harvest of Dall's porpoise for subsistence purposes is known.

STATUS OF STOCK

The level of human-caused mortality and serious injury (41) does not exceed the PBR (1,537), thus the Alaska stock of Dall's porpoise is not classified as a strategic stock.

REFERENCES

Boucher, G.C., and C.J. Boaz. 1989. Documentation for the marine mammal sightings database of the National Marine Mammal Laboratory. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-159.60 pp.

Buckland, ST., K.L. Cattanach, and R.C. Hobbs. 1993. Abundance estimates of Pacific white sided dolphin, northern right whale dolphin Dall's porpoise and northern fur seal in the North Pacific, 1987/90. Pp. 387-407, In W. Shaw, R. L. Burgner, and J. Ito (eds.), Biology, Distribution and Stock Assessment of Species Caught in the High Seas Driftnet Fisheries in the North Pacific Ocean. Intl. North Pac. Fish. Comm. Symposium; 4-6 November 1991, Tokyo, Japan.

Credle, V. R., D. P. DeMaster, M. M. Merklein, M. B. Hanson, W. A. Karp, and S. M. Fitzgerald (eds.). 1994. NMFS observer programs: minutes and recommendations from a workshop held in Galveston, Texas, November 10-11, 1993. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-94-1, 96 pp.

Dizon, A. E., C. Lockyer, W. F. Perrin, D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 6:24-36.

Hall, J. 1979. A survey of cetaceans of Prince William Sound and adjacent waters - their numbers and seasonal movements. Unpubl. rep. to Alaska Outer Continental Shelf Environmental Assessment Programs. NOAA OCSEAP Juneau Project Office, Juneau, AR. 37 pp.

Hobbs, R C., and J. A. Lerczak. 1993. Abundance of Pacific white-sided dolphin and Dall's porpoise in Alaska estimated from sightings in the North Pacific Ocean and the Bering Sea during 1987 through 1991. Annual report to the MMPA Assessment Program, Office of Protected Resources, NMFS, NOAA, 1335 East-West Highway, Silver Spring, MD 20910.

Leatherwood, J. S., and M. R. Fielding. 1974. A survey of distribution and movements of Dall's porpoise, Phocoenoides dalli, off southern California and Baja California. Working paper No. 42, FAO, United Nations, ACMRR Mtg., La Jolla, CA

Loeb, V. J. 1972. A study of the distribution and feeding habits of the Dali's porpoise in Monterey Bay, CA. MA Thesis, San Jose State Univ., CA. 62 pp.

Jones, L. L., J.M. Breiwick, G.C. Bouchet, and B.J. Turnock. 1986. Untitled ms. Submitted as NOAA-2 in Docket #MMPAH - 1986-01 in Seattle Administrative building, 1986.

National Marine Fisheries Service. In prep. Guidelines for Estimating Potential Biological Removals. U.S. Dep. Commer., NOAA Tech. Rep.

Perrin, W.F., and R.L. Brownell, Jr. 1994. A brief review of stock identity in small marine cetaceans in relation to assessment of driftnet mortality in the North Pacific. Rep. Int. Whal. Commn. (Special Issue 15):393-401.

Turnock, B. J., and T. J. Quinn. 1991. The effect of responsive movement on abundance estimation using line transect sampling. Biometrics 47:701-715.

Wynne, K. M., D. Hicks, and N. Munro. 1991. 1990 salmon gillnet fisheries observer programs in Prince William Sound and South Unimak Alaska. Annual Rept. NMFS/NOAA Contract 50ABNF000036. 65 pp. NMFS, Alaska Region, Office of Marine Mammals, P.O. Box 21668, Juneau, AK 99802.

Wynne, K. M., D. Hicks, and N. Munro. 1992. 1991 Marine mammal observer program for the salmon driftnet fishery of Prince William Sound Alaska. Annual Rept. NMFS/NOAA Contract 50ABNF000036. 53 pp. NMFS, Alaska Region, Office of Marine Mammals, P.O. Box 21668, Juneau, AK 99802.

SPERM WHALE (*Physeter macrocephalus*): Alaska Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The sperm whale is one of the most widely distributed of any marine mammal species, perhaps only exceeded by the killer whale (Rice 1989). They feed primarily on medium- to large-sized squids but may also feed on large demersal and mesopelagic sharks, skates, and fishes (Gosho et al. 1984). In the eastern north Pacific, sperm whales are distributed widely. Females and young sperm whales usually remain in tropical and temperate waters year-round, while males move north in the summer to feed in the Gulf of Alaska, Bering Sea, and waters around the Aleutian Islands. In the winter, sperm whales are typically distributed south of 40°N.

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: (1) Distributional data: geographic distribution indicates three "somewhat" discrete population centers (i.e., Hawaii, West Coast of continental U.S., and Alaska): (2) Population response data: unknown: (3) Phenotypic data: unknown: and (4) Genotypic data: unknown. The International Whaling Commission (IWC) proposed two management stocks (eastern and western) in the North Pacific, but has not reviewed sperm whale stock boundaries in recent years (Donovan 1991). Based on this limited information, and lacking additional information on sperm whale population structure, three tentative stocks of sperm whales are proposed for the eastern North Pacific: l)Alaska, 2) California/Oregon/Washington, and 3) Hawaii.

POPULATION SIZE

The sperm whale is the most abundant species of the large whales (Braham 1992). The abundance of sperm whales in the North Pacific was reported by Rice (1989) to be 930,000 in the late 1970s and 1,260,000 prior to exploitation, for which 1979 was the final season for pelagic whaling: confidence intervals were not provided. These estimates include the California/Oregon/Washington stock, for which a separate abundance estimate is currently available (see Assessment Reports for the Pacific Region). As the data used in estimating the abundance of sperm whales in the entire North Pacific are well over 5-years old at this time and there are no available estimates for numbers of sperm whales in Alaskan waters, a reliable estimate of current abundance for the Alaskan stock is not available.

Minimum Population Estimate

At this time it is not possible to produce a reliable estimate of minimum abundance for this stock, as current estimates of abundance are not available.

Current Population Trend

Reliable information on trends in abundance for this stock are currently not available (Braham 1992).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

It is recommended that the cetacean maximum net productivity rate (R_{MAX}) of 4% be employed for this stock at this time (NMFS in prep.).

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 0.1, the value for cetacean stocks which are classified as endangered (NMFS in prep.). However, because a reliable estimate of minimum abundance N_{MIN} is currently not available, the PBR for this stock is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

There have been no observed reports of incidental mortality related to commercial fishery operations in the North Pacific in the last 5 years. Based on logbook reports maintained by boat operators required by the Marine Mammal Protection Act (MMPA) interim exemption program during the 3-year periodbetween 1990-92, no injuries or mortalities from gear interactions or illegal deterrence were reported.

Because the PBR for this stock is unknown, it is currently not possible to determine what annual mortality level is insignificant.

Subsistence/Native Harvest Information

Sperm whales have never been reported to be taken by subsistence hunters (Rice 1989).

STATUS OF STOCK

This stock is listed as endangered under the Endangered Species Act of 1973 and is, therefore, classified as a strategic stock. On the basis of total abundance, current distribution, and regulatory measures that are currently in place, it is unlikely that this stock is in danger of extinction or threatened with becoming endangered in the foreseeable future (Braham 1992).

REFERENCES

Braham, H. 1992. Endangered whales: Status update. Working document presented at A Workshop on the Status of California Cetacean Stocks (SOCCS/14). 35 pp. + tables. (available upon request- Alaska Fisheries Science Center, 7600 Sand Point Way, NE, Seattle, WA 98115).

Dizon, A. E., C. Lockyer, W. F. Perrin, D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 6:24-36.

Donovan, G. P. 1991. A review of IWC stock boundaries. Rept. Int. Whal. Commn. (Special Issue 13):39-68.

Rice, D. W. 1989. Sperm whale, Physeter macrocephalus. Pp. 177-233, In S.H. Ridgway and R. Harrison (eds.), Handbook of Marine Mammals. vol 4. River Dolphins and the Larger Toothed Whales. Academic Press, New York.

Gosho, M. E., D. W. Rice, and J. M. Breiwick. 1984. The sperm whale, Physeter macrocephalus. Mar. Fish. Rev. 46(4):54-64.

National Marine Fisheries Service. In prep. Guidelines for Estimating Potential Biological Removals. U.S. Dep. Commer., NOAA Tech. Rep.

BAIRD'S BEAKED WHALE (*Berardius bairdii*): Alaska Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Baird's beaked whales inhabit the North Pacific Ocean and adjacent seas (Bering Sea, Okhotsk Sea, Sea of Japan, and the Sea of Cortez in the southern Gulf of California, Mexico), with the best-known populations occurring in the coastal waters around Japan (Balcomb 1989). Within the North Pacific Ocean Baird's beaked whales have been sighted in virtually all areas north of 35°N, particularly in regions with submarine escarpments and seamounts (Ohsumi 1983, Kasuya and Ohsumi 1984). An apparent break in distribution occurs in the eastern Gulf of Alaska, but from mid-Gulf to the Aleutian Islands and in the southern Bering Sea there are numerous sighting records (Kasuya and Ohsumi 1984). Tomilin (1957) reported that in the Sea of Okhotsk and the Bering Sea, Baird's beaked whales arrive in April-May, and are particularly numerous in summer. They are the most commonly seen beaked whales within their range, perhaps because they are relatively large and gregarious, traveling in schools of a few to several dozen, which makes them more noticeable to observers. Baird's beaked whales are migratory, arriving in continental slope waters during summer and fall months when surface water temperatures are the highest (Dohl et al. 1983, Kasuya 1986).

There are insufficient data to apply the phylogeographic approach to stock structure (Dizon et al. 1992) for Baird's beaked whale. Therefore, Baird's beaked whale stocks are defined as the two non-contiguous areas within Pacific U.S. waters where they are found: (1) Alaska and (2) California/Oregon/Washington. These two stocks were defined in this way because of (1) the large distance between the two areas and the lack of any information about whether animals move between the two areas, (2) the somewhat different oceanographic habitats found in the two areas, and (3) the different fisheries that operate within portions of those two areas, with bycatch of Baird's beaked whales only reported from the drift gillnet fishery in California.

POPULATION SIZE

Reliable estimates of abundance for this stock are currently unavailable.

Minimum Population Estimate

At this time it is not possible to produce a reliable minimum population estimate (N_{MIN}) for this stock, as current estimates of abundance are unavailable.

Current Population Trend

At present, reliable data on trends in population abundance are unavailable.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for this stock. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate (R_{MAX}) of 4% be employed (NMFS in prep.).

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 these stocks is 0.5, the value for cetacean stocks with unknown population status (NMFS in prep.). However, in the absence of a reliable estimate of minimum abundance, the PBR for this stock is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

There have been no observed reports of incidental mortality related to commercial fishery operations in Alaskan waters in the last 5 years. Based on logbook reports maintained by boat operators required by the MMPA interim exemption program during the 3-year period between 1990-92, no injuries or mortalities from gear interactions or illegal deterrence were reported. Because the PBR for this stock is unknown, it is currently not possible to determine what annual level of mortality incidental to commercial fisheries is considered insignificant.

Subsistence/Native Harvest Information

There is no known subsistence harvest of beaked whales.

STATUS OF STOCK

The estimated annual rate of human-caused mortality and serious injury is very minimal for these stocks, and thus the Alaska stock of Baird's beaked whale is not classified as strategic.

REFERENCES

Balcomb, K. C. 1989. Band's beaked whale, Berardius bairdii Stejneger, 1883: Amoux's beaked whale Iberardius arnouxii Douvemoy, 1851. Pp. 261-288, In S.H. Ridgway and R. Harrison (eds.), Handbook of Marine Mammals: River Dolphins and the Larger Toothed Whales. Academic Press, New York.

Dizon, A. E., C. Lockyer, W. F. Perrin, D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 6:24-36.

Dohl, T., R. Guess, M. Duman, and R. Helm. 1983. Cetaceans of central and northern California, 1980-1983: status, abundance, and distribution. Rep. Outer Continental Shelf Study, NMS 84-0045, U.S. Dep. Interior.

Kasuya T. 1986. Distribution and behavior of Baird's beaked whales off the Pacific coast of Japan. Sci Rep. Whales Res. Inst. 37:61-83.

Kasuya, T. and Ohsumi, S. 1984. Further analysis of the Baird's beaked whale stock in the western North Pacific. Rep. Int. Whal. Commn. 34:587-595.

National Marine Fisheries Service. In prep. Guidelines for Estimating Potential Biological Removals. U.S. Dep. Commer., NOAA Tech. Rep.

Ohsumi, S. 1983. Population assessment of Baird's beaked whales in the waters adjacent to Japan. Rep. Int. Whal.Commn. 33:633-641.

Tomilin, A. 1957. Mammals of the USSR and Adjacent Countries, vol. IX: Cetacea: (Ed. V. G. Heptner), Nauk USSR, Moscow. (English translation 1967 by Israel Program for Scientific Translations, Jerusalem. U.S. Dep. Commer., Springfield, VA.)

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The distribution of Cuvier's beaked whale is known primarily from strandings, which indicate it is the most widespread of the beaked whales and is distributed in all oceans and most seas except in the high polar waters (Moore 1963). In the northeastern Pacific from Alaska to Baja California, no obvious pattern of seasonality to strandings has been identified (Mitchell 1968). Strandings of Cuvier's beaked whale are the most numerous of all beaked whales, indicating that they are probablynot as rare as originally thought (Heyning 1989). Observations reveal that the blow is low, diffuse, and directed forward (Backus and Schevill 1961, Norris and Prescott 1961), making sightings more difficult, and there is some evidence that they avoid vessels by diving (Heyning 1989).

Mitchell (1968) examined skulls of stranded whales for geographical differences and thought that there was probably one panmictic population in the northeastern Pacific. Otherwise, there are insufficient data to apply the phylogeographic approach to stock structure (Dizon et al. 1992) for Cuvier's beaked whale. Therefore, Cuvier's beaked whale stocks are defined as the three non-contiguous areas within Pacific U.S. waters where they are found: (1) Alaska, (2) Califomia/Oregon/Washington, (3) Hawaii. These three stocks were defined in this way because of (1) the large distance between the areas and the lack of any information about whether animals move between the three areas, (2) the different oceanographic habitats found in the three areas, and (3) the different fisheries that operate within portions of those three areas, with bycatch of Cuvier's beaked whales only reported from the drift gillnet fishery in California.

POPULATION SIZE

Reliable estimates of abundance for this stock are currently unavailable.

Minimum Population Estimate

At this time it is not possible to produce a reliable minimum population estimate (N_{MIN}) for this stock, as current estimates of abundance are unavailable.

Current Population Trend

At present, reliable data on trends in population abundance are unavailable.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for this stock. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate (R_{MAX}) of 4% be employed (NMFS in prep.).

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 these stocks is 0.5, the value for cetacean stocks with unknown population status (NMFS in prep.). However, in the absence of a reliable estimate of minimum abundance, the PBR for this stock is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

There have been no observed reports of incidental mortality related to commercial fishery operations in the North Pacific in the last 5 years. Based on logbook reports maintained by boat operators required by the Marine Mammal Protection Act (MMPA) interim exemption program during the 3-year period between 1990 and 1992, no injuries or mortalities from gear interactions or illegal deterrence were reported. Because the PBR for this stock is unknown, it is currently not possible to determine what annual level of mortality incidental to commercial fisheries is considered insignificant.

Subsistence/Native Harvest Information

There is no known subsistence harvest of beaked whales.

STATUS OF STOCK

The estimated annual rate of human-caused mortality and serious injury is very minimal for these stocks, and thus the Alaska stock of Cuvier's beaked whale is not classified as strategic.

REFERENCES

Backus, R. H., and W. E. Schevill. 1961. The stranding of a Cuvier's beaked whale (Ziphius cavirostris) in Rhode Island, USA. Norsk Hval. 50:177-181.

Dizon, A. E., C. Lockyer, W. F. Perrin, D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 6:24-36.

Heyning, J.E. 1989. Cuvier's beaked whale - Ziphius cavirostris G. Cuvier, 1823. Pp. 289-308, In S.H. Ridgway and R. Harrison, (eds.), Handbook of Marine Mammals: River Dolphins and the Larger Toothed Whales. Academic Press, New York.

Mitchell, E. 1968. Northeast Pacific stranding distribution and seasonality of Cuvier's beaked whale, Ziphius cavirostris. Can. J. Zool. 46:265-279.

Moore, J. C. 1963. The goose-beaked whale, where in the world? Bull. Chicago Nat. Hist. Mus. 34:2-3,8.

National Marine Fisheries Service. In prep. Guidelines for Estimating Potential Biological Removals. U.S. Dep. Commer., NOAA Tech. Rep.

Norris, K. S. and J. H. Prescott. 1961. Observations on Pacific cetaceans of California and Mexican waters. Univ. Calif. Pub. Zool. 63:291-370.

STEJNEGER'S BEAKED WHALE (*Mesoplodon stejnegeri*): Alaska Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Stejneger's beaked whale is rarely seen at sea, and its distribution generally has been inferred from stranded specimens (Loughlin and Perez 1985, Mead 1989). It is endemic to the cold-temperate waters of the North Pacific Ocean, Sea of Japan and deep waters of the southwest Bering Sea The range of Stejneger's beaked whale extends along the coast of North America from Cardiff, California, north through the Gulf of Alaska to the Aleutian Islands, into the Bering Sea to the Pribilof Islands and Commander Islands, and, off Asia, south to Akita Beach on Noto Peninsula, Honshu, in the Sea of Japan (Loughlin and Perez 1985). The species is not known to enter the Arctic Ocean and is the only species of Mesoplodon known to occur in Alaskan waters. The distribution of M. stejnegeri in the North Pacific corresponds closely, in occupying the same cold-temperate niche and position, to that of M. bidens in the North Atlantic. It lies principally between 50° and 60°N and extends only to about 45°N on the east, but to about 40°N on the west (Moore 1963,1966).

There are insufficient data to apply the phylogeographic approach to stock structure (Dizon et al. 1992) for Stejneger's beaked whale. The Alaska stock is recognized separately from other Mesoplodon spp. along the continental U.S. West Coast because of (1) the distribution of Stejneger's beaked whale and the different oceanographic habitats found in the two areas, (2) the large distance between the two non-contiguous areas of U.S. waters and the lack of any information about whether animals move between the two areas, and (3) the different fisheries that operate within portions of those two areas, with bycatch of Mesoplodon spp. only reported from the drift gillnet fishery in California.

POPULATION SIZE

Reliable estimates of abundance for this stock are currently unavailable.

Minimum Population Estimate

At this time it is not possible to produce a reliable minimum population estimate (N_{MIN}) for this stock, as current estimates of abundance are unavailable.

Current Population Trend

At present, reliable data on trends in population abundance are unavailable.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for this stock. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate (R_{MAX}) of 4% be employed (NMFS in prep.).

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is delined 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 these stocks is 0.5, the value for cetacean stocks with unknown population status (NMFS in prep.). However, in the absence of a reliable estimate of minimum abundance, the PBR for this stock is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

There have been no observed reports of incidental mortality related to commercial fishery operations in the North Pacific in the last 5 years. Based on logbook reports maintained by boat operators required by the MMPA interim exemption program during the 3-year period between 1990-92, no injuries or mortalities from gear interactions or illegal deterrence were reported. Because the PBR for this stock is unknown, it is currently not possible to determine what annual level of mortality incidental to commercial fisheries is considered insignificant.

Subsistence/Native Harvest Information

There is no known subsistence harvest of beaked whales.

STATUS OF STOCK

The estimated annual rate of human-caused mortality and serious injury is very minimal for these stocks, and thus the Alaska stock of Stejneger's beaked whale is not classified as strategic.

REFERENCES

Dizon, A. E., C. Lockyer, W. F. Perrin, D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 624-36.

Loughlin, T. R., and M. A. Perez. 1985. Mesoplodon stejnegeri. Mammalian Species, No. 250.

Mead, J. G. 1989. Beaked whales of the genus - Mesoplodon. Pp. 349-430, In S.H. Ridgway and R. Harrison (eds.), Handbook of Marine Mammals: River Dolphins and the Larger Toothed Whales. Academic Press, New York.

Moore, J. C. 1963. Recognizing certain species of beaked whales of the Pacific Ocean . Amer. Midland Nat. 70:396-428.

Moore, J. C. 1966. Diagnoses and distributions of beaked whales of the genus Mesoplodon known from North American waters. Pp. 32-61, in K. S. Norris (ed.), Whales, Dolphins and Porpoises. Univ. California Press, Berkeley.

National Marine Fisheries Service. In prep. Guidelines for Estimating Potential Biological Removals. U.S. Dep. Commer., NOAA Tech. Rep.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The following information was considered in classifying stock structure of gray whales based on the Dizon et al. (1992) phylogeographic approach (1) Distributional data: isolated geographic distribution in the North Pacific Ocean: (2) Population response data: unknown; (3) Phenotypic data: unknown; and (4) Genotypic data: unknown. Based on this limited information, two stocks have been recognized in the North Pacific: the eastern North Pacific stock, which breeds along the West Coast of North America, and the western Pacific or "Korean" stock, which apparently breeds off the coast of eastern Asia (Rice 1981). Most of the eastern North Pacific stock spends the summer feeding in the northern Bering, Chukchi, and Beaufort Seas (Rice and Wolman 1971). However, gray whales have been reported feeding in the summer in waters off Southeast Alaska, British Columbia, Oregon, and Washington. The whales migrate near shore along the coast of North America from Alaska to the central California coast (Rugh et al. 1993) starting in October and November. After passing Point Conception, California, Rice et al. (1984) reported the majority of the animals take a more direct offshore route across the southern California Bight to northern Baja California. The eastern Pacific stock winters mainly along the west coast of Baja California. The pregnant females assemble in certain shallow, nearly landlocked lagoons and bays where the calves are born from early January to mid-February (Rice et al. 1981). The northbound migration generally begins in mid-February and continues through May (Rice et al. 1981).

POPULATION SIZE

An abundance estimate, based on shore-based counts of southward migrating gray whales in 1987/1988, of 20,869 (CV=0.044) animals was reported by Buckland et al. (1993). Preliminary estimates of abundance for the southward migrations of gray whales in 1992/1993 and 1993/1994 were reported at the International Whaling Commission's Scientific Committee meetings in 1994 (RIWC 1995), where the 1992/1993 estimate (17,674 animals) was significantly less than that for 1993/1994 (23,109 animals). However, the 1993/1994 estimate was not significantly different from the 1987/1988 estimate of abundance for this stock of gray whales. The 1993/1994 estimate is currently considered the most reliable abundance estimate, thus the abundance estimate for this stock is 23,109 (CV=0.0740).

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock is calculated from equation 1 from the PBR Guidelines (NMFS in prep.): $N_{MIN} = N/\exp(0.842*[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate of 23,109 and its associated CV of 0.074, N_{MIN} for this stock is 21,715.

Current Population Trend

The estimated annual rate of increase, based on shore counts of southward migrating gray whales between 1967 and 1988 is 3.29% with a standard error of 0.44% (Buckland et al. 1993). Incorporating the two most recent counts resulted in an annual rate of increase of 2.57% (SE = 0.4%: RIWC 1995).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Wade (1994) reported that based on a Bayesian analysis of the census data between 1968 and 1994, the eastern North Pacific stock of gray whales was between 0.51 and 0.97 of its carrying capacity and that the rate of net production at the maximum net productivity level was 0.033 (95% CI: 0.023, 0.044). However, this conclusion was regarded as questionable at the 1994 Scientific Committee meetings of the IWC because the analysis may have been unduly influenced by the 1992 census and because the variance of the abundance estimate was likely underestimated (i.e., negative biased). Until consensus is reached, it is recommended (NMFS in prep.) that the cetacean maximum net productivity rate (R,) of 4% be employed for this stock of gray whales. Because this stock is thought to be midway between the lower limit of its optimum sustainable population (OSP) level and carrying capacity (K), the observed rate of increase is likely to be substantially less than R_{MAX}.

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 upper limit of the range

(0.5-1.0) of values for cetacean stocks with unknown population status but increasing with a known human take (NMFS in prep.). Thus, for the Eastern North Pacific stock of gray whale, PBR = (21,715 x 0.02 x 1.0) or 434 animals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Since 1990, there have been no observed reports of incidental mortality related to commercial fishery operations in the eastern North Pacific. Based on logbook reports maintained by boat operators required by the MMPA interim exemption program during the 3-year period between 1990-92, one injury and one mortality was recorded in the Bristol Bay salmon set and drift gillnet fishery in 1990. However, because logbook records are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates.

The estimated annual mortality rate incidental to commercial fisheries (0.3; based on observer data (0) and logbook reports (0.3) where observer data were not available) is less than 10% of the PBR (43) and, therefore, is considered insignificant and approaching a zero mortality and serious injury rate.

Subsistence/Native Harvest Information

At the 1991 annual meeting of the International Whaling Commission, the U.S. "put on record that it was not requesting and will not in future years request an allocation or use of 10 gray whales" (RIWC 1992: pp. 32). This represented a change from the previous quota period, where an annual block quota of 179 animals had been authorized, of which 10 were subject to mutual consideration with the U.S. subsistence hunters in Russia took an average of 177 whales per year between 1966 and 1991 (RIWC 1995). No takes were reported for 1992 and 1993. In 1994, 44 gray whales were harvested by Russian aboriginals. The current IWC quota for gray whales taken by aboriginals is 140 animals per year. In addition, Treaty Indian Tribes in Washington State have expressed an interest in harvesting up to 5 animals per year for subsistence and ceremonial purposes.

STATUS OF STOCK

The estimated annual level of human-caused mortality and serious injury (0.3) does not exceed the PBR (434), thus this stock of gray whale is not classified as a strategic stock. It should be noted that this stock was recently (1994) removed from the List of Endangered and Threatened Wildlife (i.e., it is no longer considered endangered or threatened under the U.S. Endangered Species Act).

REFERENCES

Anon. 1992. Report of the Scientific Committee. Rep. Int. Whal. Commn. 42: 32.

Anon. 1995. Report of the Scientific Committee. Rep. Int. Whal. Commn. 45: 78-79.

Buckland, S. T., J. M. Breiwick, K. L. Cattanach and J. L. Laake. 1993. Estimated population size of the California gray whale. Mar. Mammal Sci. 9(3):235-249.

Credle, V. R., D. P. DeMaster, M. M. Merklein, M. B. Hanson, W. A. Karp, and S. M. Fitzgerald (eds.). 1994. NMFS observer programs: minutes and recommendations from a workshop held in Galveston, Texas, November 10-11, 1993. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-94-1, 96 pp.

Dizon, A. E., C. Lockyer, W. F. Perrin, D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 6:24-36.

National Marine Fisheries Service. In prep. Guidelines for Estimating Potential Biological Removals. U.S. Dep. Commer., NOAA Tech. Rep.

Rice, D. W. 1981. Status of the eastern Pacific (California) stock of the gray whale. Pp. 181-187, In Food and Agriculture Organization. 1981. Mammals in the Seas. vol. III. General Papers and Large Cetaceans. Food and Agriculture Organization, Rome, Italy.

Rice, D. W., and A. A. Wolman. 1971. The life history and ecology of the gray whale, Eschrichtius robustus. Am. Soc. Mammal. Spe. Publ. 3. 142 pp.

Rice, D. W., A. A. Wolman, and H. W. Braham. 1984. The gray whale, Eschrichtius robustus. Mar. Fish. Rev. 46(4):7-14.

Rice, D. W., A. A. Wolman, D. E. Withrow, and L. A. Fleischer. 1981. Gray whales on the winter grounds in Baja California. Rep. Int. Whaling Commn. 31:477-493.

Rugh, D., J. Breiwick, M. Dahlheim, and G. C. Boucher. 1993. A comparison of independent, concurrent sighting records from a shore-based count of gray whales. Wildl. Soc. Bull. 21:427-437.

Wade, P. R. 1994. Estimates of population parameters for the eastern Pacific gray whale, Eschrichtius robustus, using a Bayesian method. Working paper submitted to the 1994 Scientific Committee meeting of the IWC (SC/46/AS16). 30 pp.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The humpback whale is distributed worldwide in all ocean basins, though it is less common in Arctic waters. In winter, most humpback whales occur in temperate and tropical waters of both hemispheres (10°-23° latitude). Humpback whales in the North Pacific are seasonal migrants that feed on zooplankton and small schooling fishes in the cool, coastal waters of the western U.S., western Canada, and the Russian Far East (NMFS 1991). The historic summering range of humpback whales in the North Pacific encompassed coastal and inland waters around the Pacific rim from Point Conception, California, north to the Gulf of Alaska and the Bering Sea, and west along the Aleutian Islands to the Kamchatka Peninsula and into the Sea of Okhotsk (Tomlin 1967, Nemoto 1957, Johnson and Wolman 1984). The population status of the humpback whale in much of this range was considerablyreduced as a result of intensive commercial exploitation during this century.

Aerial, vessel, and photo-identification surveys indicate four relatively separate populations that migrate between their respective summer/fall feeding areas to winter/spring calving and mating areas (Barlow 1994): 1) winter/spring populations in coastal Central America and Mexico which migrate to the coast of California to southern British Columbia in summer/fall (Steiger et al. 1991, Calambokidis et al, 1989, Calambokidis et al. 1993); 2) winter/spring populations of Mexico's offshore islands whose migratory destination is not well known but which do not migrate to the west coast of the continental U.S. (Calambokidis et al. 1993); 3) winter/spring populations of the Hawaiian Islands which migrate to Southeast Alaska and Prince William Sound (Baker et al. 1990, Perry et al. 1990)- referred to as the Central North Pacific stock: and 4) winter/spring populations of Japan which probably migrate to waters west of the Kodiak Archipelago (the Bering Sea and Aleutian Islands) in summer/fall (Berzin and Rovnin 1966, Nishiwaki 1966, Darling 1991)- referred to as the Western North Pacific stock.

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 the California catalog (Calambokidis et al. 1993), indicating that British Columbia is the approximate geographic boundary between feeding populations. Yet, some exchange between the mating and calving areas has been documented (Darling and McSweeney 1985, Baker et al. 1986, Darling and Cerchio 1993). Population structure in humpback whales appears to be based on matrilineal fidelity to feeding areas. Following the phylogeographic approach to classifying stock structure (Dizon et al. 1992), 4 stocks of humpback whales are recognized in the North Pacific, based on the information described above: two in the Eastern North Pacific, one in the Central North Pacific, and one in the Western North Pacific.

POPULATION SIZE

A reliable estimate of abundance is currently not available for this stock of humpback whales.

Minimum Population Estimate

At this time it is not possible to produce a reliable estimate of minimum abundance for this stock, as current estimates of abundance are not available.

Current Population Trend

The North Pacific humpback whale population may have numbered approximately 15,000 individuals prior to exploitation (Rice 1978). Intensive commercial whaling removed more than 28,000 animals from the North Pacific during the 20th Century (Rice 1978). Reliable information on trends in abundance for this stock are currently not available.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivityrate is currently unavailable for this stock of humpback whales. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate (R_{MAX}) of 4% be employed for this stock (NMFS in prep.).

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,. The recovery factor (F_R) for this stock is 0.1, the value for cetacean stocks which are listed as endangered (NMFS in prep.). However, because a reliable estimate of minimum abundance is currently not available, the PBR for this stock is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS IN JURY

Fisheries Information

NMFS observers have not recorded mortality or serious injury to humpback whale incidental to commercial fisheries in Alaska in the last 5 years. Based on logbook reports maintained by boat operators required by the MMPA interim exemption program during the 3-year period between 1990-92, no injuries or mortalities were recorded.

The estimated mortality rate incidental to commercial fisheries is zero, based on observer data (0) and logbook data (0) where observer data were not available. Because the PBR for this stock is unknown, it is currently not possible to determine what annual level of mortality incidental to commercial fisheries is considered insignificant.

STATUS OF STOCK

The humpback whale is listed as endangered under the Endangered Species Act (ESA), thus this stock is classified as a strategic stock.

REFERENCES

Baker, C. S. 1992. Genetic variability and stock identity of humpback whales, world-wide. Final Contract Report to Int. whal. commn. 45 pp.

Baker, C. S., L. M. Herman, A. Perry, W. S. Lawton, J. M. Straley, A. A. Wolman, G. D. Kaufman, H. E. Winn, J. D. Hall, J. M. Reinke, and J. Ostman. 1986. Migratory movement and population structure of humpback whales (Megaptera novaeangliae) in the central and eastern North Pacific. Mar. Ecol. Prog. Ser. 31:105-119

Baker, C. S., S. R. Palumbi, R. H. Lambertsen, M. T. Weinrich, J. Calambokidis, and S. J. O'Brien. 1990. Influence of seasonal migration on geographic distribution of mitochondrial DNA haplotypes in humpback whales. Nature 344:238-240.

Baker, C. S., D. A. Gilbert, M. T. Weinrich, R. H. Lambertsen, J. Calambokidis, B. McArdle, G. K. Chambers, and S. J. O'Brien. 1993. Population characteristics of DNA fingerprints in humpback whales (Megaptera novaeangliae). J. Heredity 84:281-290.

Barlow, J. 1994. Recent information on the status of large whales in California waters.' U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SWFSC-203. 27 pp.

Berzin, A.A., and A.A. Rovnin. 1966. The distribution and migrations of whales in the northeastern part of the Pacific, Chukchi and Bering Seas. Izvestiya Tikhookeanskogo Nauchno-Issledovatel'skogo Institut Rybnogo Khozyaistva I Okeanografii 58:179-207. (Translated by Bureau of Commercial Fisheries, U. S. Fish and Wildlife Service, Seattle, 1968, pp. 103-136. In K. I. Panin (ed.), Soviet Research on Marine Mammals of the Far East.)

Calambokidis, J. G. H. Steiger, J. C. Cubbage, K. C. Balcomb III, and P. Bloedel. 1989. Biology of humpback whales in the Gulf of the Farallones. Report to Gulf of the Farallones National Marine Sanctuary, San Francisco, CA by Cascadia Research Collective, 218½ West Fourth Avenue, Olympia, WA. 93 pp.

Calambokidis, J., G. H. Steiger, and J. R. Evenson. 1993. Photographic identification and abundance estimates of humpback and blue whales off California in 1991-92. Final Contract Report 50ABNF100137 to Southwest Fisheries Science Center, P.O. Box 271, La Jolla, CA 92038. 67 pp.

Darling, J. D. 1991. Humpback whales in Japanese waters. Ogasawara and Okinawa. Fluke identification catalog 1987-1990. Final Contract Report, World Wide Fund for Nature, Japan. 22 pp.

Darling, J. D., and S. Cerchio. 1993. Movement of a humpback whale (Megaptera novaeangliae) between Japan and Hawaii. Mar. Mammal Sci. 1:84-89.

Darling, J. D., and D. J. McSweeney. 1985. Observations on the migrations of North Pacific humpback whales (Megaptera novaeangliae). Can. J. Zool. 63:308-314.

Dizon, A. E., C. Lockyer, W. F. Perrin, D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 6:24-36.

Johnson, J. H., and A. A. Wolman. 1984. The humpback whale, Megaptera novaeangliae. Mar. Fish. Rev. 46(4):30-37.

National Marine Fisheries Service. 1991. Recovery plan for the humpback whale (Megaptera novaeangliae). Prepared by the humpback recovery team for the National Marine Fisheries Service, Silver Spring, Maryland. 105 pp.

National Marine Fisheries Service. In prep. Guidelines for Estimating Potential Biological Removals. U.S. Dep. Commer., NOAA Tech. Rep.

Nemoto, T. 1957. Foods of baleen whales in the northern Pacific. Sci. Rep. Whales Res. Inst. Tokyo 12:33-89.

Nishiwaki, M 1966. Distribution and migration of the larger cetaceans in the North Pacific as shown by Japanese whaling results. Pp. 172-191, In K.S. Norris, (ed.) Whales, Dolphins and Porpoises, University of California Press, Berkeley, CA.

Perry, A., C. S. Baker, and L. M. Herman. 1990. Population characteristics of individually identified humpback whales in the central and eastern North Pacific: A summary and critique. Rep. Int. Whal. Commn. (Special Issue 12):307-317.

Rice, D. W. 1978. The humpback whale in the North Pacific: distribution, exploitation and numbers. Appendix 4. Pp. 29-44, In K.S. Norris and R.R. Reeves (eds.), Report on a workshop on problems related to humpback whales (Megaptera novaeangliae) in Hawaii. U.S. Dep. Commer., Nat. Tech. Info. Serv. PB-280 794. Springfield, VA.

Steiger, G. H., J. Calambokidis, R. Sears, K. C. Balcomb, and J. C. Cubbage. 1991. Movement of humpback whales between California and Costa Rica. Mar. Mammal Sci. 7:306-310.

Tomlin, A. G. 1967. Mammals of the USSR and adjacent countries. vol. 9, Cetacea. Israel Program Sci. Transl. No. 1124, Natl. Tech. Info. Serv. TT 65-50086. Springfield, VA. 717 pp. (Translation of Russian text published in 1957).

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The humpback whale is distributed worldwide in all ocean basins, though it is less common in Arctic waters. In winter, most humpback whales occur in temperate and tropical waters of both hemispheres (10°-23° latitude). Humpback whales in the North Pacific are seasonal migrants that feed on zooplankton and small schooling fishes in the cool, coastal waters of the western U.S., western Canada, and the Russian Far East (NMFS 1991). The historic summering range of humpback whales in the North Pacific encompassed coastal and inland waters around the Pacific rim from Point Conception, California, north to the Gulf of Alaska and the Bering Sea, and west along the Aleutian Islands to the Kamchatka Peninsula and into the Sea of Okhotsk (Tomlin 1967, Nemoto 1957, Johnson and Wolman 1984). The population status of the humpback whale in much of this range was considerably reduced as a result of intensive commercial exploitation during this century.

Aerial, vessel, and photo-identification surveys indicate four relatively separate populations that migrate between their respective summer/fall feeding areas to winter/spring calving and mating areas (Barlow 1994): 1) winter/spring populations in coastal Central America and Mexico which migrate to the coast of California to southern British Columbia in summer/fall (Steiger et al. 1991, Calambokidis et al. 1989, Calambokidis et al. 1993); 2) winter/spring populations of Mexico's offshore islands whose migratory destination is not well known but which do not migrate to the west coast of the continental U.S. (Calambokidis et al. 1993); 3) winter/spring populations of the Hawaiian Islands which migrate to Southeast Alaska and Prince William Sound (Baker et al. 1990, Perry et al. 1990)- referred to as the Central North Pacific stock: and 4) winter/spring populations of Japan which probably migrate to waters west of the Kodiak Archipelago (the Bering Sea and Aleutian Islands) in summer/fall (Berzin and Rovnin 1966, Nishiwaki 1966, Darling 199l)- referred to as the Western North Pacific 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 the California catalog (Calambokidis et al. 1993), indicating that British Columbia is the approximate geographic boundary between feeding populations. Yet, some exchange between the mating and calving areas has been documented (Darling and McSweeney 1985, Baker et al. 1986, Darling and Cerchio 1993). Population structure in humpback whales appears to be based on matrilineal fidelity to feeding areas. Following the phylogeographic approach to classifying stock structure (Dizon et al. 1992), 4 stocks of humpback whales are recognized in the North Pacific, based on the information described above: two in the Eastern North Pacific, one in the Central North Pacific, and one in the western North Pacific.

POPULATION SIZE

This stock ofhumpback whales winters in Hawaiian waters (Baker et al. 1986). Baker and Herman (1987) used capture-recapture methodology to estimate the population at 1,407 (95% CI 1,113-1,701), which they considered an estimate for the entire stock (NMFS 1991). However, this estimate is calculated from data collected between 1980-83. The current abundance estimate is considered unknown because the stock has been increasing for the past 12 years.

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock was not calculated from equation 1 from the PBR Guidelines (NMFS in prep.): $N_{MIN} = N/\exp(0.842*[\ln(1+[CV(N)]^2)]^{½})$ Rather, because a reliable abundance estimate for this stock is not currently available, the population estimate based on studies from the early 1980s, 1,407 whales, is considered a reasonable alternative. Applying equation 1 from the PBR Guidelines (NMFS in prep.) to the estimate of abundance and the associated CV from the early 1980s given the likelihood that this stock is increasing, seems unnecessarily conservative.

Current Population Trend

The North Pacific humpback whale population may have numbered approximately 15,000 individuals prior to exploitation (Rice 1978). Intensive commercial whaling removed more than 28,000 animals from the North Pacific during the 20th Century and may have reduced this population to as few as 1,000 before it was placed under international protection after the 1965 hunting season (Rice 1978). Currently, a reliable estimate of trend in abundance for this stock is unavailable. However, this stock is currently thought to be increasing (Johnson and Wolman 1984; DeMaster 1995: pp. 23).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for this stock of humpback whales. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate (R_{MAX}) of 4% be employed for this stock (NMFS in prep.).

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 0.1, the value for cetacean stocks listed as endangered under the Endangered Species Act (ESA) (NMFS in prep.). Thus, for the North Central Pacific stock of humpback whales, PBR = (1,407 x 0.02 x 0.1), or 2.8 animals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

NMFS observers have not recorded mortality or serious injury to humpback whale incidental to commercial fisheries in Alaska in the last 5 years. Based on logbook reports maintained by boat operators required by the MMPA interim exemption program during the 3-year period between 1990-92, no injuries or mortalities were recorded. Several reports of mortalities were received from commercial fishers in 1993 and 1994.

Given that 10% of the PBR is approximately zero (i.e., 0.3) and the low number of observed or reported mortalities incidental to commercial fishing, the kill rate can not be classified as insignificant at this time.

STATUS OF STOCK

The level of human-caused mortality and serious injury likely does not exceed the PBR (2.8). The humpback whale is listed as endangered under the ESA, thus this stock is classified as a strategic stock.

REFERENCES

Baker, C. S. 1992. Genetic variability and stock identity of humpback whales, world-wide. Final Contract Report to Int. Whal. Commn 45 pp.

Baker, C. S., L M. Herman A. Perry, W. S. Lawton, J. M. Straley, A. A. Wolman, G. D. Kaufman, H. E. Winn, J. D. Hall, J. M. Reinke, and J. Ostman. 1986. Migratory movement and population structure of humpback whales (Megaptera novaeangliae) in the central and eastern North Pacific Mar. Ecol. Prog. Ser. 31:105-119.

Baker, C. S., and L M. Herman. 1987. Alternative population estimates of humpback whales (Megaptera novaeangliae) in Hawaiian waters. Can. J. Zool. 65:2818-2821.

Baker, C. S., S. R. Palumbi, R. H. Lambertsen, M. T. Weinrich, J. Calambokidis, and S. J. O'Brien. 1990. Influence of seasonal migration on geographic distribution of mitochondrial DNA haplotypes in humpback whales. Nature 344:238-240.

Baker, C. S., D. A. Gilbert, M. T. Weinrich, R. H. Lambertsen, J. Calambokidis, B. McArdle, G. K. Chambers, and S. J. O'Brien. 1993. Population characteristics of DNA fmgerprints in humpback whales (Megaptera novaeangliae). J. Heredity 84:281-290.

Barlow, J. 1994. Recent information on the status of large whales in California waters. U.S. Dep Commer., NOAA Tech. Memo. NMFS-SWFSC-203.27 pp.

Berzin, A. A., and A. A. Rovnin. 1966. The distribution and migrations of whales in the northeastern part of the Pacific, Chukchi and Bering Seas. Izvestiya Tikhookeanskogo Nauchno-Issledovatel'skogo Institut Rybnogo Khozyaistva I Gkeanografii 58:179-207. (Translated by Bureau of Commercial Fisheries, U. S. Fish and Wildlife Service, Seattle, 1968, pp. 103-136. In K. I. Panin (ed.), Soviet Research on Marine Mammals of the Far East.)

Calambokidis, J. G. H. Steiger, J. C. Cubbage, K. C. Balcomb III, and P. Bloedel. 1989. Biology of humpback whales in the Gulf of the Farallones. Report to Gulf of the Farallones National Marine Sanctuary, San Francisco, CA by Cascadia Research Collective, 218½ West Fourth Avenue, Olympia, WA. 93 pp.

Calambokidis, J., G. H. Steiger, and J. R. Evenson. 1993. Photographic identification and abundance estimates of humpback and blue whales off California in 1991-92. Final Contract Report 50ABNF100137 to Southwest Fisheries Science Center, P.O. Box 271, La Jolla, CA 92038. 67 pp.

Darling, J. D. 1991. Humpback whales in Japanese waters, Ogasawara and Okinawa. Fluke identification catalog 1987-1990. Final Contract Report, World Wide Fund for Nature, Japan. 22 pp.

Darling, J. D., and S. Cerchio. 1993. Movement of a humpback whale (Megaptera novaeangliae) between Japan and Hawaii. Mar. Mammal Sci. 1:84-89.

Darling, J. D., and D. J. McSweeney. 1985. Observations on the migrations of North Pacific humpback whales (Megaptera novaeangliae). Can. J. Zool. 63:308-314.

DeMaster, D.P. 1995. Minutes from the 4-5 and 11 January 1995 meeting of the Alaska Scientific Review Group, Anchorage, Alaska. 27 pp. + appendices. (available upon request- D.P. DeMaster, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98 115).

Dizon, A. E., C. Lockyer, W. F. Perrin, D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 6:24-36.

Johnson, J. H., and A. A. Wolman. 1984. The humpback whale, Megaptera novaeangliae. Mar. Fish. Rev. 46:30-37.

National Marine Fisheries Service. 1991. Recovery plan for the humpback whale (Megaptera novaeangliae). Prepared by the humpback recovery team for the National Marine Fisheries Service, Silver Spring, Maryland. 105 pp-

National Marine Fisheries Service. In prep. Guidelines for Estimating Potential Biological Removals. U.S. Dep. Commer., NOAA Tech. Rep.

Nemoto, T. 1957. Foods of baleen whales in the northern Pacific. Sci. Rep. Whales Res. Inst. Tokyo 12:33-89.

Nishiwaki, M. 1966. Distribution and migration of the larger cetaceans in the North Pacific as shown by Japanese whaling results. Pp. 172-191, In K.S. Norris (ed.), Whales, Dolphins and Porpoises, University of California Press, Berkeley, CA. Academic Press, New York.

Perry, A., C. S. Baker, and L. M. Herman. 1990. Population characteristics of individually identified humpback whales in the central and eastern North Pacific: A summary and critique. Rep. Int. Whal. Commn. (Special Issue 12):307-317.

Rice, D. W. 1978. The humpback whale in the North Pacific: distribution, exploitation and numbers. Appendix 4. Pp. 29-44, In K.S. Norris and R.R. Reeves (eds.), Report on a workshop on problems related to humpback whales (Megaptera novaeangliae) in Hawaii. U.S. Dep. Commer., Nat. Tech. Info. Serv. PB-280 794. Springfield, VA.

Steiger, G. H., J. Calambokidis, R. Sears, K. C. Balcomb, and J. C. Cubbage. 1991. Movement of humpback whales between California and Costa Rica. Mar. Mammal Sci. 7:306-310.

Tomlin, A. G. 1967. Mammals of the USSR and adjacent countries. vol. 9, Cetacea. Israel Program Sci. Transl. No. 1124, Natl. Tech. Info. Serv. TT 65-50086. Springfield, VA. 717 pp. (Translation of Russian text published in 1957).

FIN WHALE (*Balaenoptera physalus*): Alaska Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

In U.S. waters in the Pacific, fin whales are distributed seasonally off the coast of North America and near and around the waters of Hawaii. The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: (1) Distributional data: geographic distribution continuous in winter, possibly isolated in summer: (2) Population response data: unknown; (3) Phenotypic data: unknown: and (4) Genotypic data: unknown. Based on this limited information, the International Whaling Commission considers fin whales in the North Pacific to all belong to the same stock (Mizroch et al. 1984), although Mizroch cited additional evidence that supports the establishment of subpopulations in the North Pacific. Further, Fujino (1960) describes an eastern and a western group, which are isolated. Tag recoveries reported by Rice (1974) indicate that animals that winter off the coast of southern California range from central California to the Gulf of Alaska in the summer. Stock structure of fm whales is therefore equivocal. Based on a conservative management approach, three stocks are proposed: 1) Alaska, 2) Califomia/Washington/Oregon, and 3) Hawaii.

POPULATION SIZE

Reliable estimates of current and historical abundance for fin whales in Alaska are currently not available. Reported population ranges for the North Pacific prior to exploitation and in the early 1970s are 42,000 to 45,000 and 13,430 to 18,630, respectively (Ohsumi and Wada 1974). These estimates were based on population modeling, incorporating catch and observation data, and include the California/Oregon/Washington stock for which separate abundance estimates are currently available.

Minimum Population Estimate

At this time it is not possible to produce a reliable estimate of minimum abundance for this stock, as current estimates of abundance are not available.

Current Population Trend

Reliable information on trends in abundance for this stock are currently not available. There are no published reports indicating recovery of this stock has or is taking place (Braham 1992).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

It is recommended that the cetacean maximum net productivity rate (R,) of 4% be employed for this stock at this time (NMFS in prep.).

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,. The recovery factor (F_R) for this stock is 0.1, the value for cetacean stocks which are listed as endangered (NMFS in prep.). However, because a reliable estimate of minimum abundance is currently not available. the PBR for this stock is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

There have been no reports of incidental mortalities related to fishery operations in the North Pacific in the last 5 years. Because the PBR for this stock is unknown it is not currently possible to determine what level of mortality incidental to commercial fisheries would be considered insignificant.

Subsistence/Native Harvest Information

Subsistence hunters in Alaska and Russia have not been reported to take animals from this stock.

STATUS OF STOCK

This stock is listed as endangered under the Endangered Species Act of 1973, and is thus classified as a strategic stock.

REFERENCES

Braham, H. 1992. Endangered whales: Status update. Working document presented at a Workshop on the Status of California Cetacean Stocks (SOCCS/14). 35 pp. + tables. (available upon request- Alaska Fisheries Science Center, 7600 Sand Point Way, NE, Seattle, WA 98115).

Dizon, A. E., C. Lockyer, W. F. Perrin, D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 6:24-36.

Fujino, K. 1960. Immunogenetic and marking approaches to identifying sub-populations of the North Pacific whales. Sci. Rep. Whales Res. Inst., Tokyo 15:84-142.

Mizroch, S. A., D. W. Rice, and J. M. Breiwick. 1984. The fin whale, Balaenoptera physalus. Mar. Fish. Rev. 46(4):20-24.

National Marine Fisheries Service. In prep. Guidelines for Estimating Potential Biological Removals. U.S. Dep. Commer., NOAA Tech. Rep.

Ohsumi, S., and S. Wada. 1974. Status of whale stocks in the North Pacific. 1972. Rep. Int. Whal. Commn. 24:114-126.

Rice, D.W. 1974. Whales and whale research in the eastern North Pacific. Pp. 170-195, In W.E. Schevill (ed.), The whale problem: A status report. Harvard Press, Cambridge, MA.

MINKE WHALE (*Balaenoptera acutorostrata*): Alaska Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE:

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: (1) Distributional data: geographic distribution continuous, (2) Population response data: unknown: (3) Phenotypic data: unknown; and (4) Genotypic data: unknown. Based on this limited information, 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 designation reflects the lack of exploitation in the eastern Pacific and does not indicate that only one population exists in this area (Donovan 1991). In the "remainder" area, minke whales are relatively common in the Bering and Chukchi Seas and in the inshore waters of the Gulf of Alaska (Mizroch 1992), but are not considered abundant in any other part of the eastern Pacific (Leatherwood et al. 1982, Brueggeman et al. 1990). Because the "resident" minke whales from California to Washington appear behaviorally distinct from migratory whales further north, minke whales in Alaskan waters are considered a separate stock from minke whales in California, Oregon, and Washington.

POPULATION SIZE

No estimates have been made for the number of minke whales in the entire North Pacific nor are estimates available for the number of minke whales that occur in waters of Alaska.

Minimum Population

A minimum population estimate is currently not available for this stock.

Current Population Trend

There are no data on trends in minke whale abundance in waters off Alaska.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

There are no estimates of the growth rate of minke whale populations in the North Pacific (Best 1993). In the absence of species-specific information on the annual rate of maximum net production, the default value of 0.04 should be used (NMFS in prep.).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) for this stock is calculated as the product of minimum population size, 0.5 maximum net productivity, and a recovery factor. Given the status of this stock is unknown, the appropriate recovery factor is 0.5 (NMFS in prep.). However, because an estimate of minimum abundance is not available, it is not possible to estimate a PBR for this stock at this time.

ANNUAL HUMAN-CAUSED MORTALITY

Historic Whaling

The estimated take of western North Pacific minke whales by commercial whalers was approximately 31,000 from 1930 to 1987 (C. Allison, pers. comm., International Whaling Commission, The Red House, Station Road, Histon, Cambridge, UK). No minke whales were ever taken by modem shore-based whale fishery in the eastern North Pacific which lasted from 1905-71 (Rice 1974). Reported aboriginal takes of minke whales in Alaska were seven between 1930 and 1987 (C. Allison, pers. comm.).

Fishery Information

Minke whales have been reported to have been caught in both coastal set gillnets and offshore drift gillnets. Based on logbook reports maintained by boat operators required by the Marine Mammal Protection Act (MMPA) interim exemption program during the 3-year period between 1990-92, no injuries or mortalities from gear interactions or illegal deterrence were reported. Because the PBR for this stock is unknown, it is not currently possible to determine what level of mortality incidental to commercial fisheries would be considered insignificant.

Subsistence/Native Harvest Information

Subsistence hunters in Alaska and Russia have not been reported to take animals from this stock.

STATUS OF STOCK

Minke whales are not on the List of Endangered and Threatened Wildlife. The greatest uncertainty regarding the status of the Alaskan stock has to do with the uncertainty pertaining to the stock structure of this species in the eastern North Pacific. Because minke whales are considered common in the waters off Alaska and because the number of human-related removals is currently thought to be near-zero, this stock should not be considered a strategic stock, as defined in the amended Marine Mammal Protection Act. (Note: additional information on this species is reported in the Stock Assessment Report for the stock of minke whales found in waters off California, Oregon, and Washington).

REFERENCES

Best, P.B. 1993. Increase rates in severely depleted stocks of baleen whales. ICES J. Mar. Sci. 50:169-186.

Brueggeman, JJ., G.A. Green, K.C. Balcomb, CE. Bowlby, R.A. Grotefendt, K.T. Briggs, ML. Bonnell, R.G. Ford, D.H. Varoujean, D. Heinemann, and D.G. Chapman. 1990. Oregon-Washington marine mammal and seabird survey: Information synthesis and hypothesis formulation. U.S. Dep. Interior, Outer Continental Shelf Study, Minerals Management Service 89-0030:

Dizon, A. E., C. Lockyer, W. F. Perrin, D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 6:24-36.

Donovan, G.P. 1991. A review of IWC stock boundaries. Rept. Int. Whal. Commn. (Special Issue 13):39-68.

Leatherwood, S., RR Reeves, W.F. Perrin, and WE. Evans. 1982. Whales, dolphins, and porpoises of the eastern North Pacific and adjacent Arctic waters: A guide to their identification. U.S. Dep. Commer., NOAA Tech. Rept. NMFS Circular 444.245 pp.

Mizroch, S. A. 1992. Distribution of minke whales in the North Pacific based on sightings and catch data. Document SC/43/Mi36 submitted to Scientific Committee, Int. Whal. Commn. 37 pp.

National Marine Fisheries Service. In prep. Guidelines for Estimating Potential Biological Removals. U.S. Dep. Commer., NOAA Tech. Rep.

Rice, D.W. 1974. Whales and whale research in the eastern North Pacific. Pp. 170-195, In W.E. Schevill (ed.), The whale problem: A status report. Harvard Press, Cambridge, MA.

NORTHERN RIGHT WHALE (*Eubalaena glacialis*): North Pacific Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: (1) Distributional data: geographic distribution continuous; (2) Population response data: unknown; (3) Phenotypic data: unknown; and (4) Genotypic data: unknown, Based on this limited information, two stocks of northern right whales are currently recognized: a North Atlantic stock and a North Pacific Stock (Scarff 1986, Schevill 1986). In the eastern North Pacific south of 50°N, only 29 reliable sightings have been recorded since 1900 (Scarff 1986, 1991; Carretta et al. 1994). Whaling records indicate that right whales in the North Pacific range across the entire North Pacific north of 35°N and occasionally occur as far south as 20°N. Sightings have been reported as far south as central Baja California in the eastern North Pacific and as far north as the sub-Arctic waters of the Bering Sea and Sea of Okhotsk in the summer (Berzin and Doroshenko 1982, NMFS 1991). Migration patterns of the North Pacific stock are unknown.

POPULATION SIZE

The pre-exploitation size of this stock exceeded 11,000 animals (NMFS 1991). Based on sighting data, Wada (1973) estimated a total population of 100-200 in the North Pacific. Rice (1974) stated that only a few individuals remained in the eastern North Pacific stock, and that for all practical purposes was extinct because no sightings of a cow with calf have been confirmed since 1900 (D. Rice, pers. comm., Alaska Fisheries Science Center, 7600 Sand Point Way, NE, Seattle, WA 98115). Therefore, a reliable estimate of abundance is currently not available.

Minimum Population Estimate

A reliable estimate of minimum abundance for this stock is currently not available.

Current Population Trend

A reliable estimate of trend in abundance is currently not available.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

It is recommended (NMFS in prep.) that the cetacean maximum net productivity rate (R_{MAX}) of 4% be employed for this stock. However, this default rate is likely an underestimate based on the work reported by Best (1993).

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,. The recovery factor (F_R) for this stock is 0.1, the value for cetacean stocks which are listed as endangered (NMFS in prep.). If there are less than 500 whales the PBR would equal zero (500 x 0.02 x 0.1 = 1). Therefore, the PBR is zero based on the assumption that it is extremely unlikely that there are more than 500 whales in this stock.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

In June of 1983, a right whale was reported to be incidentally killed in a gillnet in Russian waters (NMFS 1991). No other observed takes have occurred in the North Pacific. Because the PBR is zero, any mortality incidental to commercial fisheries would not be considered insignificant.

Subsistence/Native Harvest Information

Subsistence hunters in Alaska and Russia are not reported to take animals from this stock.

STATUS OF STOCK

This stock is listed as endangered under the Endangered Species Act of 1973, and is thus classified as a strategic stock.

REFERENCES

Berzin, A. A., and N.V. Doroshenko. 1982. Distribution and abundance of right whales in the North Pacific. Rep. Int. Whal. Commn. 32:381-383.

Best, P. B. 1993. Increase rates in severely depleted stocks of baleen whales. ICES J. Mar. Sci 50:169-86.

Carretta, J. V., M. S. Lynn, and C. A. LeDuc. 1994. Right whale, Eubalaena glacialis, sighting off San Clemente Island, California. Mar. Mammal Sci. 10(1):101-104.

Dizon, A. E., C. Lockyer, W. F. Pen-in, D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 6:24-36.

National Marine Fisheries Service. 1991. Recovery Plan for the Northern Right Whale (Eubalaena glacialis). Prepared by the Right Whale Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland. 86 pp.

National Marine Fisheries Service. In prep. Guidelines for Estimating Potential Biological Removals. U.S. Dep. Commer., NOAA Tech. Rep.

Rice, D.W. 1974. Whales and whale research in the eastern North Pacific. Pp. 170-195, In W.E. Schevill (ed.), The whale problem: A status report. Harvard Press, Cambridge, MA.

Scarff, J. E. 1986. Historic and present distribution of the right whale, Eubalaena glacialis, in the eastern North Pacific south of 50°N and east of 180°W. Rep. Int. Whal. Commn. (Special Issue 10):43-63.

Scarff, J. E. 1991. Historic distribution and abundance of the right whale, Eubalaena glacialis, in the North Pacific, Bering Sea, Sea of Okhotsk and Sea of Japan from the Maury Whale Charts. Rep. Int. Whal. Commn. 41:467-487.

Schevill, W. E. 1986. Right whale nomenclature. Pp. 19, In R.L. Brownell Jr., P.B. Best, and J.H. Prescott (eds.), Right whales: Past and present status. Rept. Int. Whal. Commn. (Special Issue 10).

Wada, S. 1973. The ninth memorandum on the stock assessment of whales in the North Pacific. Rep. Int. Whal. Commn. 23:164-169.

BOWHEAD WHALE (*Balaena mysticetus*): Western Arctic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bowhead whales are distributed in seasonally ice-covered waters of the Arctic and near-Arctic, generally north of 54°N and south of 75°N in the western Arctic Basin (Moore and Reeves 1993). Small stocks occur in the Sea of Okhotsk, Davis Strait, Hudson Bay, and Spitsbergen, but only a few tens to a few hundreds are found in each of these stocks (Zeh et al. 1994). The largest remnant population is the Western Arctic stock which migrates from wintering areas (November to March) in the northern Bering Sea, through the Chukchi Sea in the spring (March through June), to the Beaufort Sea where they spend much of the summer (mid-May through September) before returning to the Bering Sea in the autumn (September through November) (Braham et al. 1980; Moore and Reeves 1993). The bowhead spring migration follows fractures in the sea ice around the coast of Alaska, generally in the shear zone between the shorefast ice and the mobile polar pack ice. There is evidence of whales following each other, even when their route does not take advantage of large ice-free areas, such as polynya (Rugh and Cubbage 1980). As the whales travel east past Point Barrow, their migration is somewhat funneled between shore and the polar pack ice, making for an optimal location from which to study this stock (Krogman 1980). Most of the year, bowhead whales are closely associated with sea ice. only during the summer is this population in relatively ice-free waters in the southern Beaufort Sea, an area often exposed to industrial activity related to petroleum exploration (Richardson et al. 1985).

POPULATION SIZE

All stocks of bowhead whales were severely depleted during intense commercial whaling prior to the 20th Century, starting in the early 16th Century near Labrador and spreading to the Bering Sea in the mid-19th Century (Woodby and Botkin 1993). These authors summarized previous efforts to approximate how many bowheads there were prior to commercial whaling. They reported a minimum worldwide population estimate of 50,000, with 10,400-23,000 in the Western Arctic stock (dropping to less than 3,000 at the end of commercial whaling).

Since 1978, counts of bowhead whales have been conducted from sites on sea ice north of Point Barrow, Alaska, during the whales' spring migration (Krogman et al. 1989). These counts have been corrected for whales missed due to distance offshore (through acoustical locators, described in Clark et al. 1994), whales missed when no watch was in effect (based on sighting rates), and whales missed during a watch (estimated as a function of visibility, number of observers, and distance offshore) (Zeh et al. 1994). However, in some years a small proportion of the population may not migrate past Barrow in spring, therefore the estimate could be negatively biased. In 1993, unusually good counting conditions resulted in what is considered to be the most accurate population estimate to date for this stock: 8,000 (CV = 0.0730), with a 95% confidence interval from 6,900 to 9,200 (Zeh et al. 1994).

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock is calculated from equation 1 from the PBR Guidelines (NMFS in prep.): $N_{MIN} = N/\exp(0.842*[\ln(1+[CV(N)]^2)]½)$. Using the population estimate (N) of 8,000 and its associated CV of 0.073, NM_{IN} for the Western Arctic stock of bowhead whales is 7,524.

Current Population Trend

The Western Arctic stock of bowhead whales increased at a rate of 3.1% (95% CI = 1.4-4.7%) from 1978 to 1993, when abundance increased from approximately 5,000 to 8,000 whales (Raftery et al. 1994). This rate of increase takes into account whales that passed beyond the viewing range of the ice-based observers.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The current estimate for the rate of increase for this stock of bowhead whales (3.1%) should not be used as an estimate of (R_{MAX}) because the population is currently being harvested and because the population has recovered to population levels where the growth is expected to be significantly less than R_{MAX}. Thus, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate (R,) of 4% be employed for the Western Arctic stock of bowhead whale (NMFS in prep.).

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 rather than the default value of 0.1 for endangered species because population levels are increasing in the presence of a known take (NMFS in prep.). Thus, PBR = (7,524 x 0.02 x 0.5), or 75 animals. The IWC independently established a quota for the number of bowhead whales, such that the number of whales struck can not exceed 68 in 1995,67 in 1996,66 in 1997, and 65 in 1998, which takes precedence over the PBR estimate for the purpose of managing the Alaska native subsistence harvest.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Rare cases of rope or net entanglement have been reported from whales taken in the subsistence hunt (Philo et al. 1993), but this species' association with sea ice limits the amount of fisheries activity in bowhead habitat. Thus, there are no recent records of mortality incidental to commercial fisheries. At present, annual mortality levels less than 7.5 animals per year (i.e., 10% of PBR) are considered insignificant. Therefore, the estimated annual mortality rate incidental to commercial fisheries (0.0; based on observer data and logbook reports) is considered insignificant and approaching a zero mortality and serious injury rate.

Subsistence/Native Harvest Information

Eskimos have been taking bowhead whales for at least 2000 years (Stoker and Krupnik 1993). Subsistence takes have been under a quota system under the authority of the International Whaling Commission since 1977. Native hunters take approximately 0.l-0.5% of the population per annum, primarily from 9 Alaskan communities (Philo et al. 1993). Since 1977, the number of kills has ranged between 14-72 per year, depending in part on changes in management strategy and in part to higher population estimates (Stoker and Krupnik 1993). The total estimated kill, including struck and lost, in each of the last 5 years has been 25 (1989), 41(1990), 46 (1991), 46 (1992), and 51 (1993), for an average of 42 whales per year (Suydam et al. 1994). The Alaskan Eskimo subsistence harvest is managed under an international regime that differs from the Marine Mammal Protection Act (MMPA) amended legislation. Therefore, development of PBRs for potential incidental take of all stocks in U.S. waters (required for bowhead whales even though there is no incidental take) is independent of subsistence harvest agreements.

STATUS OF STOCK

The level of human-caused mortality and serious injury (42) does not exceed the PBR (75) nor the IWC quota for 1995 (68). Bowhead whales of the Western Arctic stock are listed as endangered under the Endangered Species Act and are thus classified as a strategic stock.

REFERENCES

Braham, H. W., M.A. Fraker, and B.D. Krogman. 1980. Spring migration of the western Arctic population of bowhead whales. Mar. Fish. Rev. 42(9-10):36-46.

Clark, C. W., S. Mitchell, and R. Charif. 1994. Distribution and behavior of the bowhead whale, Balaena mysticetus, based on preliminary analysis of acoustic data collected during the 1993 spring migration off Point Barrow, Alaska. Unpubl. doc. submitted to Int. Whal. Commn. (SC/46/AS19).

Dizon, A. E., C. Lockyer, W. F. Perrin, D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 6:24-36.

Krogman, B.D. 1980. Sampling strategy for enumerating the western Arctic population of the bowhead whale. Mar. Fish. Rev. 42(9-10):30-36.

Krogman, B., D. Rugh, R. Sonntag, J. Zeh, and D. Ko. 1989. Ice-based census of bowhead whales migrating past Point Barrow, Alaska, 1978-1983. Mar. Mammal Sci. 5:116-138.

Moore, S. E. and R.R. Reeves. 1993. Distribution and movement. Pp. 313-386, In JJ. Burns, JJ. Montague, and CJ. Cowles (eds.), The bowhead whale. Soc. Mar. Mammalogy, Spec. Publ. No. 2.

National Marine Fisheries Service. In prep. Guidelines for Estimating Potential Biological Removals. U.S. Dep. Commer., NOAA Tech. Rep.

Philo, L M.,E. B. Shotts, and J. C. George. 1993. Morbidity and mortality. Pp. 275-312, In JJ. Burns, JJ. Montague, and CJ. Cowles (eds.), The bowhead whale. Soc. Mar. Mammalogy, Spec. Publ. No. 2.

Raftery, A., J. Zeh, and G. Givens. 1995. Revised estimate of bowhead rate of increase. Rep. Int. Whal. Commn. 45:158.

Richardson, W. J., R.A. Davis, C.R. Evans, and P. Norton. 1985. Distribution of bowhead and industrial activity, 1980-84. Pp. 255-306, In WJ. Richardson (ed.), Behavior, disturbance responses and distribution of bowhead whales, Balaena mysticetus, in the eastern Beaufort Sea, 1980-84. Rept. for U.S. Minerals Mgt. Serv. by LGL Inc., NTIS PB87 124376/AS. 306 pp.

Rugh, DJ., and J.C. Cubbage. 1980. Migration of bowhead whales past Cape Lisbume, Alaska. Mar. Fish. Rev. 42(9-10):46-51.

Stoker, S.W., and I.I. Krupnik. 1993. Subsistence whaling. Pp. 579-629, In JJ. Burns, JJ. Montague, and CJ. Cowles (eds.), The bowhead whale. Spec. Publ. No. 2, Soc. Mar. Mammalogy.

Suydam, R., R. Angliss, J.C. George, S. Braund, and D.P. DeMaster. 1995. Revised data on the subsistence harvest of bowhead whales (Balaena mysticetus) by Alaska Eskimos, 1973-1993. Rep. Int. Whal. Comm. 45:335-338.

Woodby, D.A., and D.B. Botkin. 1993. Stock sizes prior to commercial whaling. Pp. 387-407, In JJ. Burns, JJ. Montague, and CJ. Cowles (eds.), The bowhead whale. Soc. Mar. Mammalogy, Spec. Publ. No. 2.

Zeh, JE., J.C. George, and R. Suydam. 1994. Rate of increase, 1978- 1993, of bowhead whales, Balaena mysticetus. Rep. Int. whal. commn.45:339-344.

Appendix 1. Summary Table

Species	Stock	N(est)	CV	C. F.	CV	C-CV	N(min)	0.5Rm	F(r)	PBR	CF kill	Subsist	Status
Baird's Beaked Whale	Alaska	N/A					N/A	0.02	0.50	N/A	0.0	0.0	NS
Bearded Seal	Alaska	N/A					N/A	0.06	0.50	N/A	6.2	N/A	NS
Beluga Whale	Beaufort	41610	0.102	2.00	N/A	0.102	38194	0.02	1.00	764	0.0	160	NS
Beluga Whale	Eastern Chukchi Sea	3710	N/A	3.09	N/A	N/A	3710	0.02	1.00	74	0.0	65	NS
Beluga Whale	Norton Sound++	7367	N/A	3.52	N/A	N/A	N/A	0.02	N/A	N/A	0.0*	147	N/A
Beluga Whale	Bristol Bay	1555	N/A	3.09	N/A	N/A+	1526	0.02	1.00	31	0.3*	22	NS
Beluga Whale	Cook Inlet++	1251	0.140	2.90	N/A	0.140	N/A	0.02	N/A	N/A	0.0*	N/A	N/A
Bowhead Whale	Western Arctic	8000	0.073			0.0730	7524	0.02	0.50	75	0.0	42	S
Cuvier's Beaked Whale	Alaska	N/A					N/A	0.02	0.50	N/A	0.0	0.0	NS
Dall's Porpoise	Alaska	83400	0.097	0.20	N/A	0.0970	76874	0.02	1.00	1537	41	0.0	NS
Fin Whale	Alaska	N/A					N/A	0.02	0.10	N/A	0.0	0.0	S
Gray Whale	Eastern N Pacific	23109	0.074			0.0740	21715	0.02	1.00	434	0.3	0.0	NS
Harbor Porpoise	Alaska	29744	N/A			N/A	24635	0.02	0.50	246	33	0.0	NS
Harbor Porpoise	Alaska-aerial	27714	0.129	3.10	0.171	0.215	23172						
Harbor Porpoise	Alaska-vessel	2030	0.392	1.28	0.091	0.404	1463						
Harbor Seal	Southeast Alaska	34652	0.026	1.61	0.062	0.0673	32745	0.06	1.00	1965	6.0*	1,643	NS
Harbor Seal	Gulf of Alaska++	19694	0.030	1.61	0.062	0.0689	N/A	0.06	N/A	N/A	35	833	N/A
Harbor Seal	Bering Sea	18322	0.037	1.61	0.062	0.0722	17243	0.06	1.00	1035	12	322	NS
Humpback Whale	Western N Pacific	N/A					N/A	0.02	0.10	N/A	0.0	0.0	S
Humpback Whale	Central N Pacific	1407	0.107				1407	0.02	0.10	2.8	0.0	0.0	S
Killer Whale	Resident	759	N/A				759	0.02	0.50	7.6	0.8	0.0	NS
Killer Whale	Transient	245	N/A				245	0.02	0.50	2.5	0.8	0.0	NS
Minke Whale	Alaska	N/A					N/A	0.02	0.50	N/A	0.0	0.0	NS
N Right Whale	North Pacific	N/A					N/A	0.02	0.10	0.0	0.0	0.0	S
Northern Fur Seal	Eastern N Pacific	1019192	0.059			0.0593	969595	0.043	0.50	20846	6.4	1,777	S
Pac White-Sided Dol	North Pacific	931000	0.900			0.900	486719	0.02	0.50	4867	1.1	0.0	NS
Ribbon Seal	Alaska	N/A					N/A	0.06	0.50	N/A	0.4	N/A	NS
Ringed Seal	Alaska	N/A					N/A	0.06	0.50	N/A	0.8	N/A	NS
Sperm Whale	Alaska	N/A					N/A	0.02	0.10	N/A	0.0	0.0	S
Spotted Seal	Alaska	N/A					N/A	0.06	0.50	N/A	1.0*	N/A	NS
Stejneger's Beaked Whale	Alaska	N/A					N/A	0.02	0.50	N/A	0.0	0.0	NS
Steller Sea Lion	Eastern	23900	0.0184	1.33	N/A	0.0184	23533	0.06	0.75	1059	4.0	4.0	S
Steller Sea Lion	Western U.S.	43200	0.0184	1.33	N/A	0.0184	42536	0.06	0.30	766	41	514	S

C.F. = Correction Factor; C-CV= Combined CV; CF kill = Commercial Fishery Kill; Status: S=Strategic, NS=Not Strategic

*No reported take by NMFS observers; however, observer coverage was minimal or nonexistent. +Nmin from literature (see text).

* ++ not calculated pending co-management agreement