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 polynyas 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).

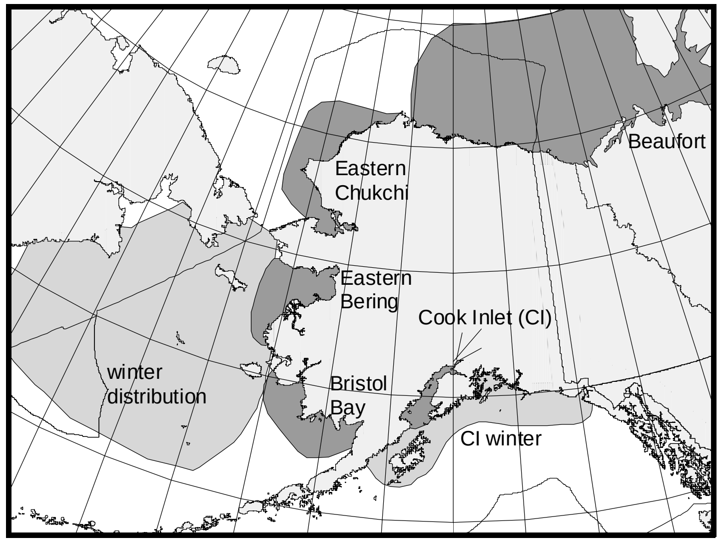

Figure 1. Approximate distribution of beluga whales in Alaska waters. The dark shading displays the summer distributions of the five stocks. Winter distributions are depicted with lighter shading.

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 (G. O'Corry-Crowe, unpubl. data, Southwest Fisheries Science Center, P.O. Box 271, La Jolla, CA 92038). Based on this information, 5 stocks of beluga whales are recognized within U. S. waters: 1) Cook Inlet, 2) Bristol Bay, 3) Eastern Bering Sea, 4) Eastern Chukchi Sea, and 5) Beaufort Sea (Fig. 14).

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 (1993) reported an estimate of 21,000 for the Beaufort Sea stock, similar to that reported by Seaman et al. (1985). The most recent aerial survey was conducted in July of 1992, when stock size was estimated to include 19,629 (CV=0.229) beluga whales (Harwood et al. 1996). To account for availability bias a correction factor of 2, which was not data-based, has been recommended for the Beaufort Sea beluga whale stock (Duval 1993), resulting in a population estimate of 39,258 (19,629 x 2) animals. A CV for the correction factor is not available; however, this correction factor was considered negatively biased by the Alaska SRG considering that CFs for this species typically range between 2.5 and 3.27 (Frost and Lowry 1995).

Minimum Population Estimate

For the Beaufort Sea stock of beluga whales, the minimum population estimate (N_{MIN}) is calculated according to Equation 1 from the PBR Guidelines (Wade and Angliss 1997). Thus, $N_{MIN} = N/\exp(0.842*[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 39,258 and an associated CV of 0.229, N_{MIN} for this stock is 32,453.

Current Population Trend

The Beaufort Sea stock of beluga whales is considered to be stable or increasing (DeMaster 1995: 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 (Wade and Angliss 1997).

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: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. As this stock is stable or increasing (DeMaster 1995: pp. 16), the recovery factor (F_R) for this stock is 1.0 (Wade and Angliss 1997). Thus, for the Beaufort Sea stock of beluga whales, PBR = 649 animals (32,453 x 0.02 x 1.0).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

The total fishery mortality and serious injury for this stock is estimated to be zero as there are no reports of mortality incidental to commercial fisheries in recent years. The estimated annual mortality rate incidental to commercial fisheries (0) is not known to exceed 10% of the PBR (65) and, therefore, is considered to be insignificant and approaching zero mortality and serious injury rate.

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 reported that the number of whales harvested annually for subsistence has averaged approximately 50 during the 5-year period from 1990 to 1994 (Frost and Suydam 1995). The 1995 harvest report for this stock is not available. Estimates from the Canadian harvest for this stock over the same 5-year period from 1990 to 1994 have averaged 110 whales per year (DeMaster 1995, pp. 15). Thus, the mean estimated subsistence take for the Beaufort Sea beluga stock is 160 (50+110). 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 does not account for animals which are struck and lost. There is not a reliable estimate for the percent struck and lost from this stock.

In the draft stock assessment reports (Hill et al. 1996), subsistence mortality was averaged over the most recent 3-year period for which data were available. This was an attempt to incorporate interannual variability, while still recognizing that mortality rates have declined in recent years. However, based on a request from the ABWC, human-related removals have been averaged over the last 5 years for which data are available for all beluga whale stocks, except the Cook Inlet stock. This request was due to the large amount of interannual variability in harvest levels in most areas (letter from ABWC to Alaska SRG, 20 December 1996).

STATUS OF STOCK

Beluga whales are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Based on currently available data, the level of human-caused mortality and serious injury (160) is not known to exceed the PBR (649). Therefore, the Beaufort Sea stock of beluga whales is not classified as a strategic stock. The population size is considered stable or increasing, however, at this time it is not possible to assess the status of this stock relative to OSP.

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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 polynyas 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).

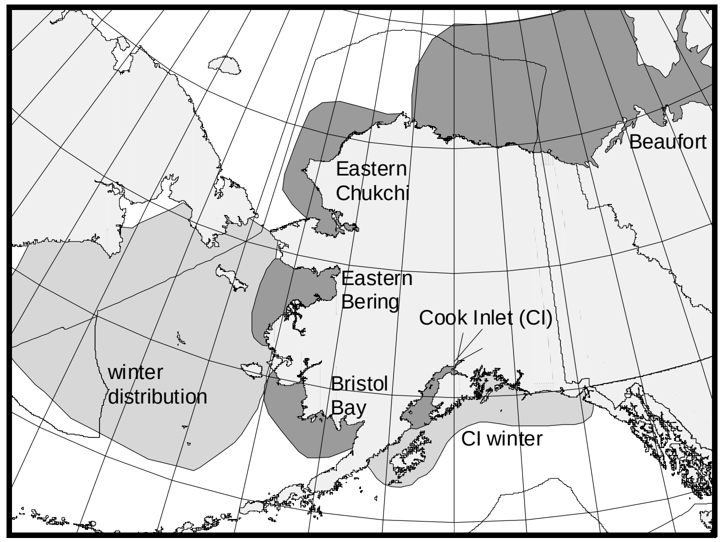

Figure 2. Approximate distribution of beluga whales in Alaska waters. The dark shading displays the summer distributions of the five stocks. Winter distributions are depicted with lighter shading.

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 (G. O'Corry-Crowe, unpubl. data, Southwest Fisheries Science Center, P.O. Box 271, La Jolla, CA 92038). Based on this information, 5 stocks of beluga whales are recognized within U. S. waters: 1) Cook Inlet, 2) Bristol Bay, 3) Eastern Bering Sea, 4) Eastern Chukchi Sea, and 5) Beaufort Sea (Fig. 15).

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 that belugas from this stock are known to frequent (e.g., Kotzebue Sound) were not surveyed. Therefore, the survey effort resulted in a minimum count. If this count is corrected for the proportion of animals that were diving using radio telemetry data 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 (Small and DeMaster 1995). That is, if the distribution of beluga whales in the eastern Chukchi Sea is similar to the distribution of beluga whales in the Beaufort Sea, which is likely, then a substantial fraction of the population remains in offshore waters during the survey period (DeMaster 1997).

Current Population Trend

The most recent raw counts (1,200 animals) of beluga whales in this area are similar to counts of 1,104 and 1,601 conducted in the same area during the summer of 1979 (Frost et al. 1993). Based on these data, there is no evidence that the Eastern Chukchi Sea stock of beluga whales is declining in spite of a history of subsistence takes.

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 (Wade and Angliss 1997).

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 considered relatively stable and not declining in the presence of known take, thus the recovery factor (F_R) for this stock is 1.0 (DeMaster 1995: pp. 17, Wade and Angliss 1997). For the Eastern Chukchi Sea stock of beluga whales, PBR = 74 animals (3,710 x 0.02 x 1.0).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Three different commercial fisheries that could have interacted with beluga whales from this stock were monitored for incidental take by NMFS observers during 1990-95: 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 vessel operators required by the MMPA interim exemption program. During the 4-year period between 1990 and 1993, logbook reports, where observer data were not available, did not include any mortality to beluga whales from this stock. Complete logbook data after 1993 are not available.

In the near shore waters of the Eastern Chukchi Sea, substantial effort occurs in gillnet (mostly set nets), and personal-use fisheries. Although a potential source of mortality, there have been no reported takes of beluga whales as a result of these fisheries.

The estimated minimum annual mortality rate incidental to commercial fisheries (0) is not known to exceed 10% of the PBR (7) and, therefore, is considered to be insignificant and approaching zero mortality and serious injury rate.

Subsistence/Native Harvest Information

The subsistence take of beluga whales from the eastern Chukchi Sea stock is provided by the ABWC, who reported that the number of whales harvested for subsistence has averaged approximately 54 whales annually during the 5-year period from 1991 to 1995 (Frost and Suydam 1995, ABWC unpubl. data, ABWC, P.O. Box 69, Barrow, AK, 99723). This estimate is based on household surveys and on-site harvest monitoring, but is negatively biased because there is not a reliable estimate for the percent struck and lost. The 1995 subsistence take of 43 animals includes 6 whales which were reported as struck and lost (ABWC unpubl. data, ABWC, P.O. Box 69, Barrow, AK, 99723).

In the draft stock assessment reports (Hill et al. 1996), subsistence mortality was averaged over the most recent 3-year period for which data were available. This was an attempt to incorporate interannual variability, while still recognizing that mortality rates have declined in recent years. However, based on a request from the ABWC, human-related removals have been averaged over the last 5 years for which data are available for all beluga whale stocks, except the Cook Inlet stock. This request was due to the large amount of interannual variability in harvest levels in most areas (letter from ABWC to Alaska SRG, 20 December 1996).

STATUS OF STOCK

Beluga whales are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Based on currently available data, the estimated annual rate of human-caused mortality and serious injury (54) is not known to exceed the PBR (74). Therefore, the Eastern Chukchi Sea stock of beluga whales is not classified as a strategic stock. The population size is considered stable, however, at this time it is not possible to assess the status of this stock relative to OSP.

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BELUGA WHALE (*Delphinapterus leucas*): Eastern Bering 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 polynyas 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).

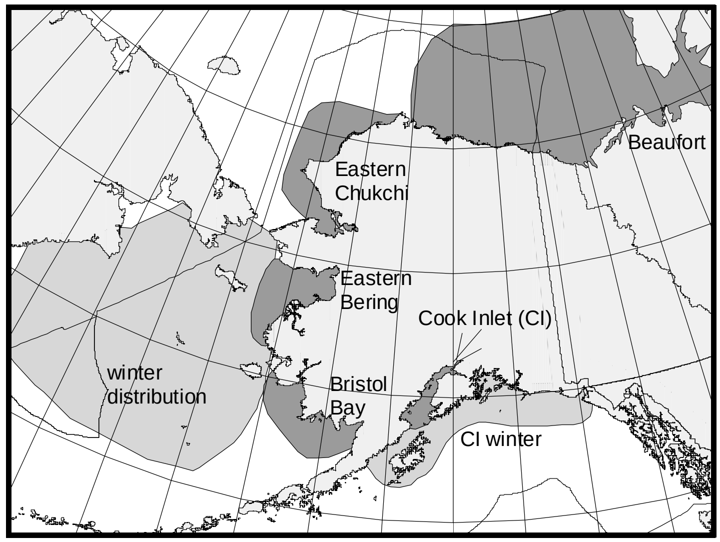

Figure 3. Approximate distribution of beluga whales in Alaska waters. The dark shading displays the summer distributions of the five stocks. Winter distributions are depicted with lighter shading.

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 (G. O'Corry-Crowe, unpubl. data, Southwest Fisheries Science Center, P.O. Box 271, La Jolla, CA 92038). Based on this information, 5 stocks of beluga whales are recognized within U. S. waters: 1) Cook Inlet, 2) Bristol Bay, 3) Eastern Bering Sea, 4) Eastern Chukchi Sea, and 5) Beaufort Sea (Fig. 16).

POPULATION SIZE

DeMaster et al. (1994) estimated the minimum abundance (e.g., uncorrected for probability of sighting) 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. As a result the 1993 and 1994 estimates were considered to be negatively biased. Due to the disparity of estimates, the Norton Sound aerial surveys were repeated in June of 1995 leading to the highest abundance estimate of any year, but not significantly different than in 1992. An aerial survey conducted June 22 of 1995 resulted in an uncorrected estimate of 2,583 beluga whales (Lowry and DeMaster 1996). It should be noted that a slightly higher estimate (2,666) occurred during the 1995 survey over three day period from June 6-8. The single day estimate of (2,583), instead of the 3-day estimate was used to minimize the potential for double counting of whales. Correction factors recommended from studies of belugas range from 2.5 to 3.27 (Frost and Lowry 1995). For Norton Sound, the correction factor of 2.62 (CV[CF] not available) is recommended for the proportion of animals that were diving and thus not visible at the surface (based on methods of Frost and Lowry 1995), given the particular altitude and speed of the survey aircraft. If this correction factor is applied to the June 22 estimate of 2,583 (CV=0.26) along with the additional correction factor for the proportion of newborns and yearlings not observed due to their small size and dark coloration (1.18; Brodie 1971), the total corrected abundance estimate for the Eastern Bering Sea stock is 7,986 (2,583 x 2.62 x 1.18) beluga whales.

Minimum Population Estimate

For the Eastern Bering Sea stock of beluga whales, the minimum population estimate (N_{MIN}) is calculated according to Equation 1 from the PBR Guidelines (Wade and Angliss 1997). Thus, $N_{MIN} = N/\exp(0.842*[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 7,986 and an associated CV of 0.26, N_{MIN} for this stock is 6,439 beluga whales. A CV(N) that incorporates variance due to all of the correction factors is currently not available. However, the Alaska Scientific Review Group (SRG) considers the CV derived from the abundance estimate (CV=0.26) as adequate in calculating a minimum population estimate (DeMaster 1996, 1997; see discussion of N_{MIN} for the Eastern Chukchi stock of beluga whales). Due to foggy conditions encountered during the 1995 surveys, it was not possible to survey the entire Norton Sound area occupied by belugas during a continuous time period. As a result, the 1995 abundance estimate is considered to be conservative (Lowry and DeMaster 1996).

Current Population Trend

Surveys to estimate population abundance in Norton Sound were not conducted prior to 1992. However, between 1992 and 1995, survey data indicate that the population is less likely to be declining than it is to be stable or increasing.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for the Eastern Bering 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 (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 1.0, the value for cetacean stocks that are thought to be stable in the presence of a subsistence harvest (Wade and Angliss 1997). The Alaska SRG recommended using a F_R of 1.0 for this stock as the Alaska Beluga Whale Committee (ABWC) intends to continue regular surveys (i.e., 3-5 years) to estimate abundance for this stock and to annually monitor levels of subsistence harvest (DeMaster 1997). For the Eastern Bering Sea stock of beluga whales, PBR = 129 animals (6,439 x 0.02 x 1.0).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Three different commercial fisheries that could have interacted with beluga whales in the Eastern Bering Sea were monitored for incidental take by NMFS observers during 1990-95: 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 vessel operators as required by the MMPA interim exemption program. During the 4-year period from 1990 to 1993, logbook reports, where observer data were not available, did not include any mortality or injury to beluga whales from this stock. Complete logbook data after 1993 are not available. In the near shore waters of the Eastern Bering Sea, substantial effort occurs in gillnet (mostly set nets), herring, and personal-use fisheries. Although a potential source of mortality, there have been no reported takes of beluga whales as a result of these fisheries.

The estimated minimum annual mortality rate incidental to commercial fisheries (0) is not known to exceed 10% of the PBR (16) and, therefore, is considered to be insignificant and approaching zero mortality and serious injury rate.

Subsistence/Native Harvest Information

The subsistence take of beluga whales from the Eastern Bering Sea stock is provided by the ABWC, who reported that the number of whales harvested for subsistence during the period from 1991 through 1994 was 209, 94, 136 and 122 whales, respectively (Frost and Suydam 1995). These estimates are based on household surveys and on-site harvest monitoring, but are negatively biased because they have not been corrected for hunters that did not respond, and there is not a reliable estimate for the percent struck and lost. In 1995, the ABWC reported 56 whales taken from the stock, including 6 animals which were struck and lost. The harvest report from one Yukon Delta village in 1995 is unknown, but based on historical information is expected to be approximately 8 (Frost 1996), making the estimated harvest from the stock 64 (56+8) whales. However, the 1995 data did not include harvest information from the Kuskokwim region, an area averaging approximately 10 whales annually from 1990 to 1994 (Frost and Suydam 1995). Assuming the Kuskokwim subsistence take was similar to previous years, the best estimate for the 1995 take from the Eastern Bering Sea stock is 74 (64+10) whales. Thus, during the 5-year period from 1991 to 1995 the average subsistence take is approximately 127 whales. As mentioned above, this estimate is negatively biased, furthermore, an unknown proportion of the animals harvested each year by Native hunters in this region may belong to other beluga stocks migrating through Norton Sound in both the fall and spring (DeMaster 1995: pp. 4).

In the draft stock assessment reports (Hill et al. 1996), subsistence mortality was averaged over the most recent 3-year period for which data were available. This was an attempt to incorporate interannual variability, while still recognizing that mortality rates have declined in recent years. However, based on a request from the ABWC, human-related removals have been averaged over the last 5 years for which data are available for all beluga whale stocks, except the Cook Inlet stock. This request was due to the large amount of interannual variability in harvest levels in most areas (letter from ABWC to Alaska SRG, 20 December 1996).

STATUS OF STOCK

Beluga whales are not listed as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act. Based on currently available data, the estimated annual rate, over the 5-year period from 1991 to 1995, of human-caused mortality and serious injury (127) is not known to exceed the PBR (129) for this stock. Further, the 1995 estimate (74) was well below the PBR, and may reflect a lower directed level of take rather than annual variation in harvest data. Therefore, the Eastern Bering Sea beluga whale stock is not classified as strategic. No decreasing trend has been detected for this stock in the presence of a known harvest, although at this time it is not possible to assess the status of this stock relative to OSP.

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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 polynyas 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).

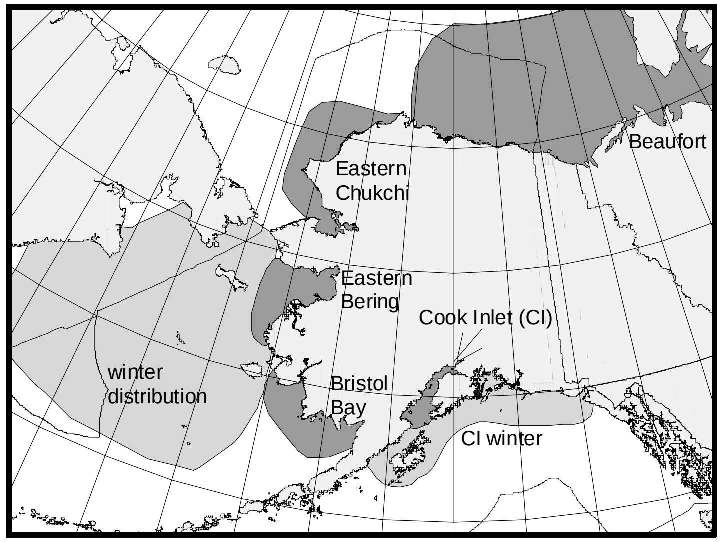

Figure 4. Approximate distribution of beluga whales in Alaska waters. The dark shading displays the summer distributions of the five stocks. Winter distributions are depicted with lighter shading.

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 (G. O'Corry-Crowe, unpubl. data, Southwest Fisheries Science Center, P.O. Box 271, La Jolla, CA 92038). Based on this information, 5 stocks of beluga whales are recognized within U. S. waters: 1) Cook Inlet, 2) Bristol Bay, 3) Eastern Bering Sea, 4) Eastern Chukchi Sea, and 5) Beaufort Sea (Fig. 17).

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). This estimate was based on a count of 503 animals, which was corrected using radio-telemetry data 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 their 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. However, for this stock, it is unlikely that significant numbers of belugas remain in offshore areas or other areas that are not included in the survey area. Given this survey methodology, an estimate of the variance of abundance is unavailable. Consistent with the recommendations of the Alaska Scientific Review group (DeMaster 1997), a default CV(N) of 0.2 was used in the calculation of the minimum population estimate (N_{MIN}). N_{MIN} for this stock is calculated using Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842*[\ln(1+[CV(N)]^2)]^{1/2})$. Using the population estimate (N) of 1,555 and the default CV (0.2), N_{MIN} for the Bristol Bay stock of beluga whales is 1,316.

Current Population Trend

Abundance estimates from surveys conducted in 1983, 1993, and 1994 are similar to estimates from the 1950s (Brooks 1955), suggesting this stock of beluga whales should be considered stable (Frost and Lowry 1990, 1995a).

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 (Wade and Angliss 1997).

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: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. As this stock is considered stable (Frost and Lowry 1990) and because of the regular surveys to estimate abundance and the annual harvest monitoring program supported by the Alaska Beluga Whale Committee (ABWC), the recovery factor (F_R) for this stock is 1.0 (Wade and Angliss 1997, DeMaster 1997; see discussion under PBR for the Eastern Bering Sea stock). Thus, for the Bristol Bay stock of beluga whales, PBR = 26 animals (1,316 x 0.02 x 1.0).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Three different commercial fisheries that could have interacted with beluga whales in Bristol Bay were monitored for incidental take by NMFS observers during 1990-95: 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.

Table 13. Summary of incidental mortality of beluga whales (Bristol Bay stock) due to commercial fisheries from 1990 through 1995 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from logbook reports.

Fishery name	Years	Data type	Range of observer coverage	Reported mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Observer program total	90-95					0
Bristol Bay salmon drift gillnet	90-93	logbook	n/a	0, 1, 0, 0	n/a	[$0.25]
Bristol Bay salmon set gillnet	90-93	logbook	n/a	1, 0, 0, 0	n/a	[$0.25]
Minimum total annual mortality						$0.5

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 vessel operators as required by the MMPA interim exemption program. Observers have never monitored the Bristol Bay salmon set gillnet and drift gillnet fisheries which combined are estimated to have over 2,800 active permits. During the 4-year period from 1990 to

1993, logbook reports included 1 mortality in both 1990 and 1991 from these fisheries (see Table 13) resulting in an annual mean of 0.5 mortalities from interactions with commercial gear. However, because logbook records are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. The 1990 logbook records from the Bristol Bay set and drift gillnet fisheries were combined. As a result, the 1990 mortality may have occurred in the drift net fishery. Complete logbook data after 1993 are not available. Larger fishery related mortalities resulting from these fisheries have been recorded in the past. In 1983 the Alaska Department of Fish and Game documented at least 12 beluga whale mortalities in Bristol Bay related to drift and set gillnet fishing (Frost et al. 1984).

The estimated minimum mortality rate incidental to commercial fisheries is 1 animal per year (rounded up from 0.5), based entirely on logbook data. However, a reliable estimate of the mortality rate incidental to commercial fisheries is currently unavailable because of the absence of observer placements in the Bristol Bay gillnet fisheries that are known to interact with this stock. Therefore, it is unknown whether the kill rate is insignificant. At present, annual mortality levels less than 2.6 per year (i.e., 10% of PBR) can be considered insignificant and approaching zero mortality and serious injury rate.

Subsistence/Native Harvest Information

The subsistence take of beluga whales from the Bristol Bay stock is provided by the ABWC, who reported that the number of whales harvested for subsistence during 1990, 1991, 1993 and 1994 was 20, 16, 34 and 16 whales, respectively (Frost and Suydam 1995). The 1992 harvest values are unavailable as they were not reported to the ABWC by the Bristol Bay villages. In 1995, the ABWC reported 9 whales taken from this stock, including 3 (33% of the total take) animals which were struck and lost (ABWC unpubl. data, ABWC, P.O. Box 69, Barrow, AK, 99723). Using the data from the most recent 5-year period (excluding the null data from 1992), the subsistence harvest has averaged approximately 19 animals per year during the period from 1990 to 1995.

In the draft stock assessment reports (Hill et al. 1996), subsistence mortality was averaged over the most recent 3-year period for which data were available. This was an attempt to incorporate interannual variability, while still recognizing that mortality rates have declined in recent years. However, based on a request from the ABWC, human-related removals have been averaged over the last 5 years for which data are available for all beluga whale stocks, except the Cook Inlet stock. This request was due to the large amount of interannual variability in harvest levels in most areas (letter from ABWC to Alaska SRG, 20 December 1996).

STATUS OF STOCK

Beluga whales are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Based on currently available data, the estimated annual rate of human-caused mortality and serious injury (20) is not known to exceed the PBR (26). Therefore, the Bristol Bay stock of beluga whales is not classified as a strategic stock. However, as noted previously, the estimate of fisheries-related mortality is unreliable and, therefore, likely to be underestimated. The population size is considered stable, however, at this time it is not possible to assess the status of this stock relative to OSP.

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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 polynyas 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).

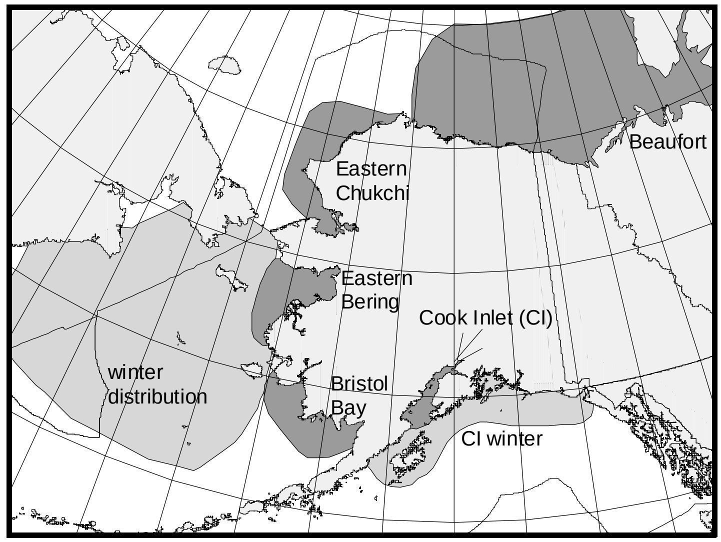

Figure 5. Approximate distribution of beluga whales in Alaska waters. The dark shading displays the summer distributions of the five stocks. Winter distributions are depicted with lighter shading.

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 (O'Corry-Crowe et al. 1997). Based on this information, 5 stocks of beluga whales are recognized within U. S. waters: 1) Cook Inlet, 2) Bristol Bay, 3) Eastern Bering Sea, 4) Eastern Chukchi Sea, and 5) Beaufort Sea (Fig. 18).

POPULATION SIZE

Aerial surveys for beluga whales in Cook Inlet were conducted annually in June or July during 1994-97 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 median counts for all groups observed in the 1994-97 surveys is 279, 338, 361, and 264 whales, respectively (Rugh et al. 1997a). The process of using medians instead of maximum counts reduces the effects of outliers (extremes in high or low counts), makes the results more comparable to other surveys which lack multiple passes over whale groups, and is more appropriate than using maximums when the counts will be corrected for missed whales (Rugh et al. 1996).

An abundance estimate based on the 1995-97 count data has not been derived. However, correcting the 1994 count data to account for subsurface animals (using the formula of McLaren 1961; 1.093, CV is unavailable) and animals at the surface that were missed (2.45; CV=0.14) resulted in an abundance estimate of 747 (CV=0.19) beluga whales in Cook Inlet (Hobbs et al. 1995). Correcting the 1994 abundance estimate to account for the proportion of newborns and yearlings not observed due to their small size and dark coloration (1.18; Brodie 1971), results in a total corrected abundance estimate of 881 whales (747 × 1.18) for the Cook Inlet stock. When applying this same approach to the count data from 1997 (264), the resulting estimate of abundance is 834 (264×[2.45×1.093×1.118]). Therefore, because similar techniques were used in 1994 and 1997, at this time the best estimate of abundance for this stock is 834. Pending the development of a CV for this approach or the development of alternative approaches, the CV for this estimate is assumed to equal the CV for the 1994 estimate (0.19).

Minimum Population Estimate

The survey technique utilized for estimating the abundance of beluga whales is a direct count which incorporates correction factors. Although a CV for the newborn and yearling correction factor is not available, the Alaska Scientific Review Group concluded that the abundance estimate and associated CV(N) are adequately conservative to serve as an estimate of minimum population size (N_{MIN}) for this stock (DeMaster 1997). N_{MIN} is calculated according to Equation 1 from the PBR Guidelines (Wade and Angliss 1997): N_{MIN}= $N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 834 and its associated CV(N) of 0.19, N_{MIN} for the Cook Inlet stock of beluga whales is 712.

Current Population Trend

In general, uncorrected counts have ranged from 300 to 500 beluga whales within Cook Inlet between 1970 and 1996. Data from prior National Marine Mammal Laboratory and NMFS Alaska Regional Office studies indicated median counts of 200 beluga whales in June 1991, 255 in June 1992, 344 in June 1993, 287 in July 1993, 157 in September 1993, 279 in June 1994, 338 in July 1995, 361 in June 1996, and 264 in June 1997. Only the 1993-97 surveys provided thorough coverage of Cook Inlet, however, all of the surveys included coverage of the Suisitna River delta where most of the whales occur (Rugh et al. 1997a). The lower count in 1997 (264) may be a cause for concern.

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 (Wade and Angliss 1997).

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: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. Based on the recommendations of the Cook Inlet Marine Mammal Council (CIMMC) and the Alaska Scientific Review Group (DeMaster 1997), for the purpose of promoting co-management of this stock an F_R of 1.0 was used. Thus, PBR = 14 animals (712 × 0.02 × 1.0) for the Cook Inlet stock of beluga whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Three types of commercial fishing gear that could possibly interact with beluga whales occur in Cook Inlet (purse seine, drift gillnet, and set gillnet) and are used to catch each of the five species of Pacific salmon, as well as Pacific herring. There are no observer data as fishery 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 self-reported fisheries information required of vessel operators by the MMPA. During the period between 1990 and 1996, fisher self-reports indicated no mortalities of beluga whales from interactions with commercial fishing operations (Table 14a). Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable for 1996 (see Appendix 4).

In the past, beluga mortalities have been attributed to Cook Inlet fisheries with the fishing-related mortality during the 3-year period from 1981 to 1983 estimated at 3-6 animals per year (Burns and Seaman 1986). Accordingly, though there were no self-reported fishery mortalities of beluga whales, the Cook Inlet gillnet fisheries (having a combined total of over 1,325 active permits in 1996) have been included in Table 14a because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994).

Based on a lack of reported mortalities, the estimated minimum mortality rate incidental to commercial fisheries is zero belugas per year from this stock. However, a reliable estimate of the mortality rate incidental to commercial fisheries is currently unavailable because of the absence of observer placements in the Cook Inlet fisheries mentioned above.

Table 14a. Summary of incidental mortality of beluga whales (Cook Inlet stock) due to commercial fisheries from 1990 through 1996 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from self-reported fisheries information. Data from 1992 to 1996 (or the most recent 5 years of available data) are used in the mortality calculation when more than 5 years of data are provided for a particular fishery. n/a indicates that data are not available.

Fishery name	Years	Data type	Range of observer coverage	Reported mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Observer program total	92-96					0
Cook Inlet salmon drift gillnet	90-96	self reports	n/a	0, 0, 0, 0, n/a n/a, n/a	n/a	[0]
Cook Inlet salmon set gillnet	90-96	self reports	n/a	0, 0, 0, 0, n/a n/a, n/a	n/a	[0]
Minimum total annual mortality						0

Subsistence/Native Harvest Information

A study conducted by the Alaska Department of Fish and Game (ADF&G), in cooperation with the Alaska Beluga Whale Committee (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 (Table 14b: 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. However, in consultation with native elders from the Cook Inlet region, the Cook Inlet Marine Mammal Council (CIMMC) estimated the annual number of belugas taken by subsistence hunters to be greater than 30 animals (DeMaster 1995: p. 5).

There was no systematic Cook Inlet beluga harvest survey in 1994. Instead, Cook Inlet harvest data for 1994 were compiled at the November 1994 ABWC meeting. Representatives of the CIMMC, ADF&G Division of Subsistence, and an active Cook Inlet hunter each presented harvest information they knew about. They discussed the information among themselves to eliminate redundancy, and agreed upon a final 1994 harvest estimate of 19 retrieved and 2 struck and lost. This included 2 belugas taken in Cook Inlet by hunters from Kotzebue Sound. The ADF&G representative estimated that there were 35-50 active beluga hunting households in the Cook Inlet region.

The most recent subsistence harvest data concerning the Cook Inlet beluga whale stock is provided in Table 14b. The most thorough subsistence harvest surveys ever completed in Cook Inlet were conducted by the CIMMC during 1995 and 1996. The CIMMC (through the ABWC) reported 72 whales taken from the stock in 1995, including 22 (30.5%) animals which were struck and lost. During 1996, 98 to 147 whales were estimated to have been taken from the stock, including a range of struck and lost estimates from 49 to 98 whales. However, some of the local hunters believe this estimate of struck and lost is positively biased. The 1995 and 1996 CIMMC take estimates are considered reliable. Given these data and using an estimate of 123 animals for 1996, the annual subsistence take averaged approximately 72 during the 3-year period from 1994 to 1996. Due to the thoroughness of the 1995 and 1996 harvest reports as compared to earlier years, it is not possible to ascertain the trend in subsistence take. However, due to the pattern of increasing harvest levels in this area, subsistence mortality for the Cook Inlet stock has been averaged over a 3-year period whereas a 5-year period is used for the other four beluga whale stocks occurring in this document.

Table 14b. Summary of the subsistence harvest data for the Cook Inlet stock of beluga whales, 1992-96. n/a indicates the data are not available.

Year	Reported total number taken	Estimated range of total take	Reported number harvested	Estimated number struck and lost
1992	9[1]	n/a	9	n/a
1993	30[2]	n/a	n/a	n/a
1994	21[2]	n/a	19[2]	2[2]
1995	72	n/a	50	22
1996	123	98-147	49	49-98
Mean annual take (1994-96)	72			

[1] Does not include the number of struck and lost; reported take an estimate; [2] Estimated value (see text).

OTHER MORTALITY

Mortalities related to stranding events have been reported in Cook Inlet. For example, in June of 1996, 63 animals stranded in the Susitna Delta (Rugh et al. 1997b). Four of these animals are known to have died as a result of the stranding event (B. Smith, pers. comm., NMFS, 222 W 7th Ave., Anchorage, AK, 99513). Such mortalities are not likely to be associated with human-related activities.

STATUS OF STOCK

Beluga whales are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. A reliable estimate of the annual rate of mortality incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the kill rate is insignificant. At present, annual commercial fishery-related mortality levels less than 1.4 per year (i.e., 10% of PBR) can be considered insignificant and approaching zero mortality and serious injury rate. Based on currently available data, the estimated annual level of total human-caused mortality is 72 beluga whales (estimated exclusively from subsistence harvest data) exceeds the PBR (14) for this stock. Therefore, the Cook Inlet beluga whale stock is classified as a strategic stock. It is not possible to ascertain trends in abundance at this time; however, the current level of human-caused removals is not sustainable.

Sustainable harvest levels for this stock will be determined from the analysis of information gathered through the cooperative management process, and will reflect the degree of uncertainty associated with the information obtained for this stock. Efforts were initiated in 1995 and continued in 1996 to develop an umbrella agreement among the Indigenous People's Council for Marine Mammals, FWS, and NMFS regarding the cooperative management of certain stocks of marine mammals utilized by Native subsistence hunters in Alaska. The final agreement was signed August 27, 1997. It is anticipated that in 1998, efforts will be initiated to formalize a specific agreement with local Alaska Native Organizations and NMFS regarding the management of this stock.

Habitat Concerns

The State of Alaska has held 41 oil and gas lease sales in Cook Inlet since 1959. The planned Cook Inlet Area-wide Sale is scheduled for Feb. 1999, and will offer 4.2 million acres in and around Cook Inlet including tracts at the major river mouths, such as the Beluga River, Susitna River, and Little Susitna River, which are areas of concentrated use by belugas in ice-free seasons. Activities associated with these sales include seismic geophysical exploration, drilling, discharge of drill muds and cuttings, discharge of sanitary wastes and production/formation waters, construction of drill platforms, vessel and aircraft support. It is unknown what affect, if any, the lease sales and associated activities will have on the Cook Inlet beluga whale stock.

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KILLER WHALE (*Orcinus orca*): Eastern North Pacific Northern 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 Alaska waters, killer whales occur along the entire Alaska 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 throughout British Columbia and the inland waterways of Washington State (Bigg et al. 1990), as well as 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) and whales identified in Southeast Alaska have been observed in Prince William Sound, British Columbia, and Puget Sound (Leatherwood et al. 1990, Dahlheim et al. 1997). Movements of killer whales between the waters of Southeast Alaska and central California have also been documented (Goley and Straley 1994).

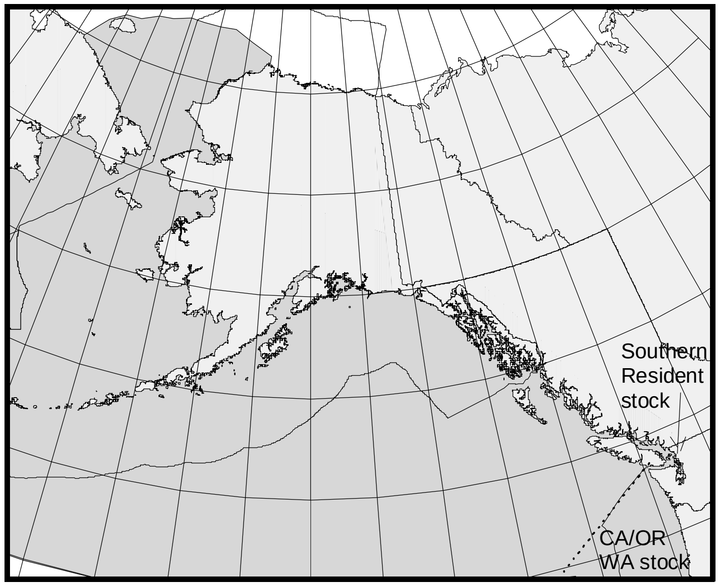

Figure 6. Approximate distribution of killer whales in the eastern North Pacific (shaded area). The distribution of the Eastern North Pacific Northern Resident and Transient stocks are largely overlapping (see text).

Killer whales along British Columbia and Washington State have been labeled as 'resident', 'transient', and 'offshore' (Bigg et al. 1990, Ford et al. 1994). Whales of a particular type have not been observed to associate with members of the other group types (Ford et al. 1994). Although less is known about killer whales in Alaska, it appears that all three types occur in Alaska waters (Dahlheim et al. 1997). The 'resident' and 'transient' group types 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, and 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' types are genetically distinct (Stevens et al. 1989, Hoelzel 1991, Hoelzel and Dover 1991, Hoelzel et al. 1998).

Less is known about the 'offshore' type killer whales, which typically travel in pods of 25-75 individuals and have been encountered primarily off the coasts of California, Oregon, British Columbia and, rarely, in Southeast Alaska (Ford et al. 1994, Black et al. 1997, Dahlheim et al. 1997). Studies indicate the 'offshore' group type, although distinct from the other types ('resident' and 'transient'), appears to be more closely related genetically, morphologically, behaviorally, and vocally to the 'resident' type killer whales (Black et al. 1997, Hoelzel et al. 1998; J. Ford, pers. comm., Vancouver Aquarium, P. O. Box 3232, Vancouver, B.C. V6B3X8; L. Barrett-Lennard, pers. comm., Univ. of British Columbia, 6270 University Blvd., Vancouver, B.C. V6T1Z4).

Based primarily on data regarding association patterns, acoustics, movements, genetic differences and potential fishery interactions, five killer whale stocks are recognized along the west coast of North America from California to Alaska: 1) the Eastern North Pacific Northern Resident stock - occurring from British Columbia through Alaska, 2) the Eastern North Pacific Southern Resident stock - occurring within the inland waters of Washington state and southern British Columbia, 3) the Eastern North Pacific Transient stock - occurring from Alaska to Cape Flattery, WA, 4) the California/Oregon/Washington Pacific Coast stock - occurring from Cape Flattery through California (Fig. 19), and 5) the Eastern North Pacific Offshore stock - occurring from Southeast Alaska through California. Because the stock area for the Eastern North Pacific Northern Resident stock is defined as the waters from British Columbia through Alaska, 'resident' whales in Canadian waters are considered part of the Eastern North Pacific Northern Resident stock. The Stock Assessment Reports for the Pacific Region contain information concerning the Eastern North Pacific Southern Resident stock, the California/Oregon/Washington Pacific Coast stock, the Eastern North Pacific Offshore stock (to be included in the 1999 stock assessment revisions), and a Hawaiian stock. The stock structure recommended in this report should be considered preliminary pending a joint review by the Alaska and Pacific Scientific Review Groups.

POPULATION SIZE

The Eastern North Pacific Northern Resident stock is a transboundary stock, including killer whales from British Columbia. Preliminary analysis of photographic data resulted in the following minimum counts for 'resident' killer whales belonging to the Eastern North Pacific Northern Resident stock (Note: individual whales have been matched between geographical regions and missing animals likely to be dead have been subtracted). In British Columbia, 200 'resident' whales have been identified (Ford et al. 1994). In Southeast Alaska, an additional 89 'resident' whales have been identified (Dahlheim et al. 1997). In Prince William Sound and Kenai Fjords, another 360 'resident' whales have been identified (Matkin et al. 1998). Based on data collected from all Alaska waters west of Seward (Dahlheim and Waite 1993, Dahlheim 1994, Dahlheim 1997), 68 whales are considered 'residents' as they have been linked by association to 'resident' whales from Prince William Sound (G. Ellis, pers. comm., Pacific Biological Station, Nanaimo, BC, V9R 5K6), and an additional 174 have been provisionally classified as 'residents' and 53 as 'transients.' Provisional classifications were based primarily on morphological differences identified from the photographs. Accordingly, the numbers of 'residents' and 'transients' in Alaska waters west of Seward are considered preliminary at this time. Combining the counts of 'resident' whales gives a minimum number of 717 (200 + 89 + 360 + 68) killer whales belonging to the Eastern North Pacific Northern Resident stock.

Minimum Population Estimate

The survey technique utilized for obtaining the abundance estimate of killer whales is a direct count of individually identifiable animals. 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. However, the rate of discovering new whales within Southeast Alaska and Prince William Sound is relatively low. In addition, the abundance estimate does not include 174 unclassified whales from western Alaska that have been provisionally classified as 'residents'.

Other estimates of the overall population size (i.e., N_{BEST}) and associated CV(N) are not currently available. Thus, the minimum population estimate (N_{MIN}) for the Eastern North Pacific Northern Resident stock of killer whales is 717 animals, which includes animals found in Canadian waters (see PBR Guidelines regarding the status of migratory transboundary stocks, Wade and Angliss 1997). Information on the percentage of time animals typically encountered in Canadian waters spend in U. S. waters is unknown. However, as noted above, this minimum population estimate is considered conservative. This approach is consistent with the recommendations of the Alaska Scientific Review Group (DeMaster 1996).

Current Population Trend

Mortality and recruitment rates for six 'resident' killer whale pods in Prince William Sound from 1985 to 1991 and for 16 pods in northern British Columbia from 1981 to 1986 indicate a 2% annual rate of increase for each region over the years examined (Matkin and Saulitis 1994). However, at present, reliable data on trends in population abundance for the entire Eastern North Pacific Northern Resident 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. Studies of 'resident' killer whale pods in the Pacific Northwest resulted in estimated population growth rates of 2.92% and 2.54% over the period from 1973 to 1987 (Olesiuk et al. 1990, Brault and Caswell 1993). However, a population increases at the maximum growth rate (R_{MAX}) only when the population is at extremely low levels; thus, the estimate of 2.92% is not a reliable 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 (Wade and Angliss 1997).

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 cetacean stocks with unknown population status (Wade and Angliss 1997). Thus, for the Eastern North Pacific Northern Resident killer whale stock, PBR = 7.2 animals (717 × 0.02 × 0.5).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Six different commercial fisheries in Alaska that could have interacted with killer whales were monitored for incidental take by fishery observers from 1990 to 1996: Bering Sea (and Aleutian Islands) and Gulf of Alaska groundfish trawl, longline, and pot fisheries. Of the 6 observed fisheries, killer whale mortalities occurred only in the Bering Sea groundfish trawl and longline fisheries. For the fisheries with observed takes, the range of observer coverage over the 7-year period, as well as the annual observed and estimated mortalities are presented in Table 15. Both the 1991 and 1995 mortalities in the longline fishery occurred during unmonitored hauls and could not be used to estimate total mortality for the fishery in those years (80% and 28% observer coverage in 1991 and 1995, respectively). For computational purposes, the estimated mortality in 1991 and 1995 was set at 1, because at a minimum, one whale is known to have perished in each of those years. The 1993 mortality in the trawl fishery occurred under similarly circumstances and was treated in the same manner (66% observer coverage in 1993). The mean annual (total) mortality was 0.6 (CV=0.67) for the Bering Sea groundfish trawl fishery and 0.2 (CV=1.0) for the combined Bering Sea longline fishery, resulting in a mean annual mortality rate of 0.8 (CV=0.56) killer whales per year from observed fisheries.

Table 15. Summary of incidental mortality of killer whales (Eastern North Pacific Northern Resident stock) due to commercial fisheries from 1990 through 1996 and calculation of the mean annual mortality rate. Data from 1992 to 1996 are used in the mortality calculation when more than 5 years of data are provided for a particular fishery.

Fishery name	Years	Data type	Range of observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Bering Sea/Aleutian Is. (BSAI) groundfish trawl	90-96	obs data	53-74%	0, 1, 1, 1, 0, 0, 0	1, 2, 2, 1, 0, 0, 0	0.6 (CV=0.67)
BSAI groundfish longline (incl. misc. finfish and sablefish fisheries)	90-96	obs data	27-80%	0, 1, 0, 0, 0, 1, 0	0, 1, 0, 0, 0, 1, 0	0.2 (CV=1.0)
Estimated total annual mortality						0.8 (CV=0.56)

An additional source of information on the number of killer whales killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1990 and 1996, fisher self-reports from all Alaska fisheries indicated only one killer whale mortality, which occurred in the Bering Sea groundfish trawl fishery in 1990. That mortality has been included as an estimated mortality in Table 15 even though an observer program was in operation for that fishery (with 74% observer coverage) and did not report any killer whale mortalities during that year. However, because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable for 1996 (see Appendix 4).

The estimated minimum mortality rate incidental to U. S. commercial fisheries recently monitored is 0.8 animals per year, based exclusively on observer data. As the animals which were taken incidental to commercial fisheries have not been identified genetically, it is not possible to determine whether they belonged to the Eastern North Pacific Northern Resident or the Eastern North Pacific Transient killer whale stock. Accordingly, these same mortalities can be found in the stock assessment report for the Transient stock.

Due to a lack of Canadian observer programs, there are few data concerning the mortality of marine mammals incidental to Canadian commercial fisheries, which are analogous to U.S. fisheries that are known to interact with killer whales. The sablefish longline fishery accounts for a large proportion of the commercial fishing/killer whale interactions in Alaska waters. Such interactions have not been reported in Canadian waters where sablefish are taken via a pot fishery. Since 1990, there have been no reported fishery-related strandings of killer whales in Canadian waters. However, in 1994, one killer whale was reported to have contacted a salmon gillnet but did not entangle (Guenther et al. 1995). Data regarding the level of killer whale mortality related to commercial fisheries in Canadian waters, though thought to be small, are not readily available or reliable which results in an underestimate of the annual mortality for this stock.

Subsistence/Native Harvest Information

There are no reports of a subsistence harvest of killer whales in Alaska or Canada.

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 1995). 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 Islands region (Yano and Dahlheim 1995). During the 1992 surveys conducted in the Bering Sea and western Gulf of Alaska, 9 of 182 (4.9%) individual whales in 7 of the 12 (58%) 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 and 1991, 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 may be related to gunshot wounds or effects of the *Exxon Valdez* oil spill (Dahlheim and Matkin 1994).

The shooting of killer whales in Canadian waters has also been a concern in the past. However, in recent years the Canadian portion of the stock has been researched so extensively that evidence of bullet wounds would have been noticed if shooting was prevalent (G. Ellis, pers. comm., Pacific Biological Station, Nanaimo, BC, V9R 5K6).

Other Issues

Although only small numbers of killer whales are taken in the Bering Sea fisheries, there is considerable interaction between the whales and the fisheries. Interactions between killer whales and longline vessels have been well documented (Dahlheim 1988, Yano and Dahlheim 1995). However, less has been documented regarding interactions with the trawl fishery. Recently several observers reported that large groups of killer whales in the Bering Sea have followed vessels for days at a time, actively consuming the processing waste (Fishery Observer Program, unpubl. data, NMFS, AFSC, 7600 Sand Point Way NE, Seattle, WA 98115).

STATUS OF STOCK

Killer whales are not listed as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act. Recall, that the human-caused mortality has been underestimated due primarily to a lack of information on Canadian fisheries, and that the minimum abundance estimate is considered conservative (because researchers continue to encounter new whales and unclassified whales from western Alaska were not included), resulting in a conservative PBR estimate. However, based on currently available data, the estimated annual fishery-related mortality level (0.8) exceeds 10% of the PBR, (i.e., 0.72) and therefore cannot be considered to be insignificant and approaching zero mortality and serious injury rate. The estimated annual level of human-caused mortality and serious injury (0.8 animals per year) is not known to exceed the PBR (7.2). Therefore, the Eastern North Pacific Northern Resident stock of killer whales is not classified as a strategic stock. Population trends and status of this stock relative to its Optimum Sustainable Population size are currently unknown.

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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 Alaska waters, killer whales occur along the entire Alaska 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 throughout British Columbia and the inland waterways of Washington State (Bigg et al. 1990), as well as 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) and whales identified in Southeast Alaska have been observed in Prince William Sound, British Columbia, and Puget Sound (Leatherwood et al. 1990, Dahlheim et al. 1997). Movements of killer whales between the waters of Southeast Alaska and central California have also been documented (Goley and Straley 1994).

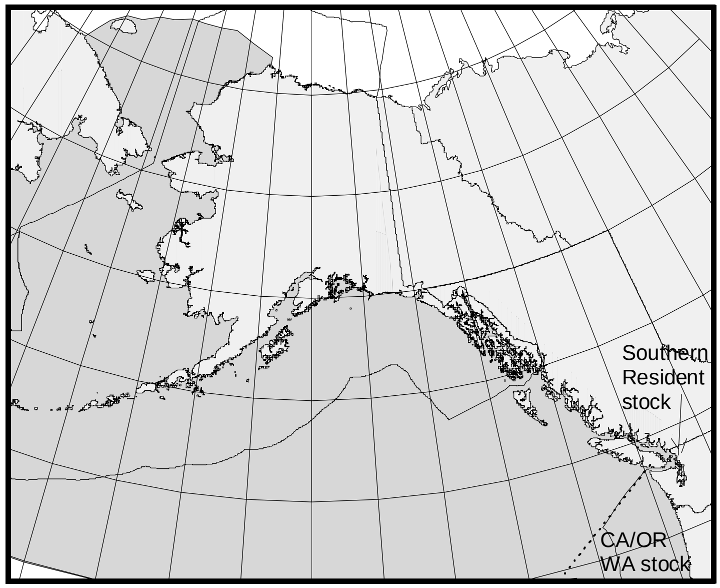

Figure 7. Approximate distribution of killer whales in the eastern North Pacific (shaded area). The distribution of the Eastern North Pacific Northern Resident and Transient stocks are largely overlapping (see text).

Killer whales along British Columbia and Washington State have been labeled as 'resident', 'transient', and 'offshore' (Bigg et al. 1990, Ford et al. 1994). Whales of a particular type have not been observed to associate with members of the other group types (Ford et al. 1994). Although less is known about killer whales in Alaska, it appears that all three types occur in Alaska waters (Dahlheim et al. 1997). The 'resident' and 'transient' types 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, and 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' types are genetically distinct (Stevens et al. 1989, Hoelzel 1991, Hoelzel and Dover 1991, Hoelzel et al. 1998).

Less is known about the 'offshore' type killer whales, which typically travel in pods of 25-75 individuals and have been encountered primarily off the coasts of California, Oregon, British Columbia and, rarely, in Southeast Alaska (Black et al. 1997, Dahlheim et al. 1997, Ford et al. 1994). Studies indicate the 'offshore' group type, although distinct from the other types ('resident' and 'transient'), appears to be more closely related genetically, morphologically, behaviorally, and vocally to the 'resident' type killer whales (Black et al. 1997, Hoelzel et al. 1998; J. Ford, pers. comm., Vancouver Aquarium, P. O. Box 3232, Vancouver, B.C. V6B3X8; L. Barrett-Lennard, pers. comm., Univ. of British Columbia, 6270 University Blvd., Vancouver, B.C. V6T1Z4).

Based primarily on data regarding association patterns, acoustics, movements, genetic differences and potential fishery interactions, five killer whale stocks are recognized along the west coast of North America from California to Alaska: 1) the Eastern North Pacific Northern Resident stock - occurring from British Columbia through Alaska, 2) the Eastern North Pacific Southern Resident stock - occurring within the inland waters of Washington state and southern British Columbia, 3) the Eastern North Pacific Transient stock - occurring from Alaska to Cape Flattery, WA, 4) the California/Oregon/Washington Pacific Coast stock - occurring from Cape Flattery through California (Fig. 20), and 5) the Eastern North Pacific Offshore stock - occurring from Southeast Alaska through California. Because the stock area for the Eastern North Pacific Transient stock is defined as the waters from Cape Flattery through Alaska, 'transient' whales in Canadian waters are considered part of the Eastern North Pacific Transient stock. The Stock Assessment Reports for the Pacific Region contain information concerning the Eastern North Pacific Southern Resident stock, the California/Oregon/Washington Pacific Coast stock, the Eastern North Pacific Offshore stock (to be included in the 1999 stock assessment revisions), and a Hawaiian stock. The stock structure recommended in this report should be considered preliminary pending a joint review by the Alaska and Pacific Scientific Review Groups.

POPULATION SIZE

The Eastern North Pacific Northern Transient stock is a transboundary stock, including killer whales from British Columbia. Preliminary analysis of photographic data resulted in the following minimum counts for 'transient' killer whales belonging to the Eastern North Pacific Transient stock (Note: individual whales have been matched between geographical regions and missing animals likely to be dead have been subtracted). In British Columbia and southeastern Alaska, 170 'transient' whales have been identified (Ford et al. 1994). In the Gulf of Alaska, 17 'transient' killer whales have been identified genetically and acoustically (L. Barrett-Lennard, pers. comm., Univ. of British Columbia, 6270 University Blvd., Vancouver, B.C. V6T1Z4). The transient group AT1, commonly seen in Prince William Sound, was thought to have an additional 11 whales alive in 1997 (Matkin et al. 1998). Based on data collected from all Alaska waters west of Seward (Dahlheim and Waite 1993, Dahlheim 1994, Dahlheim 1997), 68 whales are considered 'residents' as they have been linked by association to 'resident' whales from Prince William Sound (G. Ellis, pers. comm., Pacific Biological Station, Nanaimo, BC, V9R 5K6), and an additional 174 are provisionally classified as 'residents' and 53 as 'transients.' Provisional classifications were based primarily on morphological differences identified from the photographs. Accordingly, the numbers of 'residents' and 'transients' in Alaska waters west of Seward are considered preliminary at this time. Combining the counts of 'transient' whales gives a minimum number of 198 (170 + 17 + 11) killer whales belonging to the Eastern North Pacific Transient stock.

Minimum Population Estimate

The survey technique utilized for obtaining the abundance estimate of killer whales is a direct count of individually identifiable animals. 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. However, the rate of discovering new whales within Southeast Alaska and Prince William Sound is relatively low. In addition, the abundance estimate does not include: 1) 53 unclassified whales from western Alaska that have been provisionally classified as 'transients', or 2) 105 'transients' encountered in California which have been linked by association and acoustic data to 'transient' whales in British Columbia (Black et al. 1997; G. Ellis, pers. comm., Pacific Biological Station, Nanaimo, BC, V9R 5K6). The California animals are currently accounted for in the abundance estimate for the California/Oregon/Washington Pacific Coast stock.

Other estimates of the overall population size (i.e., N_{BEST}) and associated CV(N) are not currently available. Thus, the minimum population estimate (N_{MIN}) for the Eastern North Pacific Transient stock of killer whales is 198 animals, which includes animals found in Canadian waters (see PBR Guidelines regarding the status of migratory transboundary stocks, Wade and Angliss 1997). Information on the percentage of time animals typically encountered in Canadian waters spend in U. S. waters is unknown. However, as noted above, this minimum population estimate is considered conservative. This approach is consistent with the recommendations of the Alaska Scientific Review Group (DeMaster 1996).

Current Population Trend

At present, reliable data on trends in population abundance for the Eastern North Pacific Transient 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. Studies of 'resident' killer whale pods in the Pacific Northwest resulted in estimated population growth rates of 2.92% and 2.54% over the period from 1973 to 1987 (Olesiuk et al. 1990, Brault and Caswell 1993). However, a population increases at the maximum growth rate (R_{MAX}) only when the population is at extremely low levels; thus, the estimate of 2.92% is not a reliable 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 (Wade and Angliss 1997).

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 cetacean stocks with unknown population status (Wade and Angliss 1997). Thus, for the Eastern North Pacific Transient killer whale stock, PBR = 2.0 animals (198 × 0.02 × 0.5).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Six different commercial fisheries in Alaska that could have interacted with killer whales were monitored for incidental take by NMFS observers from 1990 to 1996 Bering Sea (and Aleutian Islands) and Gulf of Alaska groundfish trawl, longline, and pot fisheries. Of the 6 observed fisheries, killer whale mortalities occurred only in the Bering Sea groundfish trawl and longline fisheries. For the fisheries with observed takes, the range of observer coverage over the 7-year period, as well as the annual observed and estimated mortalities are presented in Table 16. Both the 1991 and 1995 mortalities in the longline fishery occurred during unmonitored hauls and could not be used to estimate total mortality for the fishery in those years (80% and 28% observer coverage in 1991 and 1995, respectively). For computational purposes, the estimated mortality in 1991 and 1995 was set at 1, because at a minimum, one whale is known to have perished in each of those years. The 1993 mortality in the trawl fishery occurred under similarly circumstances and was treated in the same manner (66% observer coverage in 1993). The mean annual (total) mortality was 0.6 (CV=0.67) for the Bering Sea groundfish trawl fishery and 0.2 (CV=1.0) for the combined Bering Sea longline fishery, resulting in a mean annual mortality rate of 0.8 (CV=0.56) killer whales per year from observed fisheries.

Table 16. Summary of incidental mortality of killer whales (Eastern North Pacific Northern Transient stock) due to commercial fisheries from 1990 through 1996 and calculation of the mean annual mortality rate. Data from 1992 to 1996 are used in the mortality calculation when more than 5 years of data are provided for a particular fishery.

Fishery name	Years	Data type	Range of observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Bering Sea/Aleutian Is. (BSAI) groundfish trawl	90-96	obs data	53-74%	0, 1, 1, 1, 0, 0, 0	1, 2, 2, 1, 0, 0, 0	0.6 (CV=0.67)
BSAI groundfish longline (incl. misc. finfish and sablefish fisheries)	90-96	obs data	27-80%	0, 1, 0, 0, 0, 1, 0	0, 1, 0, 0, 0, 1, 0	0.2 (CV=1.0)
Estimated total annual mortality						0.8 (CV=0.56)

An additional source of information on the number of killer whales killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1990 and 1996, fisher self-reports from all Alaska fisheries indicated only one killer whale mortality, which occurred in the Bering Sea groundfish trawl fishery in 1990. That mortality has been included as an estimated mortality in Table 16 even though an observer program was in operation for that fishery (with 74% observer coverage) and did not report any killer whale mortalities during that year. However, because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable for 1996 (see Appendix 4).

The estimated minimum mortality rate incidental to U. S. commercial fisheries recently monitored is 0.8 animals per year, based exclusively on observer data. As the animals which were taken incidental to commercial fisheries have not been identified genetically, it is not possible to determine whether they belonged to the Eastern North Pacific Northern Resident or the Eastern North Pacific Transient killer whale stock. Accordingly, these same mortalities can be found in the stock assessment report for the Resident stock.

Due to a lack of Canadian observer programs, there are few data concerning the mortality of marine mammals incidental to Canadian commercial fisheries, which are analogous to U.S. fisheries that are known to interact with killer whales. The sablefish longline fishery accounts for a large proportion of the commercial fishing/killer whale interactions in Alaska waters. Such interactions have not been reported in Canadian waters where sablefish are taken via a pot fishery. Since 1990, there have been no reported fishery-related strandings of killer whales in Canadian waters. However, in 1994, one killer whale was reported to have contacted a salmon gillnet but did not entangle (Guenther et al. 1995). Data regarding the level of killer whale mortality related to commercial fisheries in Canadian waters, though thought to be small, are not readily available or reliable which results in an underestimate of the annual mortality for this stock.

Subsistence/Native Harvest Information

There are no reports of a subsistence harvest of killer whales in Alaska or Canada.

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 1995). 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 1995). During the 1992 surveys conducted in the Bering Sea and western Gulf of Alaska, 9 of 182 (4.9%) individual whales in 7 of the 12 (58%) 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 and 1991, 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 may be related to gunshot wounds or effects of the *Exxon Valdez* oil spill (Dahlheim and Matkin 1994).

The shooting of killer whales in Canadian waters has also been a concern in the past. However, in recent years there have been no reports of shooting incidents in Canadian waters. In fact, the likelihood of shooting incidents involving ‘transient’ killer whales is thought to be minimal since commercial fishermen are most likely to observe ‘transients’ feeding on seals or sea lions instead of interacting with their fishing gear (G. Ellis, pers. comm., Pacific Biological Station, Nanaimo, BC, V9R 5K6).

Other Issues

Although only small numbers of killer whales are taken in the Bering Sea fisheries, there is considerable interaction between the whales and the fisheries. Interactions between killer whales and longline vessels have been well documented (Dahlheim 1988, Yano and Dahlheim 1995). However, less has been documented regarding interactions with the trawl fishery. Recently several observers reported that large groups of killer whales in the Bering Sea have followed vessels for days at a time, actively consuming the processing waste (Fishery Observer Program, unpubl. data, NMFS, AFSC, 7600 Sand Point Way NE, Seattle, WA 98115).

STATUS OF STOCK

Killer whales are not listed as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act. Recall, that the human-caused mortality has been underestimated primarily due to a lack of information on Canadian fisheries, and that the minimum abundance estimate is considered conservative (because researchers continue to encounter new whales and unclassified whales from western Alaska were not included), resulting in a conservative PBR estimate. Based on currently available data, the estimated annual fishery-related mortality level (0.8) exceeds 10% of the PBR (i.e., 0.20) and therefore can not be considered to be insignificant and approaching zero mortality and serious injury rate. The estimated annual level of human-caused mortality and serious injury (0.8 animals per year) is not known to exceed the PBR (2.0). Therefore, the Eastern North Pacific Transient stock of killer whales is not classified as a strategic stock. Population trends and status of this stock relative to its Optimum Sustainable Population size are currently unknown.

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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. In the eastern North Pacific the species occurs from the southern Gulf of California, north to the Gulf of Alaska, west to Amchitka in the Aleutian Islands, and is rarely encountered in the southern Bering Sea. The species is common both on the high seas and along the continental margins, and animals are known to enter the inshore passes of Alaska, British Columbia, and Washington (RIWC 1997).

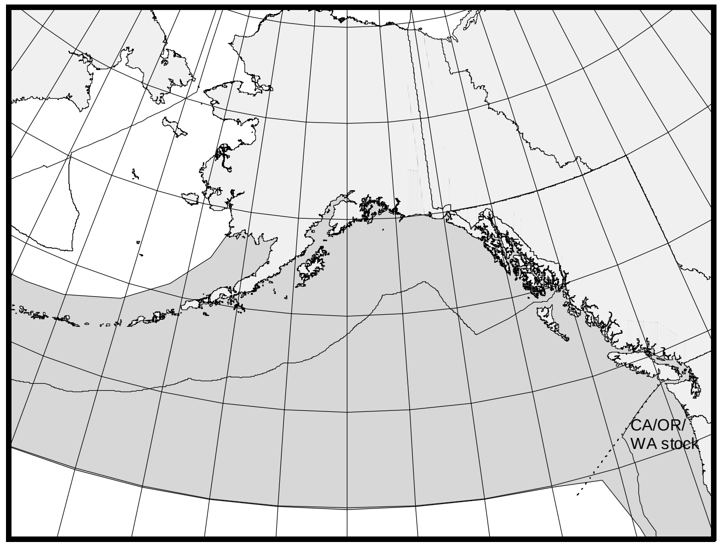

Figure 8. Approximate distribution of Pacific white-sided dolphins in the eastern North Pacific (shaded area).

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 is continuous; 2) Population response data: unknown; 3) Phenotypic data: two morphological forms are recognized (Walker et al. 1986, Chivers et al. 1993); and 4) Genotypic data: preliminary genetic analyses on 116 Pacific white-sided dolphin collected in four areas (Baja California, the west coast of the U. S., British Columbia/southeast Alaska, and offshore) were not statistically significant to support phylogeographic partitioning, though lend credence support the hypothesis that animals from the different regions are sufficiently isolated to treat them as separate management units (RIWC 1997). Based on this limited information, stock structure throughout the North Pacific is poorly defined, 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. The northern and southern forms can not, however, currently be differentiated for abundance and mortality estimation, and are thus managed as a single unit. Because the California and Oregon thresher shark/swordfish drift gillnet fishery operates between 33°N and 45°N and is known to interact with Pacific white-sided dolphins, two stocks are recognized: 1) the California/Oregon/Washington stock, and 2) the Central North Pacific stock (Fig. 21). The California/Oregon/ Washington stock is reported separately in the Stock Assessment Reports for the Pacific Region.

POPULATION SIZE

The most recent population abundance estimate for Pacific white-sided dolphins was calculated from line transect analyses applied to the 1987-90 central North Pacific marine mammal sightings survey data (Buckland et al. 1993). The 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*).

In other words, the abundance estimates for Pacific white-sided dolphins may be biased upwards by more than five-fold.

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock is calculated according to Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/exp(0.842*[ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 931,000 and its associated CV of 0.900, N_{MIN} for the Central 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_{MAX}) of 4% be employed for this stock (Wade and Angliss 1997).

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 cetacean stocks of unknown status (Wade and Angliss 1997). Thus, for the Central North Pacific stock of Pacific white-sided dolphin, PBR = 4,867 animals (486,719 x 0.02 x 0.5).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Between 1978 and 1991, thousands of Pacific white-sided dolphins were killed annually incidental to high seas fisheries. However, these fisheries have not operated in the central North Pacific since 1991.

Six different commercial fisheries in Alaska that could have interacted with Pacific white-sided dolphins were monitored for incidental take by NMFS observers from 1990 to 1995: Bering Sea (and Aleutian Islands) and Gulf of Alaska groundfish trawl, longline, and pot fisheries. For the fisheries with observed takes, the range of observer coverage over the 6-year period, as well as the annual observed and estimated mortalities are presented in Table 17. The mean annual (total) mortality was 0.2 (CV=1.0) in the Bering Sea groundfish trawl fishery and 0.8 (CV=1.0) in the Bering Sea groundfish longline fishery. The 1992 mortality in the Bering Sea groundfish trawl fishery occurred during an unmonitored haul and therefore could not be used to estimate mortality for the entire fishery. Therefore, 1 mortality was used as both the observed mortality and estimated mortality in 1992 for that fishery, and should be considered a minimum estimate. Combining the estimates results in a mean annual (total) mortality rate of 1 Pacific white-sided dolphin in observed fisheries.

The Prince William Sound salmon drift gillnet fishery was also monitored by observers in 1990 and 1991. In 1990, observers boarded 300 (57.3%) of the 524 vessels participating in that fishery, monitoring a total of 3,166 sets, or roughly 4% of the estimated number of sets made by the fleet (Wynne et al. 1991). In 1991, observers boarded 531 (86.9%) of the 611 registered vessels and monitored a total of 5,875 sets, or roughly 5% of the estimated sets made by the fleet (Wynne et al. 1992). The low level of observer coverage for this fishery apparently missed interaction with Pacific-white sided dolphins which had occurred, as logbook mortalities were reported in both years (see Table 17) which were not recorded by the observer program.

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 vessel operators required by the MMPA interim exemption program. During the 4-year period from 1990 to 1993, logbook reports from 3 unobserved fisheries (see Table 17) resulted in an annual mean of 2.25 mortalities from interactions with commercial fishing gear. It is unclear exactly which Bristol Bay fishery caused the 1990 mortalities because the logbook records from the Bristol Bay set and drift gillnet fisheries were combined. They have been attributed to the Bristol Bay drift gillnet fishery due to the more pelagic nature of the fishery. However, because logbook records are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. These totals are based on all available logbook reports for all Alaska fisheries. Complete logbook data after 1993 are not available.

It should be noted that no observers have been assigned several of the gillnet fisheries that are known to interact with this stock, making the estimated mortality unreliable. However, the large stock size makes it unlikely that unreported mortalities from those fisheries would be a significant source of mortality for the stock. The estimated minimum annual mortality rate incidental to commercial fisheries (4; based on observer data (1) and logbook reports (rounded up to 3) where observer data were not available) is less than 10% of the PBR (487) and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate.

Table 17. Summary of incidental mortality of Pacific white-sided dolphins (Central North Pacific stock) due to commercial fisheries from 1990 through 1995 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from logbook reports. Data from 1991 to 1995 are used in the mortality calculation when more than 5 years of data are provided for a particular fishery.

Fishery name	**Years**	**Data type**	**Range of observer coverage**	**Observed mortality (in given yrs.)**	**Estimated mortality (in given yrs.)**	**Mean annual mortality**
Bering Sea/Aleutian Is. (BSA) groundfish trawl	90-95	obs data	53-74%	0, 0, 1, 0, 0, 0	0, 0, 1, 0, 0, 0	0.2 (CV=1.0)
BSA groundfish longline (incl. misc. finfish and sablefish fisheries	90-95	obs data	27-80%	0, 0, 0, 0 0, 1	0, 0, 0, 0 0, 4	0.8 (CV=1.0)
Observer program total						1.0
				Reported mortalities		
Prince William Sound salmon drift gillnet	90-93	logbook	n/a	1, 4, 0, 0	n/a	[$1.25]
Southeast Alaska salmon drift gillnet	90-93	logbook	n/a	0, 0, 1, 0	n/a	[$.25]
Bristol Bay salmon drift gillnet	90-93	logbook	n/a	3, 0, 0, 0	n/a	[$.75]
Minimum total annual mortality						$3.25

Subsistence/Native Harvest Information

There are no reports of subsistence take of Pacific white-sided dolphins in Alaska.

STATUS OF STOCK

Pacific white-sided dolphins are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Based on currently available data, the level of human-caused mortality and serious injury (4) does not exceed the PBR (4,867). Therefore, the Central North Pacific stock of Pacific white-sided dolphins is not classified as a strategic stock. Population trends and status of this stock relative to OSP are currently unknown.

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HARBOR PORPOISE (*Phocoena phocoena*): Southeast Alaska Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

In the eastern North Pacific Ocean, the harbor porpoise ranges from Point Barrow, along the Alaska coast, and down the west coast of North America to Point Conception, California (Gaskin 1984). The harbor porpoise primarily frequents coastal waters. Relatively high densities of harbor porpoise have been recorded along the coasts of Washington and northern Oregon and California. Relative to the waters off the west coast of the continental U. S., harbor porpoise do not occur in high densities in Alaska waters (Dahlheim et al. submitted). Stock discreteness in the eastern North Pacific was analyzed using mitochondrial DNA from samples collected along the west coast (Rosel 1992) and is summarized in Osmek et al. (1994). Two distinct mitochondrial DNA groupings or clades exist. One clade is present in California, Washington, British Columbia and Alaska (no samples were available from Oregon), while the other is found only in California and Washington. Although these two clades are not geographically distinct by latitude, the results may indicate a low mixing rate for harbor porpoise along the west coast of North America. Investigation of pollutant loads in harbor porpoise ranging from California to the Canadian border also suggests restricted harbor porpoise movements (Calambokidis and Barlow 1991). Further genetic testing of the same data mentioned above along with additional samples found significant genetic differences for 4 of the 6 pair-wise comparisons between the four areas investigated: California, Washington, British Columbia, and Alaska (Rosel et al. 1995). These results demonstrate that harbor porpoise along the west coast of North America are not panmictic or migratory, and that movement is sufficiently restricted to evolve genetic differences. This is consistent with low movement suggested by genetic analysis of harbor porpoise specimen from the North Atlantic. Numerous stocks have been delineated with clinal differences over areas as small as the waters surrounding the British Isles. Unfortunately, no conclusions can be drawn about the genetic structure of harbor porpoise within Alaska because of insufficient samples. Only 19 samples are available from Alaska porpoise and 12 of these come from a single area (Copper River Delta). Accordingly, harbor porpoise stock structure in Alaska remains unknown at this time.

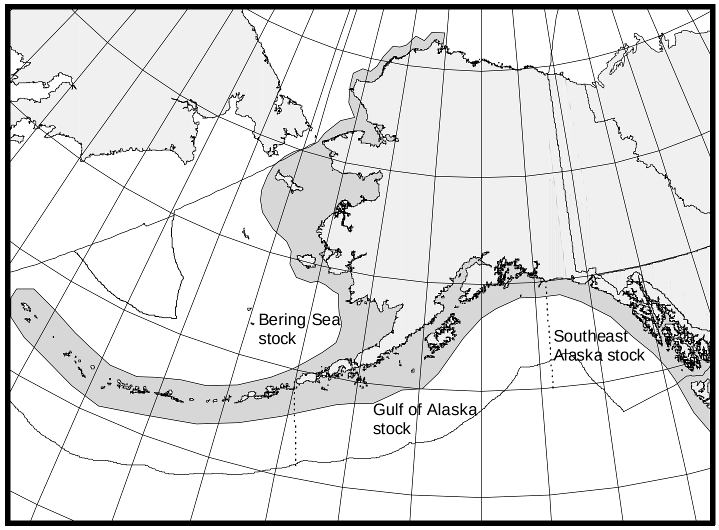

Figure 9. Approximate distribution of harbor porpoise in Alaska waters (shaded area). The distributions of all three stocks found in Alaska waters are shown.

Although it is difficult to determine the true stock structure of harbor porpoise populations in the northeast Pacific, from a management standpoint, it would be prudent to assume that regional populations exist and that they should be managed independently (Rosel et al. 1995, Taylor et al. 1996). The Alaska SRG concurred that while the available data were insufficient to justify recognizing three biological stocks of harbor porpoise in Alaska, it did not recommend against the establishment of three management units in Alaska (DeMaster 1996, 1997). Aerial surveys (Dahlheim et al. 1994) reveal a lower density of harbor porpoise between Yakutat and Cape Suckling. Accordingly, from the above information, three separate harbor porpoise stocks in Alaska are recommended: 1) the Southeast Alaska stock - occurring from the northern border of British Columbia border to Cape Suckling, Alaska, 2) the Gulf of Alaska stock - occurring from Cape Suckling to Unimak Pass, and 3) the Bering Sea stock - occurring throughout the Aleutian Islands and all waters north of Unimak Pass (Fig. 22). Information concerning the 4 harbor porpoise stocks occurring along the west coast of the continental U. S. (Central California, Northern California, Oregon/Washington Coast, and Inland Washington) can be found in the Stock Assessment Reports for the Pacific Region.

POPULATION SIZE

In June of 1993, an aerial survey covering the offshore Alaska waters from Dixon Entrance to Prince William Sound was conducted, resulting in an abundance estimate of 3,982 (CV=0.187) harbor porpoise (Dahlheim et al. submitted). Of the 106 harbor porpoise sightings during the 1993 aerial survey, 71 were encountered east of Cape Suckling (144EW), representing approximately 67% of the sightings. Prorating the abundance estimate to include only the portion of the survey conducted east of Cape Suckling results in an abundance estimate of 2,668 animals from the Southeast Alaska harbor porpoise stock. This estimate is admittedly ad hoc and deemed provisional at this time, pending reanalysis of the 1993 aerial survey data. The coefficient of variation for the entire 1993 survey area (0.187) is considered a reasonable estimate until such reanalysis occurs. 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 et al. 1988) from the west coast of the continental U.S. The correction factor of 3.1 should be used for this harbor porpoise stock, as both estimates are considered conservative for Alaska aerial surveys due to differences in survey conditions. Thus, the estimated corrected abundance from this survey is 8,271 (2,668 x 3.1; CV=0.255) harbor porpoise for the offshore waters from Dixon Entrance to Cape Suckling.

Systematic vessel surveys of harbor porpoise in the inside waters of Southeast 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 with abundance estimates relatively similar in each year (Dahlheim et al. 1994). The June 1993 vessel survey of the inside waters occurred simultaneously with the 1993 aerial survey, mentioned above, and resulted in an abundance estimate of 1,586 (CV=0.392) harbor porpoise. Correction factors for vessel surveys of harbor porpoise have been estimated at 1.28 (CV=0.091) in the Pacific Ocean along the west coast of the U. S. (Barlow 1988) and at 1.9 (CV=0.142) from vessel surveys in the Gulf of Maine (D. Palka, pers. comm., Northeast Fisheries Science Center, P. O. Box 314, Woods Hole, MA 02543). The estimated correction factor from the Pacific Ocean surveys (1.28) should be used for the Alaska vessel surveys because it is more conservative and the techniques used in the Barlow study were more similar to the Alaska surveys than those employed in the Gulf of Maine. Therefore, the total corrected abundance estimate for the inside waters of Southeast Alaska is 2,030 (1,586 x 1.28; CV=0.404) harbor porpoise. Accordingly, the corrected abundance estimate for the Southeast Alaska harbor porpoise stock, from aerial surveys in offshore waters and vessel surveys in inside waters, is 10,301 (8,271+2,030) animals.

In the previous stock assessment, harbor porpoise in Alaska were considered a single stock composed of 29,744 animals (Small and DeMaster 1995). If the abundance estimates for the 3 Alaska stocks of harbor porpoise in this volume are pooled, the resulting estimate would also be 29,744 animals (10,301+8,497+10,946).

Minimum Population Estimate

For the Southeast 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 (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842*[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimates (N) of 8,271 and 2,030 along with their associated CVs (0.255 and 0.404, respectively), N_{MIN} for this stock is 8,156 (6,693+1,463).

Current Population Trend

At present, there is no reliable information on trends in abundance for the Southeast 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 the Southeast Alaska 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 (Wade and Angliss 1997).

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 cetacean stocks with unknown population status (Wade and Angliss 1997). Thus, for the Southeast Alaska stock of harbor porpoise, PBR = 82 animals (8,156 x 0.02 x 0.5).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Some fishing effort by vessels participating in the Gulf of Alaska (GOA) groundfish longline fishery occurs in the offshore waters of Southeast Alaska. Effort levels are insignificant for the portion of the GOA groundfish trawl and pot fisheries operating in these waters. However, during the period from 1990 to 1995, 21-31% of the GOA longline catch occurred within the range of the Southeast Alaska harbor porpoise stock. This fishery has been monitored for incidental take by NMFS observers from 1990 to 1995 (8-21% observer coverage), although observer coverage has been very low in the offshore waters of Southeast Alaska (<1-4% observer coverage). No mortalities from this stock of harbor porpoise incidental to commercial fisheries have been observed.

The only source of information on the number of harbor porpoise killed or injured incidental to commercial fishery operations is the logbook reports maintained by vessel operators as required by the MMPA interim exemption program. During the 4-year period between 1990 and 1993, logbook reports from the Southeast Alaska salmon drift gillnet fishery (Table 18) resulted in an annual mean of 3.25 mortalities from interactions with commercial fishing gear. However, because logbook records are most likely negatively biased (Credle et al. 1994), this is considered to be a minimum estimate. There were no other logbook mortalities for any other fishery within the range of the Southeast Alaska harbor porpoise stock. Complete logbook data after 1993 are not available.

Table 18. Summary of incidental mortality of harbor porpoise (Southeast Alaska stock) due to commercial fisheries from 1990 through 1995 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from logbook reports.

Fishery name	Years	Data type	Range of observer coverage	Reported mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Observer program total	90-95					0
Southeast Alaska salmon drift gillnet	90-93	logbook	n/a	2, 2, 7, 2	n/a	[$3.25]
Minimum total annual mortality						$3.25

For this stock of harbor porpoise, the estimated minimum annual mortality rate incidental to commercial fisheries is 4 animals (rounded up from 3.25), based entirely on logbook data. However, a reliable estimate of the mortality rate incidental to commercial fisheries is currently unavailable because of the absence of observer placements in Southeast Alaska fisheries. Therefore, it is unknown whether the kill rate is insignificant. At present, annual mortality levels less than 8.2 animals per year (i.e., 10% of PBR) can be considered to be insignificant and approaching zero mortality and serious injury rate.

Subsistence/Native Harvest Information

Subsistence hunters in Alaska have not been reported to take from this stock of harbor porpoise.

STATUS OF STOCK

Harbor porpoise are not listed as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act. Logbook records are most likely negatively biased (Credle et al. 1994) resulting in an underestimate of incidental kill. However, based on the best scientific information available, the estimated level of human-caused mortality and serious injury (4) is not known to exceed the PBR (82). Therefore, the Southeast Alaska stock of harbor porpoise is not classified as a strategic stock. Population trends and status of this stock relative to OSP are currently unknown.

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HARBOR PORPOISE (*Phocoena phocoena*): Gulf of Alaska Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

In the eastern North Pacific Ocean, the harbor porpoise ranges from Point Barrow, along the Alaska coast, and down the west coast of North America to Point Conception, California (Gaskin 1984). The harbor porpoise primarily frequents coastal waters. Relatively high densities of harbor porpoise have been recorded along the coasts of Washington and northern Oregon and California. Relative to the waters off the west coast of the continental U. S., harbor porpoise do not occur in high densities in Alaska waters (Dahlheim et al. submitted). Stock discreteness in the eastern North Pacific was analyzed using mitochondrial DNA from samples collected along the west coast (Rosel 1992) and is summarized in Osmek et al. (1994). Two distinct mitochondrial DNA groupings or clades exist. One clade is present in California, Washington, British Columbia and Alaska (no samples were available from Oregon), while the other is found only in California and Washington. Although these two clades are not geographically distinct by latitude, the results may indicate a low mixing rate for harbor porpoise along the west coast of North America. Investigation of pollutant loads in harbor porpoise ranging from California to the Canadian border also suggests restricted harbor porpoise movements (Calambokidis and Barlow 1991). Further genetic testing of the same data mentioned above along with additional samples found significant genetic differences for 4 of the 6 pair-wise comparisons between the four areas investigated: California, Washington, British Columbia, and Alaska (Rosel et al. 1995). These results demonstrate that harbor porpoise along the west coast of North America are not panmictic or migratory, and that movement is sufficiently restricted to evolve genetic differences. This is consistent with low movement suggested by genetic analysis of harbor porpoise specimen from the North Atlantic. Numerous stocks have been delineated with clinal differences over areas as small as the waters surrounding the British Isles. Unfortunately, no conclusions can be drawn about the genetic structure of harbor porpoise within Alaska because of insufficient samples. Only 19 samples are available from Alaska porpoise and 12 of these come from a single area (Copper River Delta). Accordingly, harbor porpoise stock structure in Alaska remains unknown at this time.

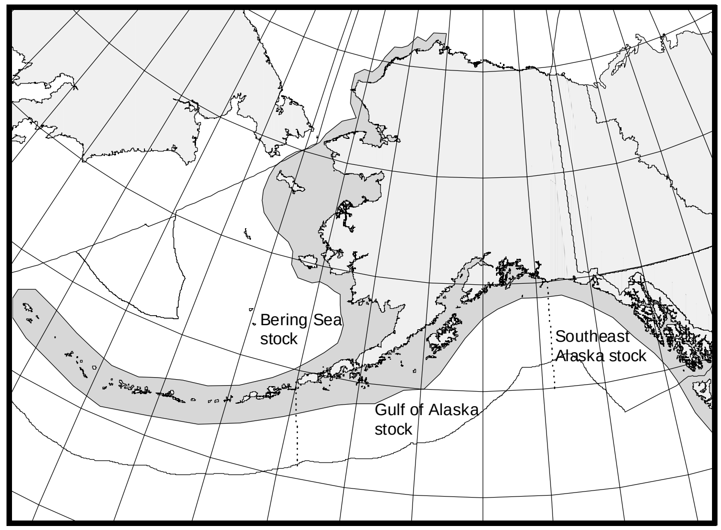

Figure 10. Approximate distribution of harbor porpoise in Alaska waters (shaded area). The distributions of all three stocks found in Alaska waters are shown.

Although it is difficult to determine the true stock structure of harbor porpoise populations in the northeast Pacific, from a management standpoint, it would be prudent to assume that regional populations exist and that they should be managed independently (Rosel et al. 1995, Taylor et al. 1996). The Alaska SRG concurred that while the available data were insufficient to justify recognizing three biological stocks of harbor porpoise in Alaska, it did not recommend against the establishment of three management units in Alaska (DeMaster 1996, 1997). Aerial surveys (Dahlheim et al. 1994) reveal a lower density of harbor porpoise between Yakutat and Cape Suckling. Accordingly, from the above information, three separate harbor porpoise stocks in Alaska are recommended: 1) the Southeast Alaska stock - occurring from the northern border of British Columbia border to Cape Suckling, Alaska, 2) the Gulf of Alaska stock - occurring from Cape Suckling to Unimak Pass, and 3) the Bering Sea stock - occurring throughout the Aleutian Islands and all waters north of Unimak Pass (Fig. 23). Information concerning the 4 harbor porpoise stocks occurring along the west coast of the continental U. S. (Central California, Northern California, Oregon/Washington Coast, and Inland Washington) can be found in the Stock Assessment Reports for the Pacific Region.

POPULATION SIZE

Systematic aerial surveys of harbor porpoise covering portions of the Gulf of Alaska were conducted in 1991 (Dahlheim et al. 1992), 1992 (Dahlheim et al. 1993), and 1993 (Dahlheim et al. 1994). The 1991 aerial survey covering Cook Inlet waters resulted in an abundance estimate of 136 (CV=0.632) harbor porpoise (Dahlheim et al. submitted). The 1992 aerial survey covered the waters around Kodiak Island and along the south side of the Alaska Peninsula from Shelikof Strait to the Shumagin Islands. Inclement weather during the 1992 survey prohibited covering the portion of the Alaska Peninsula extending from the Shumagin Islands to Unimak Pass, approximately 160-165EW (Dahlheim et al. 1993). The 1992 survey resulted in an abundance estimate of 740 (CV=0.339) harbor porpoise around Kodiak Island and 551 (CV=0.122) harbor porpoise along the southern Alaska Peninsula (Dahlheim et al. submitted). The 1993 aerial survey covered the offshore Alaska waters from Dixon Entrance to Prince William Sound, resulting in an abundance estimate of 3,982 (CV=0.187) harbor porpoise (Dahlheim et al. submitted). Of the 106 harbor porpoise sightings during the 1993 aerial survey, 35 were encountered west of Cape Suckling (144EW), representing approximately 33% of the sightings. Prorating the abundance estimate to include only the portion of the survey conducted west of Cape Suckling results in an abundance estimate of 1,314 animals from the Gulf of Alaska harbor porpoise stock. This estimate is admittedly ad hoc and deemed provisional at this time, pending reanalysis of the 1993 aerial survey data. Until such reanalysis occurs, the coefficient of variation for the 1993 survey area (0.187) is considered a reasonable estimate for the CV of the portion of the survey conducted to the west of Cape Suckling. Adding the abundance estimates for the portions of the 1991-93 surveys within the range of the Gulf of Alaska harbor porpoise stock results in a total estimated abundance of 2,741 (136+740+551+1314; CV=0.134) animals.

Correction factors for harbor porpoise aerial surveys have been estimated at 3.1 (CV=0.171) (Calambokidis et al. 1993) from Puget Sound, Washington, and 3.2 (Barlow et al. 1988) from the west coast of the continental U. S. The correction factor of 3.1 should be used for this harbor porpoise stock, as both estimates are considered conservative for Alaska aerial surveys due to differences in survey conditions. Therefore, the total corrected abundance estimate for the Gulf of Alaska stock of harbor porpoise is 8,497 (CV=0.218) animals. This abundance estimate is conservative because several areas within the Gulf of Alaska were not included in the 1991-93 aerial surveys. These areas include the region from 160-165EW along the southern Alaska Peninsula (mentioned above) and the coastal waters from western Prince William Sound to the Kenai Peninsula (approximately 148-152EW).

In the previous stock assessment, harbor porpoise in Alaska were considered a single stock composed of 29,744 animals (Small and DeMaster 1995). If the abundance estimates for the 3 Alaska stocks of harbor porpoise in this volume are pooled, the resulting estimate would also be 29,744 animals (10,301+8,497+10,946).

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock is calculated using Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842*[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 8,497 and its associated CV of 0.218, N_{MIN} for the Gulf of Alaska stock of harbor porpoise is 7,085.

Current Population Trend

At present, there is no reliable information on trends in abundance for the Gulf of 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 the Gulf of Alaska 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 (Wade and Angliss 1997).

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 cetacean stocks with unknown population status (Wade and Angliss 1997). Thus, for the Gulf of Alaska stock of harbor porpoise, PBR = 71 animals (7,085 x 0.02 x 0.5).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Three different commercial fisheries operating within the range of the Gulf of Alaska stock of harbor porpoise were monitored for incidental take by NMFS observers during 1990-95: Gulf of Alaska groundfish trawl, longline, and pot fisheries. No incidental mortality of harbor porpoise was observed in these fisheries. Observers also monitored the Prince William Sound salmon drift gillnet fishery in 1990 and 1991, recording 1 mortality in 1990 and 3 mortalities in 1991. These mortalities extrapolated to 8 (95% CI 1-23) and 32 (95% CI 3-103) kills for the entire fishery, resulting in a mean kill rate of 20 (CV=0.60) 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 salmon drift gillnet fishery, monitoring a total of 3,166 sets, or roughly 4% of the estimated number of sets made by the fleet (Wynne et al. 1991). In 1991, observers boarded 531 (86.9%) of the 611 registered vessels and monitored a total of 5,875 sets, or roughly 5% of the estimated sets made by the fleet (Wynne et al. 1992). Logbook reports from this fishery detail 6, 5, 6, and 1 harbor porpoise mortalities in 1990, 1991, 1992, and 1993, respectively. The extrapolated (estimated) observer mortality accounts for these mortalities, so they do not appear in Table 19. The Prince William Sound salmon drift gillnet fishery has not been observed since 1991; therefore, no additional data are available for that fishery.

An additional source of information on the number of harbor porpoise mortalities incidental to commercial fishing operations is the logbook reports maintained by vessel operators as required by the MMPA interim exemption program. During the 4-year period between 1990 and 1993, logbook reports from 2 unobserved fisheries (see Table 19) resulted in an annual mean of 4.5 mortalities from interactions with commercial fishing gear. In 1990, logbook records from the Cook Inlet set and drift gillnet fisheries were combined. As it is not possible to determine which fishery was responsible for the harbor porpoise mortalities reported in 1990, both fisheries have been included in Table 19. However, because logbook records are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. These totals are based on all available logbook reports for Gulf of Alaska fisheries, except the Prince William Sound salmon drift gillnet fishery for which observer data were presented above. Complete logbook data after 1993 are not available.

Table 19. Summary of incidental mortality of harbor porpoise (Gulf of Alaska stock) due to commercial fisheries from 1990 through 1995 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from logbook reports or stranding data.

Fishery name	Years	Data type	Range of observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Prince William Sound salmon drift gillnet	90-91	obs data	4-5%	1, 3	8, 32	20 (CV=.60)
Observer program total						20
				Reported mortalities		
Cook Inlet salmon drift and set gillnet fisheries	90-93	logbook	n/a	3, 0, 0, 0	n/a	[$0.75]
Kodiak salmon set gillnet	90-93	logbook	n/a	8, 4, 2, 1	n/a	[$3.75]
Minimum total annual mortality						$24.5

Strandings of marine mammals with fishing gear attached or with injuries caused by interactions with fishing gear are a final source of mortality data. In the period from 1990 to 1994, 12 harbor porpoise scarred with gillnet marks were discovered stranded in Prince William Sound (Copper River Delta). These stranding reports were likely the result of operations in the Prince William Sound salmon drift gillnet fishery. The extrapolated (estimated) observer mortality for this fishery accounts for these mortalities, so they do not appear in Table 19.

A reliable estimate of the mortality rate incidental to commercial fisheries is considered unavailable because of the absence of observer placements in several gillnet fisheries mentioned above. However, the estimated minimum annual mortality rate incidental to commercial fisheries is 25, based on observer data (20) and logbook reports (rounded to 5) where observer data were not available. This estimated annual mortality rate is greater than 10% of the PBR (7.1) and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate.

Subsistence/Native Harvest Information

Subsistence hunters in Alaska have not been reported to take from this stock of harbor porpoise.

STATUS OF STOCK

Harbor porpoise are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. The lack of surveys in a significant portion of the Gulf of Alaska results in a conservative PBR for this stock. Logbook records are most likely negatively biased (Credle et al. 1994) resulting in an underestimate of incidental mortality. However, based on the best scientific information available, the estimated level of human-caused mortality and serious injury (25) is not known to exceed the PBR (71). Therefore, the Gulf of Alaska stock of harbor porpoise is not classified as a strategic stock. Population trends and status of this stock relative to OSP are currently unknown.

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HARBOR PORPOISE (*Phocoena phocoena*): Bering Sea Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

In the eastern North Pacific Ocean, the harbor porpoise ranges from Point Barrow, along the Alaska coast, and down the west coast of North America to Point Conception, California (Gaskin 1984). The harbor porpoise primarily frequents coastal waters. Relatively high densities of harbor porpoise have been recorded along the coasts of Washington and northern Oregon and California. Relative to the waters off the west coast of the continental U. S., harbor porpoise do not occur in high densities in Alaska waters (Dahlheim et al. submitted). Stock discreteness in the eastern North Pacific was analyzed using mitochondrial DNA from samples collected along the west coast (Rosel 1992) and is summarized in Osmek et al. (1994). Two distinct mitochondrial DNA groupings or clades exist. One clade is present in California, Washington, British Columbia and Alaska (no samples were available from Oregon), while the other is found only in California and Washington. Although these two clades are not geographically distinct by latitude, the results may indicate a low mixing rate for harbor porpoise along the west coast of North America. Investigation of pollutant loads in harbor porpoise ranging from California to the Canadian border also suggests restricted harbor porpoise movements (Calambokidis and Barlow 1991). Further genetic testing of the same data mentioned above along with additional samples found significant genetic differences for 4 of the 6 pair-wise comparisons between the four areas investigated: California, Washington, British Columbia, and Alaska (Rosel et al. 1995). These results demonstrate that harbor porpoise along the west coast of North America are not panmictic or migratory, and that movement is sufficiently restricted to evolve genetic differences. This is consistent with low movement suggested by genetic analysis of harbor porpoise specimen from the North Atlantic. Numerous stocks have been delineated with clinal differences over areas as small as the waters surrounding the British Isles. Unfortunately, no conclusions can be drawn about the genetic structure of harbor porpoise within Alaska because of insufficient samples. Only 19 samples are available from Alaska porpoise and 12 of these come from a single area (Copper River Delta). Accordingly, harbor porpoise stock structure in Alaska remains unknown at this time.

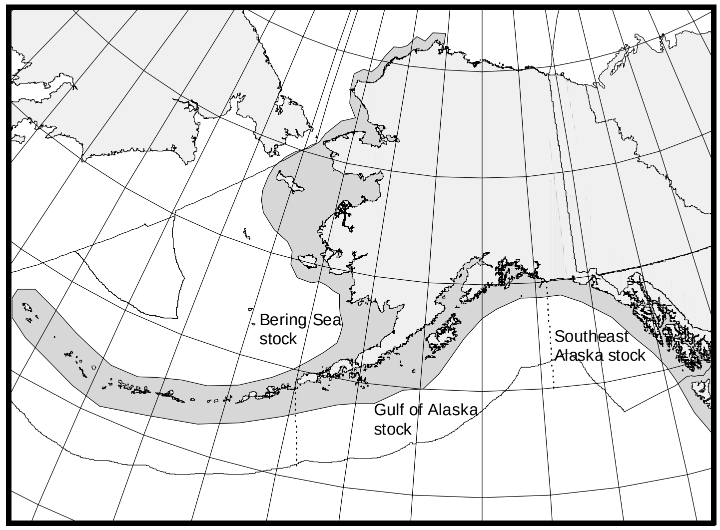

Figure 11. Approximate distribution of harbor porpoise in Alaska waters (shaded area). The distributions of all three stocks found in Alaska waters are shown.

Although it is difficult to determine the true stock structure of harbor porpoise populations in the northeast Pacific, from a management standpoint, it would be prudent to assume that regional populations exist and that they should be managed independently (Rosel et al. 1995, Taylor et al. 1996). The Alaska SRG concurred that while the available data were insufficient to justify recognizing three biological stocks of harbor porpoise in Alaska, it did not recommend against the establishment of three management units in Alaska (DeMaster 1996, 1997). Aerial surveys (Dahlheim et al. 1994) reveal a lower density of harbor porpoise between Yakutat and Cape Suckling. Accordingly, from the above information, three separate harbor porpoise stocks in Alaska are recommended: 1) the Southeast Alaska stock - occurring from the northern border of British Columbia border to Cape Suckling, Alaska, 2) the Gulf of Alaska stock - occurring from Cape Suckling to Unimak Pass, and 3) the Bering Sea stock - occurring throughout the Aleutian Islands and all waters north of Unimak Pass (Fig. 24). Information concerning the 4 harbor porpoise stocks occurring along the west coast of the continental U. S. (Central California, Northern California, Oregon/Washington Coast, and Inland Washington) can be found in the Stock Assessment Reports for the Pacific Region.

POPULATION SIZE

In the summer of 1991, an aerial survey covering the Bristol Bay region was conducted resulting in an abundance estimate of 3,531 (CV=0.243) harbor porpoise (Dahlheim et al. submitted). No survey effort was conducted in the vicinity of the Pribilof Islands or along the Aleutian Islands because of the lack of commercial fisheries that could potentially affect harbor porpoise in those areas (Dahlheim et al. 1992). In addition, no survey effort was conducted north of Cape Newenham (approximately 59EN), when harbor porpoise are regular visitors as far north as Point Barrow during the summer months (Suydam and George 1992). Clearly, the 1991 survey covered only a fraction of the range occupied by the Bering Sea stock of harbor porpoise.

Correction factors for harbor porpoise aerial surveys have been estimated at 3.1 (CV=0.171) (Calambokidis et al. 1993) from Puget Sound, Washington, and 3.2 (Barlow et al.1988) from the west coast of the continental U. S. The correction factor of 3.1 should be used for this harbor porpoise stock, as both estimates are considered conservative for Alaska aerial surveys due to differences in survey conditions. Therefore, the total corrected abundance estimate for the Bering Sea stock of harbor porpoise is 10,946 (3,531 x 3.1; CV=0.300) animals.

In the previous stock assessment, harbor porpoise in Alaska were considered a single stock composed of 29,744 animals (Small and DeMaster 1995). If the abundance estimates for the 3 Alaska stocks of harbor porpoise in this volume are pooled, the resulting estimate would also be 29,744 animals (10,301+8,497+10,946).

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock is calculated using Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842*[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 10,946 and its associated CV of 0.300, N_{MIN} for the Bering Sea stock of harbor porpoise is 8,549.

Current Population Trend

At present, there is no reliable information on trends in abundance for the Bering Sea 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 (Wade and Angliss 1997).

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 cetacean stocks with unknown population status (Wade and Angliss 1997). Thus, for the Bering Sea stock of harbor porpoise, PBR = 86 animals (8,549 x 0.02 x 0.5).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Three different commercial fisheries operating within the range of the Bering Sea stock of harbor porpoise were monitored for incidental take by NMFS observers during 1990-95: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries. The harbor porpoise mortality was observed only in the Bering Sea groundfish trawl fishery. The range of observer coverage over the 6-year period, as well as the annual observed and estimated mortalities are presented in Table 20. The mean annual (total) mortality rate resulting from observed mortalities was 0.60 (CV=.67). In 1990, observers also boarded 59 (38.3%) of the 154 vessels participating in the Alaska Peninsula/Aleutian Island salmon drift gillnet fishery, monitoring a total of 373 sets, or roughly 4% of the estimated number of sets made by the fleet (Wynne et al. 1991). The low level of observer coverage for this fishery apparently missed interactions with harbor porpoise which had occurred, as logbook mortalities were reported in 1990 (see Table 20) which were not recorded by the observer program.

An additional source of information on the number of harbor porpoise mortalities incidental to commercial fishery operations is the logbook reports maintained by vessel operators as required by the MMPA interim exemption program. During the 4-year period from 1990 to 1993, logbook reports from 2 unobserved fisheries (see Table 20) resulted in an annual mean of 1.25 mortalities from interactions with commercial fishing gear. However, because logbook records are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. These totals are based on all available logbook reports for fisheries occurring within the range of the Bering Sea harbor porpoise stock, except the Bering Sea groundfish fisheries for which observer data were presented above. Complete logbook data after 1993 are not available.

Logbook records for three fisheries listed in Table 20 did not report any harbor porpoise mortality over the 1990-93 period. These fisheries have been included above because of the large number of participants and the significant potential for interaction with harbor porpoise. During the period from 1981 to 1987, 7 harbor porpoise mortalities have resulted from gillnet entanglement in the area from Nome to Unalakleet, 3 were reported near Kotzebue from 1989 to 1990, and some take of harbor porpoise is likely in the Bristol Bay gillnet fisheries (Barlow et al. 1994). A similar set gillnet fishery conducted by subsistence fishers incidentally took 6 harbor porpoise in 1991 near Point Barrow, Alaska (Suydam and George 1992).

Table 20. Summary of incidental mortality of harbor porpoise (Bering Sea stock) due to commercial fisheries from 1990 through 1995 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from logbook reports. Data from 1991 to 1995 are used in the mortality calculation when more than 5 years of data are provided for a particular fishery.

Fishery name	**Years**	**Data type**	**Range of observer coverage**	**Observed mortality (in given yrs.)**	**Estimated mortality (in given yrs.)**	**Mean annual mortality**
Bering Sea/Aleutian Is. (BSA) groundfish trawl	90-95	obs data	53-74%	0, 0, 0, 0, 1, 1	0, 0, 0, 0, 2, 1	0.6 (CV=.67)
Observer program total						0.6
				Reported mortalities		
AK Peninsula/Aleutian Island salmon drift gillnet	90-93	logbook	n/a	2, 0, 1, 0	n/a	[$0.75]
AK Peninsula/Aleutian Island salmon set gillnet	90-93	logbook	n/a	0, 0, 2, 0	n/a	[$0.5]
Bristol Bay salmon drift gillnet	90-93	logbook	n/a	0, 0, 0, 0	n/a	[0]
Bristol Bay salmon set gillnet	90-93	logbook	n/a	0, 0, 0, 0	n/a	[0]
AK Kuskokwim, Yukon, Norton Sound, Kotzebue salmon gillnet	90-93	logbook	n/a	0, 0, 0, 0	n/a	[0]
Minimum total annual mortality						$1.85

The estimated minimum annual mortality rate incidental to commercial fisheries is rounded up to 2 animals, based on observer data (0.60) and logbook reports (1.25) 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 gillnet fisheries discussed above. Therefore, it is unknown whether the kill rate is insignificant. At present, annual mortality levels less than 8.6 animals per year (i.e., 10% of PBR) can be considered to be insignificant and approaching zero mortality and serious injury rate.

Subsistence/Native Harvest Information

Subsistence hunters in Alaska have not been reported to take from this stock of harbor porpoise.

STATUS OF STOCK

Harbor porpoise are not listed as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act. The lack of surveys in a significant portion of this stock’s range results in a conservative PBR for this stock. Logbook records are most likely negatively biased (Credle et al. 1994) resulting in an underestimate of incidental kill. However, based on the best scientific information available, the estimated level of human-caused mortality and serious injury (2) is not known to exceed the PBR (86). Therefore, the Bering Sea stock of harbor porpoise is not classified as a strategic stock. Population trends and status of this stock relative to OSP are currently unknown.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Dall's porpoise are widely distributed across the entire North Pacific Ocean (Fig. 25). 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 Alaska 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 continental 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).

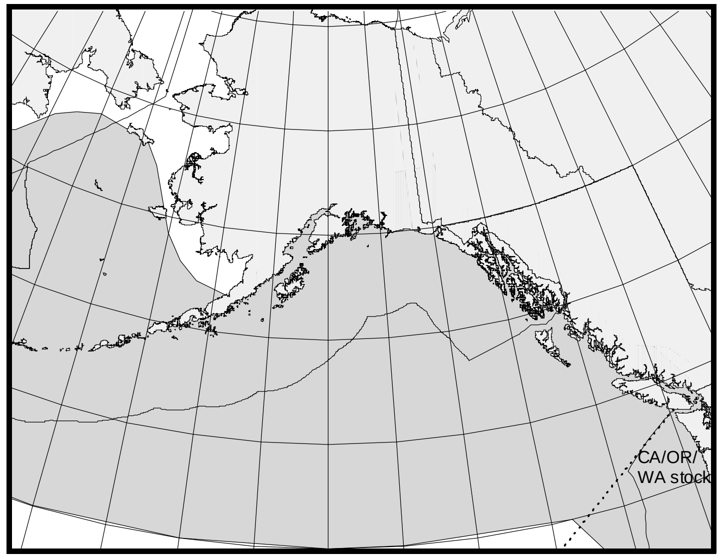

Figure 12. Approximate distribution of Dall's porpoise in the eastern North Pacific (shaded area).

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 timing 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 Dall's porpoise is recognized in Alaska waters. Dall's porpoise along the west coast of the continental U. S. from California to Washington comprise a separate stock and are reported separately in the Stock Assessment Reports for the Pacific Region.

POPULATION SIZE

Data collected from vessel surveys, performed by both U. S. fishery observers and U. S. researchers from 1987 to 1991, were analyzed to provide population estimates of Dall'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 (9,000 + 302,000 + 106,000) results in a total abundance estimate of 417,000 (CV=0.097) for the Alaska stock of Dall'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 using Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842*[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 83,400 and its associated CV of 0.097, 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

A reliable estimate of the maximum net productivity rate is not currently available for the Alaska stock of Dall's porpoise. Hence, 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 (Wade and Angliss 1997).

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: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. As this stock is considered to be within optimum sustainable population (Buckland et al. 1993), the recovery factor (F_R) for this stock is 1.0 (Wade and Angliss 1997). Thus, for the Alaska stock of Dall's porpoise, PBR = 1,537 animals (76,874 x 0.02 x 1.0).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Six different commercial fisheries operating within the range of the Alaska stock of Dall's porpoise were monitored for incidental take by NMFS observers during 1990-95: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries, and Gulf of Alaska groundfish trawl, longline, and pot fisheries. No mortalities of Dall's porpoise were observed by NMFS observers in either pot fishery or the Gulf of Alaska longline fishery. For the fisheries with observed takes, the range of observer coverage over the 6-year period, as well as the annual observed and estimated mortalities are presented in Table 21. The mean annual (total) mortality was 4.6 (CV=0.20) for the Bering Sea groundfish trawl fishery, 0.6 (CV=1.0) for the Gulf of Alaska groundfish trawl fishery, and 1.6 (CV=.61) for the Bering Sea groundfish longline fishery.

The Alaska Peninsula and Aleutian Island salmon driftnet fishery was monitored in 1990. Observers boarded 59 (38.3%) of the 154 vessels participating in the fishery, monitoring a total of 373 sets, or less than 4% of the estimated number of sets made by the fleet (Wynne et al. 1991). One Dall's porpoise mortality was observed which extrapolated to an annual (total) incidental mortality rate of 28 Dall's porpoise. Combining the estimates from the Bering Sea and Gulf of Alaska fisheries presented above (4.6+0.6+1.6=6.8) with the estimate from the Alaska Peninsula and Aleutian Island salmon drift gillnet fishery (28) results in an estimated annual incidental kill rate in observed fisheries of 34.8 porpoise per year from this stock.

The Prince William Sound driftnet fishery was also monitored by observers during 1990 and 1991, with no incidental mortality of Dall's porpoise reported. In 1990, observers boarded 300 (57.3%) of the 524 vessels that fished in the Prince William Sound salmon drift gillnet fishery, monitoring a total of 3,166 sets, or roughly 4% of the estimated number of sets made by the fleet (Wynne et al. 1991). In 1991, observers boarded 531 (86.9%) of the 611 registered vessels and monitored a total of 5,875 sets, or roughly 5% of the estimated sets made by the fleet (Wynne et al. 1992). The low level of observer coverage for this fishery apparently missed interaction with Dall's porpoise which had occurred, as logbook mortalities were reported in 1991 (see Table 21) which were not recorded by the observer program.

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 vessel operators as required by the MMPA interim exemption program. During the 4-year period between 1990 and 1993, logbook reports from 4 unobserved fisheries (see Table 21) resulted in an estimated annual mean of 6.5 mortalities from interactions with commercial fishing gear. In 1990, logbook records from the Cook Inlet set and drift gillnet fisheries were combined. As a result, the Dall's porpoise mortality reported in 1990 may have occurred in the Cook Inlet set gillnet fishery an not the drift gillnet fishery as reported in Table 21. 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 those fisheries which observer data were presented above. The Southeast Alaska salmon drift gillnet fishery accounted for the majority of the reported incidental take in unobserved fisheries. Complete logbook data after 1993 are not available.

Table 21. Summary of incidental mortality of Dall’s porpoise (Alaska stock) due to commercial fisheries from 1990 through 1994 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from logbook reports. Data from 1991 to 1995 are used in the mortality calculation when more than 5 years of data are provided for a particular fishery.

Fishery name	**Years**	**Data type**	**Range of observer coverage**	**Observed mortality (in given yrs.)**	**Estimated morality (in given yrs.)**	**Mean annual mortality**
Bering Sea/Aleutian Is. (BSA) groundfish trawl	90-95	obs data	53-74%	6, 1, 5, 4, 4, 2	7, 2, 6, 5, 7, 3	4.6 (CV=.20)
Gulf of Alaska (GOA) groundfish trawl	90-95	obs data	33-55%	0, 0, 0, 1, 0, 0	0, 0, 0, 3, 0, 0	0.6 (CV=1.0)
BSA groundfish longline (incl. misc finfish and sablefish fisheries)	90-95	obs data	27-80%	0, 0, 0, 0, 1, 1	0, 0, 0, 0, 4, 4	1.6 (CV=.61)
AK Peninsula/ Aleutian Island salmon drift gillnet	90	obs data	4%	1	28	28 (CI 1-81)
Observer program total						34.8
				Reported mortalities		
Prince William Sound salmon drift gillnet	90-93	logbook	n/a	0, 2, 0, 0	n/a	[$0.5]
Southeast Alaska salmon drift gillnet	90-93	logbook	n/a	6, 6, 4, 6	n/a	[$5.5]
Cook Inlet set and drift gillnet fisheries	90-93	logbook	n/a	1, 0, 1, 0	n/a	[$0.5]
Minimum total annual mortality						$41.3

Note that no observers have been assigned several of the gillnet fisheries that are known to interact with this stock, making the estimated mortality unreliable. However, the large stock size makes it unlikely that unreported mortalities from those fisheries would be a significant source of mortality for the stock. The estimated minimum annual mortality rate incidental to commercial fisheries (42 animals; based on observer data (35) and logbook reports (rounded to 7) where observer data were not available) is not known to exceed 10% of the PBR (154) and, therefore can be considered to be insignificant and approaching zero mortality and serious injury rate.

Subsistence/Native Harvest Information

There are no reports of subsistence take of Dall's porpoise in Alaska.

STATUS OF STOCK

Dall’s porpoise are not listed as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act. Based on currently available data, the level of human-caused mortality and serious injury (42) does not exceed the PBR (1,537). Therefore, the Alaska stock of Dall's porpoise is not classified as a strategic stock. Population trends and status of this stock relative to OSP are currently unknown.

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SPERM WHALE (*Physeter macrocephalus*): North Pacific 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-sized to large-sized squids but may also feed on large demersal and mesopelagic sharks, skates, and fishes (Gosho et al. 1984). In the North Pacific, sperm whales are distributed widely (Fig. 26), with the northernmost boundary extending from Cape Navarin (62ΕN) to the Pribilof Islands (Omura 1955). The shallow continental shelf apparently bars their movement into the north-eastern Bering Sea and Arctic Ocean (Rice 1989). Females and young sperm whales usually remain in tropical and temperate waters year-round, while males are thought to 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 (Gosho et al. 1984). However, discovery tag data from the days of commercial whaling revealed a great deal of east-west movement between Alaska waters and the western North Pacific (Japan and the Bonin Islands), with little evidence of north-south movement in the eastern North Pacific. For example, of several hundred sperm whales tagged off San Francisco (Calif.), none were recovered north of 53° in the Gulf of Alaska despite large takes there (B. Taylor, pers. comm., Southwest Fisheries Science Center, P. O. Box 271, La Jolla, CA 92038). Therefore, seasonal movement of sperm whales in the North Pacific is unclear at this time.

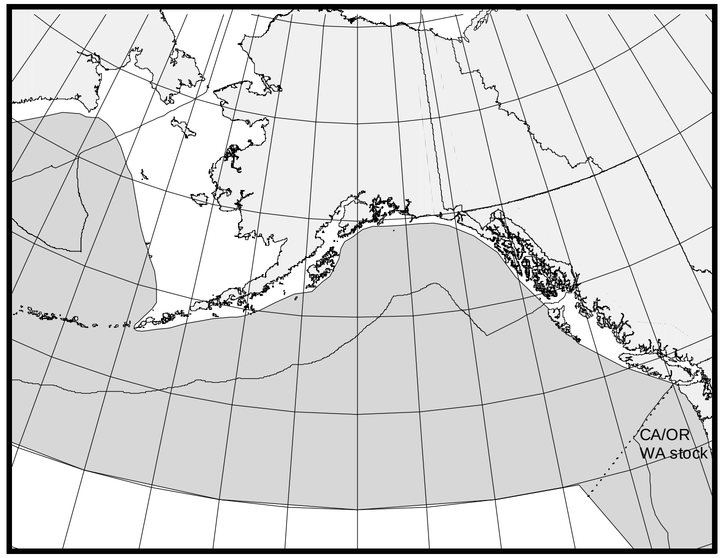

Figure 13. Approximate distribution of sperm whales in the eastern North Pacific (shaded area).

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution continuous though indicates three "somewhat" discrete population centers (i.e., Hawaii, west coast of the continental United States, and Alaska); 2) Population response data: unknown; 3) Phenotypic data: unknown; and 4) Genotypic data: unknown. For management purposes, the International Whaling Commission (IWC) recognizes two management units of sperm whales in the North Pacific (eastern and western). However, the IWC has not reviewed its sperm whale stock boundaries in recent years (Donovan 1991). Based on this limited information, and lacking additional data concerning population structure, sperm whales of the eastern North Pacific have been divided into three separate stocks as dictated by the U. S. waters in which they are found: 1) Alaska (North Pacific stock), 2) California/Oregon/Washington, and 3) Hawaii. The California/Oregon/Washington and Hawaii sperm whale stocks are reported separately in the Stock Assessment Reports for the Pacific Region.

POPULATION SIZE

Current and historic estimates for the abundance of sperm whales in the North Pacific are considered unreliable. Therefore, caution should be exercised in interpreting published estimates of abundance. The abundance of sperm whales in the North Pacific was reported to be 1,260,000 prior to exploitation, which by the late 1970s was estimated to have been reduced to 930,000 whales (Rice 1989). Confidence intervals for these estimates were not provided. These estimates include whales from the California/Oregon/Washington stock, for which a separate abundance estimate is currently available (see Stock Assessment Reports for the Pacific Region).

Although Kato and Miyashita (1998) believe their estimate to be upwardly biased, preliminary analysis indicates 102,112 (CV=0.155) sperm whales in the western North Pacific. In the eastern temperate North Pacific a preliminary estimate indicates 39,200 (CV=0.60) sperm whales (Barlow and Taylor, 1998). The number of sperm whales of the North Pacific occurring within Alaska waters is unknown. 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 Alaska waters, a reliable estimate of abundance for the North Pacific 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 a current estimate of abundance is 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

A reliable estimate of the maximum net productivity rate is not currently available for the North Pacific stock of sperm whale. Hence, until additional data become available, it is recommended that the cetacean maximum net productivity rate (R_{MAX}) of 4% be employed for this stock at this time (Wade and Angliss 1997).

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 0.1, the value for cetacean stocks which are classified as endangered (Wade and Angliss 1997). 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

Six different commercial fisheries operating within the range of the North Pacific stock of sperm whale were monitored for incidental take by fishery observers during 1990-96: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries, and Gulf of Alaska groundfish trawl, longline, and pot fisheries. No mortalities of sperm whale were observed by NMFS observers in any observed fishery. However, it appears that sperm whale interactions with longline fisheries operating in the Gulf of Alaska are known to occur and may be increasing in frequency (Hill and Mitchell 1998). NMFS observers aboard longline vessels targeting both sablefish and halibut have documented sperm whales feeding off the longline gear in the Gulf of Alaska. Fishery observers recorded several instances during 1995-97 in which sperm whales were deterred by fishermen (i.e., yelling at the whales or throwing seal bombs in the water). The first entanglement (not classified as a serious injury according to Angliss and DeMaster 1998) of a sperm whale in a Gulf of Alaska longline was documented in June of 1997 (Fishery Observer Program, unpubl. data, NMFS, AFSC, 7600 Sand Point Way NE, Seattle, WA 98115).

An additional source of information on the number of sperm whales killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1990 and 1996, fisher self-reports from all Alaska fisheries indicated no mortalities of sperm whales from interactions with commercial fishing gear. Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable for 1996 (see Appendix 4).

Therefore, based on the lack of reported mortalities, the estimated annual mortality rate incidental to commercial fisheries is zero. As a result, the annual human-caused mortality level is considered to be insignificant and approaching a zero mortality and serious injury rate.

Subsistence/Native Harvest Information

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

Other Mortality

The population of sperm whales in the Pacific was likely well below pre-whaling levels before modern whaling for them became especially intense in the late 1940s (Reeves and Whitehead 1997). A total of 258,000 sperm whales were reported to have been taken by commercial whalers operating in the North Pacific between 1947 and 1987 (C. Allison, pers. comm., International Whaling Commission, The Red House, Station Road, Histon, Cambridge, UK). This value underestimates the actual kill in the North Pacific as a result of under-reporting by USSR pelagic whaling operations, which are estimated to have under-reported catches during 1949-71 by 60% (Brownell et al. 1998). In addition, new information suggests that Japanese land based whaling operations also under-reported sperm whale catches during the post-World War II era (Kasuya 1998). The Japanese officially stopped catching sperm whales in the North Pacific in 1988 (Reeves and Whitehead 1997).

STATUS OF STOCK

Sperm whales are listed as "endangered" under the Endangered Species Act of 1973, and therefore designated as "depleted" under the MMPA. As a result, this stock is classified as a strategic stock. However, 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). Reliable estimates of the minimum population, population trends, PBR, and status of the stock relative to its Optimum Sustainable Population size are currently not available, although the estimated annual rate of human-caused mortality and serious injury seems minimal for this stock. There are no known habitat issues that are of particular concern for this stock.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Baird's beaked, or giant bottlenose, whale inhabits 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). The range of the species extends north to at least the Pribilof Islands where individuals have been found stranded (Rice 1986, Fig. 27). An apparent break in distribution occurs in the eastern Gulf of Alaska, but from the 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 during the 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 than other beaked whale species. 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).

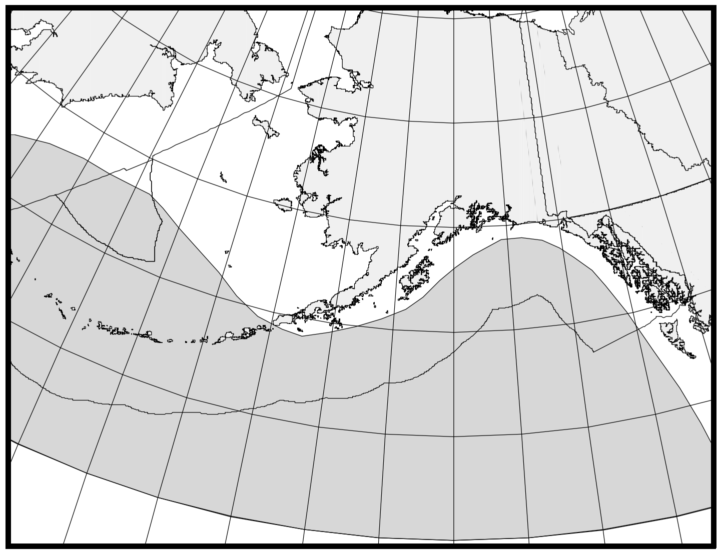

Figure 14. Approximate distribution of Baird's beaked whales in the eastern North Pacific (shaded area).

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 manner because of 1) the large distance between the two areas in conjunction with 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 California/Oregon thresher shark and swordfish drift gillnet fishery. The California/ Oregon/Washington Baird's beaked whale stock is reported separately in the Stock Assessment Reports for the Pacific Region.

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 the Alaska stock of Baird's beaked whale. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate (R_{MAX}) of 4% be employed (Wade and Angliss 1997).

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 (Wade and Angliss 1997). 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

Six different commercial fisheries operating within the range of the Alaska stock of Baird's beaked whale were monitored for incidental take by NMFS observers during 1990-95: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries, and Gulf of Alaska groundfish trawl, longline, and pot fisheries. No Baird's beaked whale mortalities were observed by NMFS observers in any observed fishery.

An additional source of information on the number of Baird's beaked whales killed or injured incidental to commercial fishery operations is the logbook reports maintained by vessel operators as required by the MMPA interim exemption program. During the 4-year period from 1990 to 1993, logbook reports indicated no mortalities of Baird's beaked whales from interactions with commercial fishing gear. Complete logbook data after 1993 are not available.

The estimated annual mortality rate incidental to commercial fisheries is zero. Therefore, the annual human-caused mortality level is considered to be insignificant and approaching a zero mortality and serious injury rate.

Subsistence/Native Harvest Information

There is no known subsistence harvest of Baird's beaked whales by Alaska Natives.

Other Mortality

The Japanese have reported taking 54 Baird's beaked whales annually off their coasts during the 3-year period between 1992 and 1994 (RIWC 1996). Due to the unknown stock structure and migratory patterns in the North Pacific, it is unclear whether these animals belong to the Alaska stock of Baird's beaked whales.

STATUS OF STOCK

Baird's beaked whales are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Reliable estimates of the minimum population, population trends, PBR, and status of the stock relative to OSP are currently not available. However, the estimated annual rate of human-caused mortality and serious injury seems minimal for this stock. Thus, the Alaska stock of Baird's beaked whale is not classified as strategic.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The distribution of Cuvier's beaked, or goosebeak, whale (Fig. 28) is known primarily from strandings, which indicate that 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 Pacific, they range north to southeastern Alaska, the Aleutian Islands, and the Commander Islands (Rice 1986). 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 whales are the most numerous of all beaked whales, indicating that they are probably not 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).

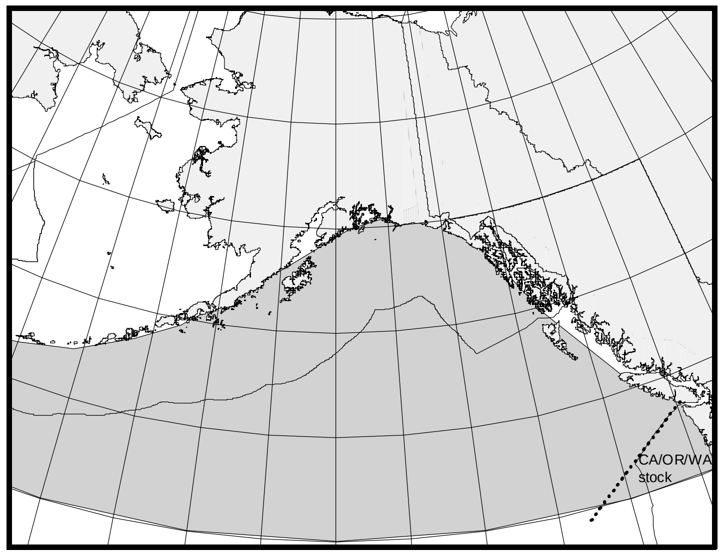

Figure 15. Approximate distribution of Cuvier's beaked whales in the eastern North Pacific (shaded area).

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 the 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) California/Oregon/Washington, and 3) Hawaii. These three stocks were defined in this way because of 1) the large distance between the areas in conjunction with 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 California/Oregon thresher shark and swordfish drift gillnet fishery. The California/Oregon/Washington and Hawaii Baird's beaked whale stocks are reported separately in the Stock Assessment Reports for the Pacific Region.

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 the Alaska stock of Cuvier's beaked whale. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate (R_{MAX}) of 4% be employed (Wade and Angliss 1997).

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 cetacean stocks with unknown population status (Wade and Angliss 1997). 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

Six different commercial fisheries operating within the range of the Alaska stock of Cuvier's beaked whale were monitored for incidental take by NMFS observers during 1990-95: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries, and Gulf of Alaska groundfish trawl, longline, and pot fisheries. No Cuvier's beaked whale mortalities were observed by NMFS observers in any observed fishery.

An additional source of information on the number of Cuvier's beaked whales killed or injured incidental to commercial fishery operations is the logbook reports maintained by vessel operators as required by the MMPA interim exemption program. During the 4-year period from 1990 to 1993, logbook reports indicated no mortalities from interactions with commercial fishing gear. Complete logbook data after 1993 are not available.

The estimated annual mortality rate incidental to commercial fisheries is zero. Therefore, the annual human-caused mortality level is considered to be insignificant and approaching a zero mortality and serious injury rate.

Subsistence/Native Harvest Information

There is no known subsistence harvest of Cuvier's beaked whales.

STATUS OF STOCK

Cuvier's beaked whales are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Reliable estimates of the minimum population, population trends, PBR, and status of the stock relative to OSP are currently not available. However, the estimated annual rate of human-caused mortality and serious injury seems minimal for this stock. Thus, the Alaska stock of Cuvier's beaked whale is not classified as strategic.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Stejneger's, or Bering Sea, 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 (Fig. 29). 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). Near the central Aleutian Islands, groups of 3-15 Stejneger's beaked whales have been sighted on a number of occasions (Rice 1986). The species is not known to enter the Arctic Ocean and is the only species of *Mesoplodon* known to occur in Alaska 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 in the eastern Pacific, but to about 40°N in the western Pacific (Moore 1963, Moore 1966).

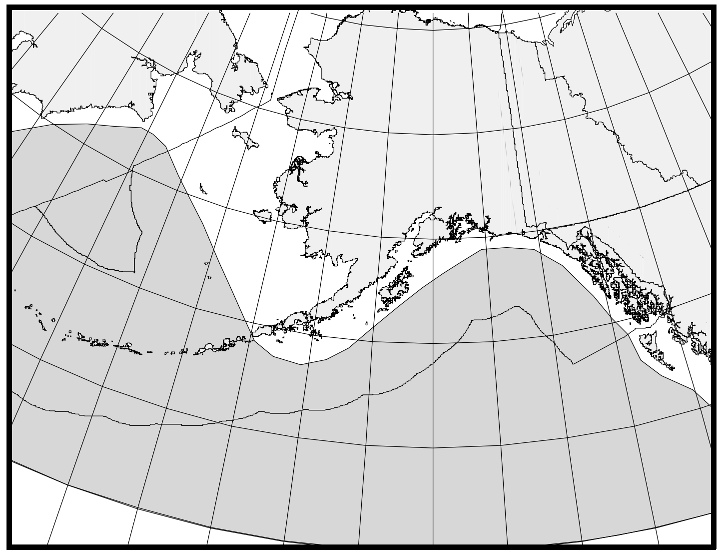

Figure 16. Approximate distribution of Stejneger's beaked whales in the eastern North Pacific (shaded area).

There are insufficient data to apply the phylogeographic approach to stock structure (Dizon et al. 1992) for Stejneger's beaked whale. The Alaska Stejneger's beaked whale stock is recognized separately from other *Mesoplodon* spp. along the west coast of the continental U. S. because 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 in conjunction with 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 California/Oregon thresher shark and swordfish drift gillnet fishery.

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 the Alaska stock of Stejneger's beaked whale. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate (R_{MAX}) of 4% be employed (Wade and Angliss 1997).

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 cetacean stocks with unknown population status (Wade and Angliss 1997). 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

Six different commercial fisheries operating within the range of the Alaska stock of Stejneger's beaked whale were monitored for incidental take by NMFS observers during 1990-95: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries, and Gulf of Alaska groundfish trawl, longline, and pot fisheries. No Stejneger's beaked whale mortalities were observed by NMFS observers in any observed fishery.

An additional source of information on the number of Stejneger's beaked whales killed or injured incidental to commercial fishery operations is the logbook reports maintained by vessel operators as required by the MMPA interim exemption program. During the 4-year period between 1990 and 1993, logbook reports indicated no mortalities from interactions with commercial fishing gear. Complete logbook data after 1993 are not available.

The estimated annual mortality rate incidental to commercial fisheries is zero. Therefore, the annual human-caused mortality level is considered to be insignificant and approaching a zero mortality and serious injury rate.

Subsistence/Native Harvest Information

There is no known subsistence harvest of Stejneger's beaked whales.

STATUS OF STOCK

Stejneger's beaked whales are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Reliable estimates of the minimum population, population trends, PBR, and status of the stock relative to OSP are currently not available. However, the estimated annual rate of human-caused mortality and serious injury seems minimal for this stock. Thus, the Alaska stock of Stejneger's beaked whale is not classified as strategic.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The gray whale formerly occurred in the North Atlantic Ocean (Fraser 1970), but is currently only found in the North Pacific (Rice et al. 1984). 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: increasing in the eastern North Pacific, unknown in the western North Pacific; 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 Pacific stock, which breeds along the west coast of North America (Fig. 30), 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 of 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 (Rice and Wolman 1971) starting in October or 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 North 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). Interestingly, a small, but increasing proportion of newborn calves have been sighted along the California coast during the southward migration (Shelden et al. 1995). The northbound migration generally begins in mid-February and continues through May (Rice et al. 1981) with cows and newborn calves primarily migrating northward between March and June along the U. S. west coast.

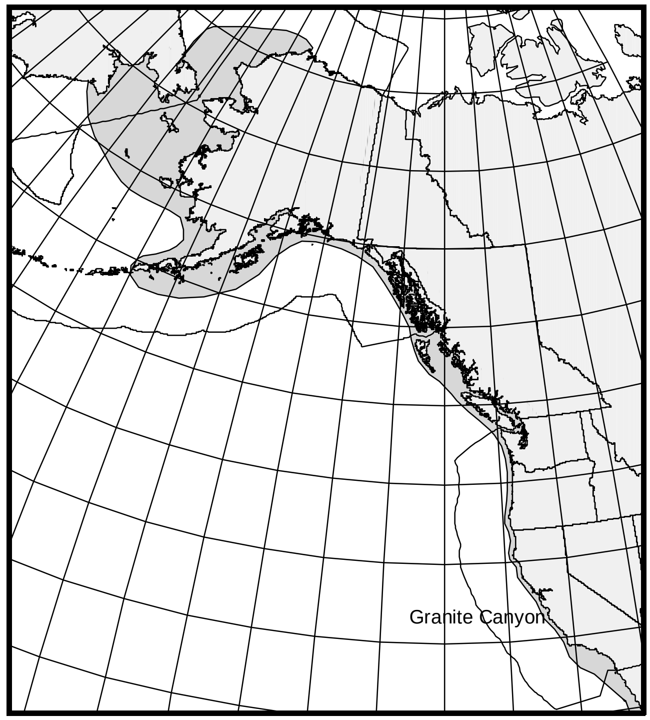

Figure 17. Approximate distribution of the Eastern North Pacific stock of gray whales (shaded area). Excluding some Mexican waters, the entire range of this stock is depicted in the figure.

POPULATION SIZE

Systematic counts of gray whales migrating along the central California coast were conducted by shore-based observers (at Granite Canyon) through the entire duration of the 1995-96 southbound migration (Hobbs et al. 1996). The preliminary abundance estimate resulting from the 1995-96 census is 22,571 (CV=.0524) whales. This estimate is similar to the 1993/1994 abundance estimate of 23,109 (CV=.0542) whales (RIWC 1995), slightly higher than the 1987-88 estimate of 21,296 (CV=.0605) whales (Buckland et al. 1993), and significantly higher than the 1992-93 estimate of 17,674 (CV=.0587) whales (RIWC 1995). Variations in estimates may be due in part to undocumented sampling variation due to differences in the proportion of the gray whale stock migrating as far as the central California coast each year (Hobbs et al. 1996). The 1995-96 abundance estimate is the most recent and is considered a reliable estimate of abundance for this stock.

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock is calculated from Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842*[\ln(1+[CV(N)]^2)]^{½})$. Using the 1995-96 population estimate of 22,571 and its associated CV of 0.0524, N_{MIN} for this stock is 21,597.

Current Population Trend

The population size of Eastern North Pacific gray whale stock has been increasing over the past several decades. 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 census data through the 1993-94 migration resulted in an annual rate of increase of 2.57% (SE = 0.4%: RIWC 1995). Most recently, Breiwick (1996) and Wade and DeMaster (1996) estimated the annual rate of increase from 1967-68 to 1995-96 at 2.5% (95% CI: 2.37-2.61%) and 2.4% (95% CI: 1.6%-3.2%), respectively.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Wade (1994) reported that based on a Bayesian analysis of the census data between 1967-68 and 1993-94, 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 International Whaling Commission (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).

When incorporating the 1995-96 abundance estimate, Wade and DeMaster (1996) estimated R_{MAX} from the period between 1967-68 and 1995-96 at 0.044 (95% CI: 0.031-0.056). This estimate is not significantly different than the cetacean maximum net productivity rate (R_{MAX}) of 4% (Wade and Angliss 1997). Therefore, it is recommended that the 4% R_{MAX} be employed for this stock. 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}. In addition, it should be noted that the estimated R_{MAX} was calculated during a period in which gray whales from this stock were being harvested by Russian aboriginals.

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 non-listed stocks which are increasing while undergoing removals due to subsistence hunters (Wade and Angliss 1997). Thus, for the Eastern North Pacific stock of gray whale, PBR = 432 animals (21,597 x 0.02 x 1.0).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Six different commercial fisheries operating in Alaska waters within the range of the Eastern North Pacific gray whale stock were monitored for incidental take by NMFS observers during 1990-95: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries, and Gulf of Alaska groundfish trawl, longline, and pot fisheries. No gray whale mortalities were observed for any of these Alaska fisheries.

Between 1990 and 1995, NMFS observers also monitored the northern Washington marine set gillnet fishery, otherwise known as the Makah tribal fishery for chinook salmon. No data for 1994 are presented in Table 22 because no fishery observer program occurred during that year. Accordingly, when calculating the mean annual mortality, the 1994 data omission will be accounted for (e.g., the summed estimated mortality will be divided by 4, not 5). One gray whale was observed taken in 1990 (Gearin et al. 1994) and one observed taken in 1995 (P. Gearin unpubl. data, NMFS, 7600 Sand Point Way NE, Seattle, WA, 98115), resulting in a mean annual mortality of 0.5 gray whales from observed fisheries. In July of 1996, one gray whale was entangled in the same tribal set gillnet fishery though released unharmed (P. Gearin, pers. comm., NMFS, 7600 Sand Point Way NE, Seattle, WA, 98115).

An additional source of information on the number of gray whales killed or injured incidental to commercial fishery operations is the logbook reports maintained by vessel operators as required by the MMPA interim exemption program. During the 4-year period between 1990 and 1993, logbook reports indicated 2 gray whale mortalities related to the Bristol Bay gillnet fisheries in 1990, resulting in an annual mean of 0.5 gray whale mortalities from interactions with commercial fishing gear. In 1990, logbook records from the Bristol Bay set and drift gillnet fisheries were combined. As it is not possible to determine which fishery was responsible for the gray whale mortalities reported in 1990, both fisheries have been included in Table 22. However, because logbook records are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. Complete logbook data after 1993 are not available.

Table 22. Summary of incidental mortality of gray whales (Eastern North Pacific stock) due to commercial fisheries from 1990 through 1995 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from logbook reports.

Fishery name	**Years**	**Data type**	**Range of observer coverage**	**Observed mortality (in given yrs.)**	**Estimated mortality (in given yrs.)**	**Mean annual mortality**
Northern Washington marine set gillnet (tribal)	90-95	obs data	47-87%	1, 0, 0, n/a, 1	1, 0, 0, n/a, 1	0.5 (CV=.61)
Observer program total						0.5
				Reported mortalities		
Bristol Bay salmon drift and set gillnet fisheries	90-93	logbook	n/a	2, 0, 0, 0	n/a	[$0.5]
unknown west coast fisheries	93-95	strand data	n/a	0, 5, 2	n/a	[$2.3]
Minimum total annual mortality						$3.3

Other Alaska fisheries (not included in Table 22) may interact with gray whales as strandings of individuals entangled in gillnets have been reported, including a 1987 stranding along the Alaska Peninsula and a 1988 stranding near Yakutat. These strandings have not been attributed to a particular fishery and have not been included in the annual mortality rate calculation because they occurred prior to 1990.

Reports of entangled gray whales found swimming, floating, or stranded with fishing gear attached also occurs along the west coast of the continental U. S. and British Columbia. In U. S. waters there are confirmed reports of 3 gray whale mortalities in 1994 (2 in San Diego County and 1 in Del Norte County) and 2 mortalities in 1995 (1 in Santa Barbara county, and 1 in Washington State). There were no confirmed mortalities in 1993 (J. Cordaro, pers. comm., NMFS Southwest Region, 501 West Ocean Blvd. Ste. 4200, Long Beach, CA, 90802). In 1994, two gray whale mortalities related to fisheries were reported in British Columbia (Guenther et al. 1995). Other entangled gray whales were reported, though only confirmed mortalities have been included here. These stranding data are included in Table 22 (listed as unknown west coast fisheries) as they resulted from commercial fishing. However, the mortalities have not been attributed to particular fisheries and their locations suggest that some may have been related to Mexican or Canadian, but not U. S. fisheries. Therefore, during the 3-year period from 1993 to 1995, stranding network data indicate a minimum annual mean of 2.3 gray whale mortalities resulting from interactions with commercial fishing gear.

It should be noted that no observers have been assigned to most Alaska gillnet fisheries, including those in Bristol Bay which are known to interact with this stock, making the estimated mortality from U. S. fisheries unreliable. Further, due to a lack of observer programs there are few data concerning the mortality of marine mammals incidental to Canadian commercial fisheries, which are analogous to U.S. fisheries that are known to interact with gray whales. Data regarding the level of gray whale mortality related to commercial fisheries in Canadian waters, though thought to be small, are not readily available or reliable which results in an underestimate of the annual mortality for this stock. However, the large stock size and observed rate of increase over the past 20 years makes it unlikely that unreported mortalities from those fisheries would be a significant source of mortality for the stock. The estimated minimum annual mortality rate incidental to commercial fisheries (rounded to 4; based on observer data (0.5) and logbook reports (0.5) or stranding reports (2.3) where observer data were not available) is not known to exceed 10% of the PBR (43) and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate.

Subsistence/Native Harvest Information

Subsistence hunters in Alaska and Russia have traditionally harvested whales from this stock. There have been no reported takes by subsistence hunters in Alaska during this decade, with the most recent reported harvest occurring in 1989 (RIWC 1991). Russian subsistence hunters reported taking no whales from this stock during 1993 (RIWC 1995), 44 in 1994 (RIWC 1996), and 85 in 1995 (RIWC 1997). The 1995 harvest consisted of 40 females, 44 males, and 1 whale reported struck and lost. Based on this information, the annual subsistence take averaged 43 whales during the 3-year period from 1993 to 1995. This level of take is well below the 1968-93 average of 159 whales per year (RIWC 1995), during which time the population size increased. The current IWC quota for gray whales taken by aboriginals is 140 animals per year.

In 1995, the Makah Indian Tribe in Washington state officially requested for an annual quota of 5 gray whales per year for subsistence and ceremonial purposes. At the 1996 IWC meetings, the U. S. delegation requested the quota on behalf of the Makah, which was subsequently withdrawn during the same meeting. It is anticipated that the Makah Indian Tribe will seek an annual quota of 5 whales in 1997 and thereafter.

Other Mortality

The near shore migration route used by gray whales makes ship strikes another potential source of mortality. There are confirmed reports from the California stranding network of ship strikes causing one gray whale mortality per year over the 3-year period from 1993 to 1995 (J. Cordaro, pers. comm., NMFS Southwest Region, 501 West Ocean Blvd. Ste. 4200, Long Beach, CA, 90802). Additional mortality from ship strikes probably goes unreported because the whales either do not strand or do not have obvious signs of trauma. Therefore, it is not possible to quantify the actual mortality of gray whales from this source and the annual mortality rate of 1 gray whale per year due to collisions with vessels represents a minimum estimate from this source of mortality.

STATUS OF STOCK

The eastern North Pacific stock of gray whale has been increasing in recent years while being subjected to known subsistence harvests by Russian subsistence hunters. Based on currently available data, the estimated annual level of human-caused mortality and serious injury (48), which includes mortality from commercial fisheries (4), takes by Russian subsistence hunters (43), and ship strikes (1) does not exceed the PBR (432). Therefore, the Eastern North Pacific stock of gray whale is not classified as a strategic stock. It should be noted that in 1994 this stock was removed from the List of Endangered and Threatened Wildlife (i.e., it is no longer considered endangered or threatened under the Endangered Species Act).

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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 the temperate and tropical waters of the North and South Hemispheres (from 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 United States, western Canada, and the Russian Far East (NMFS 1991). The historic summer time 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). Humpback whales have been known to enter the Chukchi Sea (Johnson and Wolman 1984). The humpback whale population in much of this range was considerably reduced as a result of intensive commercial exploitation during this century.

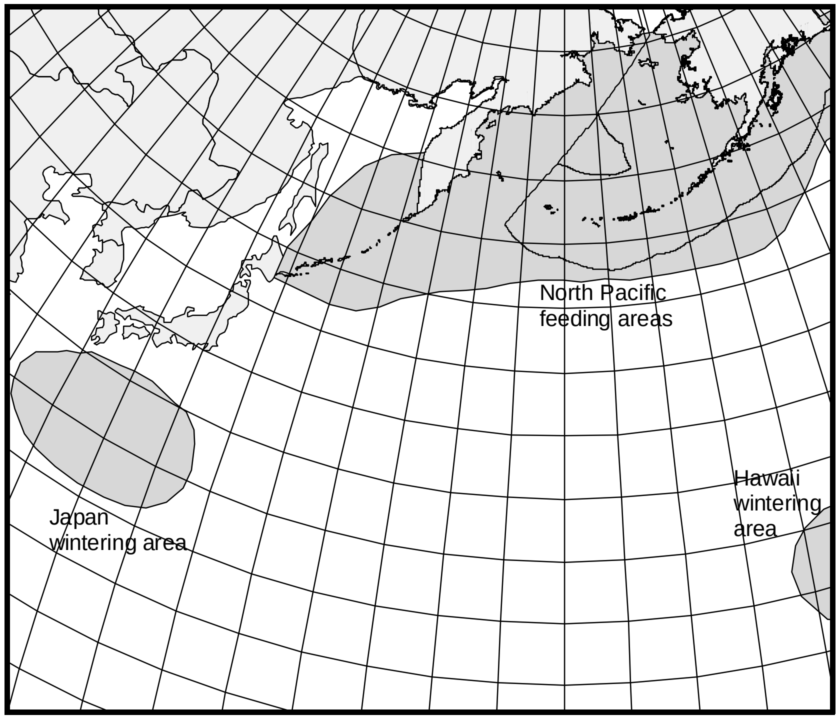

Figure 18. Approximate distribution of humpback whales in the western North Pacific (shaded area). Feeding and wintering areas are presented above (see text). See Figure 32 for humpback whale distribution in the eastern North Pacific.

Aerial, vessel, and photo-identification surveys indicate that there may be four relatively separate populations that migrate between their respective summer/fall feeding areas to winter/spring calving and mating areas (Barlow 1994, Figs. 31 and 32): 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) - referred to as the California/Oregon/Washington and Mexico stock; 2) winter/spring populations of Mexico's offshore islands whose migratory destination is not well known (Calambokidis et al. 1993) - referred to as the Mexico offshore island stock; 3) winter/spring populations of the Hawaiian Islands which migrate to northern British Columbia/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, based on Discovery Tag information, probably migrate to waters west of the Kodiak Archipelago (the Bering Sea and Aleutian Islands) in summer/fall (Berzin and Rovnin 1966, Nishiwaki 1966, Darling 1991) - referred to as the Western North Pacific stock. However, some recent exchange between winter/spring areas has been documented (Darling and McSweeney 1985, Baker et al. 1986, Darling and Cerchio 1993), as well as movement between Japan and British Columbia, and Japan and the Kodiak Archipelago (Darling et al. 1996, Calambokidis et al. 1997). Currently, there are insufficient data to apply the Dizon et al.(1992) phylogeographic approach to classify population structure in humpback whales. Until further information becomes available, 4 management units of humpback whales (as described above) are recognized in the North Pacific: two in the Eastern North Pacific (the California/Oregon/Washington - Mexico stock, and the Mexico offshore island stock), one in the Central North Pacific, and one in the Western North Pacific. The California/Oregon/Washington - Mexico humpback whale stock is reported separately in the Stock Assessment Reports for the Pacific Region.

The feeding areas for the Western North Pacific humpback whale stock are largely unknown. There has been little to no effort to photo-identify individual humpback whales in the North Pacific waters west of the Kodiak Archipelago. As a result, none of the whales identified off Japan have been resighted in the historical feeding areas of the stock (Bering Sea and Aleutian Islands). Individuals identified off Japan, however, have been resighted in the eastern North Pacific (Calambokidis et al. 1997). This may indicate that the Western North Pacific humpback whale stock did not exclusively use the feeding areas in the western Pacific, or, perhaps, a shift in the migratory destination of this stock has occurred. Thus, some unknown fraction of whales from the wintering grounds off Japan spend their summers feeding in areas typically utilized by whales from the Central North Pacific stock.

POPULATION SIZE

The abundance estimate of humpback whales in the North Pacific is based on data collected by nine independent research groups that conducted photo-identification studies of humpback whales in the three wintering areas (Mexico, Hawaii, and Japan). Photographs taken between 1991 and 1993 were used to estimate abundance because samples throughout the entire North Pacific were the largest and most complete during this period. Using Darroch's (1961) method, which utilizes only data from wintering areas, and averaging the 1991-92, 1992-93, and 1991-93 winter release-recovery information results in an abundance estimate of 394 (CV=0.084) for the Western North Pacific humpback whale stock (Calambokidis et al. 1997).

A vessel survey conducted in August of 1994 covered 2,050 nautical miles of trackline south of the Aleutian Islands encountered humpback whales in scattered aggregations (57 sightings) throughout the study area (Forney and Brownell 1996). It is unknown whether the humpback whales encountered during this survey belonged to the Western or Central North Pacific stock.

There are no reliable estimates for the abundance of humpback whales at feeding areas for this stock because the specific feeding areas are largely unknown.

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock is calculated according to Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 394 and its associated CV(N) of 0.084, N_{MIN} for this humpback whale stock is 367.

Current Population Trend

Reliable information on trends in abundance for the Western North Pacific humpback whale stock are currently not available.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Ninety-five percent confidence intervals for observed rates of increase have been estimated for humpback whale stocks in the Atlantic and have ranged from 3.0% to 14.6% (IWC 1994). Utilizing a birth-interval model, Barlow and Clapham (1997) have estimated a population growth rate of 6.5% (SE=1.2%) for the well-studied humpback whale population in the Gulf of Maine. However, there are no estimates of the growth rate of humpback whale populations in the North Pacific (Best 1993). Hence, until additional data become available from this or other North Pacific humpback whale stocks, it is recommended that the cetacean maximum net productivity rate (R_{MAX}) of 4% be employed for this stock (Wade and Angliss 1997).

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 0.1, the value for cetacean stocks listed as endangered under the Endangered Species Act (Wade and Angliss 1997). Thus, for the Western North Pacific stock of humpback whale, PBR = 0.73 animals (367 × 0.02 × 0.1).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Six different commercial fisheries operating in Alaska waters within the range of this stock were monitored for incidental take by fishery observers during 1990-96: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries, and Gulf of Alaska groundfish trawl, longline, and pot fisheries. No humpback whale mortalities were observed for any of these fisheries.

An additional source of information on the number of humpback whales killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1990 and 1996, there were no fisher self-reports of humpback whale injuries or mortalities from interactions with commercial fishing gear in any Alaska fishery within the presumed range of the Western North Pacific humpback whale stock. Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable for 1996 (see Appendix 4).

Therefore, based on the lack of reported mortalities, the estimated annual mortality rate incidental to commercial fisheries is zero whales per year from this stock. However, this estimate is considered a minimum because there are no data concerning fishery-related mortalities in Japanese, Russian, or international waters. In addition, there is a small probability that fishery interactions discussed in the assessment for the Central North Pacific stock may have involved animals from this stock because the only known matches to feeding areas come from areas typically used by the Central North Pacific stock.

Subsistence/Native Harvest Information

Subsistence hunters in Alaska and Russia have not been reported to take humpback whales from this stock.

Other Mortality

The number of humpback whales in the North Pacific 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). This mortality estimate likely underestimates the actual kill as a result of under-reporting of the Soviet catches (Yablokov 1994).

STATUS OF STOCK

As the estimated annual mortality rate (0) is considered a minimum, it is unclear whether the level of human-caused mortality and serious injury exceeds the PBR (0.73). However, the estimated fishery mortality and serious injury in U. S. fisheries is zero and, therefore, can be considered to be insignificant and approaching a zero mortality and serious injury rate. The humpback whale is listed as "endangered" under the Endangered Species Act, and therefore designated as "depleted" under the MMPA. As a result, the Western North Pacific humpback whale stock is classified as a strategic stock. Reliable population trend data and the status of this stock relative to its Optimum Sustainable Population size are unknown. There are no known habitat issues that are of particular concern for this stock.

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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 the temperate and tropical waters of the North and South Hemispheres (from 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 United States, 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). Humpback whales have been known to enter the Chukchi Sea (Johnson and Wolman 1984). The humpback whale population in much of this range was considerably reduced as a result of intensive commercial exploitation during this century.

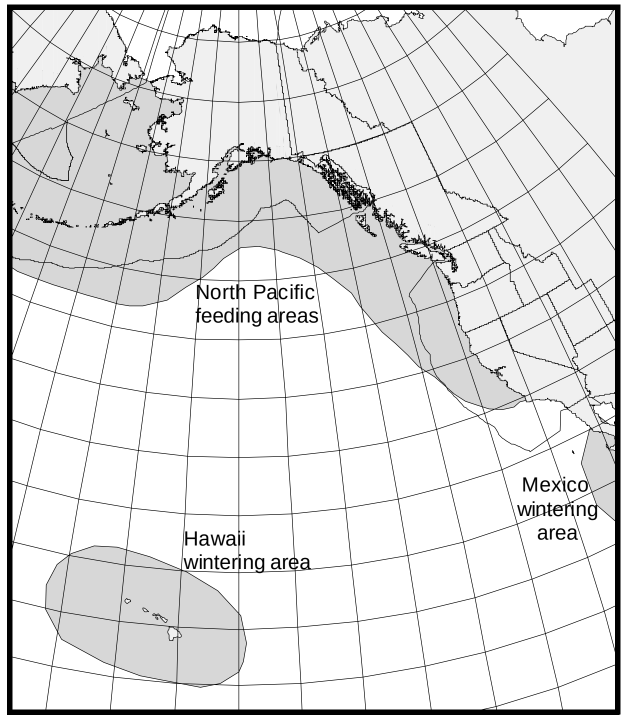

Figure 19. Approximate distribution of humpback whales in the eastern North Pacific (shaded area). Feeding and wintering areas are presented above (see text). See Figure 31 for distribution of humpback whales in the western North Pacific.

Aerial, vessel, and photo-identification surveys indicate that there may be four relatively separate populations that migrate between their respective summer/fall feeding areas to winter/spring calving and mating areas (Barlow 1994, Figs. 31 and 32): 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) - referred to as the California/Oregon/Washington and Mexico stock; 2) winter/spring populations of Mexico's offshore islands whose migratory destination is not well known (Calambokidis et al. 1993) - referred to as the Mexico offshore island stock; 3) winter/spring populations of the Hawaiian Islands which migrate to northern British Columbia/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, based on Discovery Tag information, probably migrate to waters west of the Kodiak Archipelago (the Bering Sea and Aleutian Islands) in summer/fall (Berzin and Rovnin 1966, Nishiwaki 1966, Darling 1991) - referred to as the Western North Pacific stock. However, some recent exchange between winter/spring areas has been documented (Darling and McSweeney 1985, Baker et al. 1986, Darling and Cerchio 1993), as well as movement between Japan and British Columbia, and Japan and the Kodiak Archipelago (Darling et al. 1996, Calambokidis et al. 1997). Currently, there are insufficient data to apply the Dizon et al.(1992) phylogeographic approach to classify population structure in humpback whales. Until further information becomes available, 4 management units of humpback whales (as described above) are recognized in the North Pacific: two in the Eastern North Pacific (the California/Oregon/Washington - Mexico stock, and the Mexico offshore island stock), one in the Central North Pacific, and one in the Western North Pacific. The California/Oregon/Washington - Mexico humpback whale stock is reported separately in the Stock Assessment Reports for the Pacific Region.

POPULATION SIZE

This stock of humpback 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, the robustness of this estimate is questionable due to the opportunistic nature of the survey methodology in conjunction with a small sample size. Further, the data used to produce this estimate were collected between 1980 and 1983.

The current abundance estimate of humpback whales in the North Pacific is based on data collected by nine independent research groups that conducted photo-identification studies of humpback whales in the three wintering areas (Mexico, Hawaii, and Japan). Photographs taken between 1991 and 1993 were used to estimate abundance because samples throughout the entire North Pacific were the largest and most complete during this period. Using Darroch's (1961) method, which utilizes only data from wintering areas, and averaging the 1991-92, 1992-93, and 1991-93 winter release-recovery information results in an abundance estimate of 4,005 (CV=0.095) for the Central North Pacific humpback whale stock (Calambokidis et al. 1997).

The Central North Pacific stock of humpback whales consists of feeding aggregations along the northern Pacific rim. Humpback whale distribution in summer is continuous from British Columbia to the Russian Far East, and humpbacks are present offshore in the Gulf of Alaska (Brueggeman et al. 1989, Forney and Brownell 1996). The three feeding areas for the Central North Pacific stock that have been studied using photographs to identify individual whales are southeastern Alaska, Prince William Sound, and Kodiak Island. There has been some exchange of individual whales between these locations. For example, six whales have been sighted in Prince William Sound and southeastern Alaska since studies began in 1977 (Perry et al. 1990, von Ziegesar et al. 1994; S. Baker, D. McSweeny, J. Straley, and O. von Ziegesar, unpubl. data); nine whales have been sighted between Kodiak Island, including the area adjacent to Kodiak along the Kenai Peninsula, and Prince William Sound; and two whales between Kodiak and southeastern Alaska (Waite et al. in press). The humpback whales of the Central North Pacific stock show some degree of fidelity to feeding areas, with this fidelity maternally directed; that is, whales return to the feeding areas where their mothers first brought them as calves (Martin et al. 1984, Baker et al. 1987). However, the degree of this fidelity to a specific area is unknown for many whales and given the continuous distribution in the North Pacific, and the known interchange among areas, setting distinct boundaries between feeding areas may not be possible.

Using photographs of the unique markings on the underside of each whales' flukes, there were 149 individual humpback whales identified in Prince William Sound from 1977 to 1993 (von Ziegesar 1992, Waite et al. in press). The abundance of the Prince William Sound feeding aggregation is thought to be less than 200 whales (Waite et al. in press). In southeastern Alaska, 648 individual humpback whales were identified from 1985 to 1992, resulting in an annual abundance estimate of 404 whales (95% CI:350-458) (Straley 1994). In the Kodiak Island region 127, individual humpback whales were identified from 1991 to 1994 (Waite et al. in press), resulting in an annual abundance estimate of 651 whales (95% CI:356-1,523). These estimates represent minimum estimates for the three known feeding areas because the study areas did not include the entire geographic region (i.e., the southeast Alaska study area did not include waters to the south of Chatham Strait). In addition, little is known regarding humpback whale abundance between feeding areas, south of Chatham Strait, and west of Kodiak Island. As a result, the sum of the estimates from these feeding aggregations (approximately 1,250) is considerably less than 4,005 animals.

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock is calculated according to Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 4,005 and its associated CV(N) of 0.095, N_{MIN} for this humpback whale stock is 3,698.

Current Population Trend

Comparison of the estimate provided by Calambokidis et al. (1997) with the 1981 estimate of 1,407 (95% CI 1,113-1,701) from Baker and Herman (1987) demonstrates that the stock has increased in abundance between the early 1980s and early 1990s. However, the robustness of the Baker and Herman (1987) estimate is questionable due to the opportunistic nature of the survey methodology in conjunction with a small sample size. As a result, although data support an increasing population size for this stock, it is not possible to assess the rate of increase.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Ninety-five percent confidence intervals for observed rates of increase have been estimated for humpback whale stocks in the Atlantic and have ranged from 3.0% to 14.6% (IWC 1994). Utilizing a birth-interval model, Barlow and Clapham (1997) have estimated a population growth rate of 6.5% (SE=1.2%) for the well-studied humpback whale population in the Gulf of Maine. However, there are no estimates of the growth rate of humpback whale populations in the North Pacific (Best 1993). Hence, until additional data become available from this or other North Pacific humpback whale stocks, it is recommended that the cetacean maximum net productivity rate (R_{MAX}) of 4% be employed for this stock (Wade and Angliss 1997).

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 0.1, the value for cetacean stocks listed as endangered under the Endangered Species Act (Wade and Angliss 1997). Thus, for the Central North Pacific stock of humpback whale, PBR = 7.4 animals (3,698 × 0.02 × 0.1).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Three different commercial fisheries operating in Alaska waters within the range of the Central North Pacific humpback whale stock were monitored for incidental take by fishery observers during 1990-96: Gulf of Alaska groundfish trawl, longline, and pot fisheries. No humpback whale mortalities were observed for any of these Alaska fisheries. Fishery observers also monitored the Hawaii swordfish, tuna, billfish, mahi mahi, wahoo, oceanic shark longline/setline fishery during the same 7-year period. The range of observer coverage for this fishery, as well as the annual observed and estimated mortalities, are presented in Table 23. The observer program in the Hawaii fishery was voluntary from 1990 through 1993, leading to very low levels of observer coverage during those years (<1%). In 1994, the observer program became mandatory and observer coverage has been approximately 5% since that time. Fishery observers recorded one humpback whale entangled in longline gear in 1991. The fate of this animal is unknown, though it is presumed to have died. The mortality rate was not estimated from the 1991 mortality due to the low level of observer coverage in that year (<1%). Therefore, that single mortality also appears as the estimated mortality for 1991 and should be considered a minimum estimate. Note that another humpback whale was reported by fishers and whalewatch operators entangled in longline gear off Maui in during 1993 (E. Nitta, pers. comm., Southwest Fisheries Science Center, Honolulu Laboratory, 2570 Dole St., Honolulu, HI, 96822). This report was never confirmed and the fate of this animal is also unknown. The estimated mean annual mortality rate in observed fisheries during the 5-year period from 1992-96 is zero humpback whales per year from this stock.

An additional source of information on the number of humpback whales killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the 4-year period between 1990 and 1993, there were no fisher self-reports of humpback whale injuries or mortalities from interactions with commercial fishing gear in any Alaska fishery within the range of the Central North Pacific humpback whale stock. Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable for 1996 (see Appendix 4). In 1994, the incidental take of a humpback whale was reported in the Southeast Alaska salmon purse seine fishery. Another humpback whale is known to have been taken incidentally in this fishery in 1989, but due to its historic nature has not been included in Table 23. In 1996, a humpback whale was reported entangled and trailing gear as a result of interacting with the Southeast Alaska drift gillnet fishery. This whale is presumed to have died. Averaging these two mortalities over the most recent 5 years for which data are available results in an annual mortality of 0.4 humpback whales based on self-reported fisheries information (Table 23). This is considered to be a minimum estimate because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994).

Strandings of humpback whales entangled in fishing gear or with injuries caused by interactions with gear are another source of mortality data. Fishery-related humpback strandings have been reported in Hawaii (1992, 1996) and in Alaska (1992, 1994, 1996). In February 1992, the U. S. Coast Guard successfully disentangled a humpback from set longline gear (ulua fishery) off the island of Hawaii (Mazzuca et al. 1998). In February 1996, a juvenile humpback entangled in fishing gear (thought to be Hawaiian crab gear) was sighted off Oahu, then resighted the following week off Kauai (Mazzuca et al. 1998). This animal is believed to have perished after a disentanglement attempt left pieces of gear around a pectoral fin and through the mouth. An entanglement of a humpback whale occurred in the Southeast Alaska salmon drift gillnet fishery in 1992 and was reported as a stranding. In 1994, a humpback whale was reported in a weakened condition entangled in a fishing net with floats attached and is presumed to have died. The 1994 entanglement could not be attributed to a particular fishery. Due to the location of the report (Chatham Strait), the mortality has been included along with the data for the Southeast Alaska salmon drift gillnet fishery (Table 23), when it may have resulted from operations in the Southeast Alaska salmon purse seine fishery. In August 1996, an entangled humpback was released from fishing gear near Sand Point, Alaska. The whale slowly lumbered off, staying near the surface and is thought to have perished. Both 1996 mortalities have been listed in Table 23 as occurring in unknown fisheries because they can not be attributed to a particular fishery. There have been no reports of fishery-related strandings in northern British Columbia this decade. Fishery-related strandings from Hawaii and Alaska during 1992-96 result in an estimated annual mortality of 0.8 humpback whales from this stock. This estimate is considered a minimum because not all entangled animals strand and not all stranded animals are found or reported.

Table 23. Summary of incidental mortality of humpback whales (Central North Pacific stock) due to commercial fisheries from 1990 through 1996 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate. For a particular fishery, the most recent 5 years of available data are used in the mortality calculation when more than 5 years of data are provided. n/a indicates that data are not available.

Fishery name	Years	Data type	Range of observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Hawaii swordfish, tuna, billfish, mahi mahi, oceanic shark longline/setline	90-96	obs data	<1-5%	0, 1, 0, 0, 0, 0, 0	0, 1, 0, 0, 0, 0, 0	0
Observer program total						0
				Reported mortalities		
Southeast Alaska salmon drift gillnet	90-96	self reports	n/a	0, 0, 0, 0, n/a, n/a, 1	n/a	[$0.2]
Southeast Alaska salmon purse seine	90-96	self reports	n/a	0, 0, 0, 0, 1, n/a, n/a	n/a	[$0.2]
Southeast Alaska salmon drift gillnet	90-96	strand data	n/a	0, 0, 1, 0, 1, 0, 0	n/a	[$0.4]
unknown fishery (Hawaii and Gulf of Alaska)	92-96	strand data	n/a	0, 0, 0, 0, 2	n/a	[$0.4]
Minimum total annual mortality						[$1.2]

The estimated minimum mortality rate incidental to commercial fisheries is 1.2 humpback whales per year, based on observer data (0), and self-reported fisheries information (0.4) or stranding data (0.8) where observer data were not available. As mentioned previously, this estimate should be considered a minimum. No observers have been assigned to several fisheries that are known to interact with this stock, making the estimated mortality unreliable. Further, due to a lack of Canadian observer programs there are few data concerning the mortality of marine mammals incidental to Canadian commercial fisheries, which are analogous to U.S. fisheries that are known to interact with humpback whales. Though interactions are thought to be minimal, the lack of data regarding the level of humpback whale mortality related to commercial fisheries in northern British Columbia are not available, again reinforcing the point that the estimated mortality incidental to commercial fisheries is underestimated for this stock.

Subsistence/Native Harvest Information

Subsistence hunters in Alaska have not been reported to take from this stock of humpback whales.

Other Mortality

Ship strikes and interactions with vessels unrelated to fisheries have also occurred to humpback whales. In 1995, a humpback whale was reported in Hawaiian waters trailing line which did not appear to be related to a fishery. This animal then entangled in a mooring line, but was successfully released. However, the whale was subsequently attacked and killed by sharks. The extent to which the entanglement contributed to the shark predation is unknown. In 1996, another humpback was found in Hawaiian waters entangled in a line attached to a sea anchor. This animal appeared in good health after it was successfully released (E. Nitta, pers. comm., Southwest Fisheries Science Center, Honolulu Laboratory, 2570 Dole St., Honolulu, HI, 96822). During 1992-96, the only reported ship strike mortality of a humpback from this stock occurred in Oahu during February of 1996. Averaging these mortalities over the 5-year period from 1992 to 1996 results in a mortality rate of 0.4 whales per year from this stock resulting from ship strikes or entanglement in line (other than fishing gear).

The number of humpback whales in the North Pacific 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). This mortality estimate likely underestimates the actual kill as a result of under-reporting of the Soviet catches (Yablokov 1994).

STATUS OF STOCK

As the estimated annual mortality rate (1.6; 1.2 of which was fishery-related) is considered a minimum, it is unclear whether the level of human-caused mortality and serious injury exceeds the PBR (7.4). The minimum estimated fishery mortality and serious injury for this stock is not less that 10% of the calculated PBR (0.74) and, therefore, can not be considered to be insignificant and approaching a zero mortality and serious injury rate. The humpback whale is listed as “endangered” under the Endangered Species Act, and therefore designated as “depleted” under the MMPA. As a result, the Central North Pacific stock of humpback whale is classified as a strategic stock. The stock appears to have increased in abundance between the early 1980s and early 1990s; however, the status of this stock relative to its Optimum Sustainable Population size is unknown.

Habitat Concerns

This stock is the focus of a large whalewatching industry in its wintering grounds (Hawaii) and a growing whalewatching industry in its summering grounds (Alaska). Regulations concerning minimum distance to keep from whales and how to operate vessels when in the vicinity of whales have been developed for Hawaii waters in an attempt to minimize the impact of whalewatching. Similar, although more general, marine mammal viewing guidelines have been developed for Alaska waters. The growth of the industry, however, is a concern as preferred habitats may be abandoned if disturbance levels are too high.

Noise pollution from the Acoustic Thermometry of Ocean Climate (ATOC) program in Hawaii waters is another concern for this stock. Results from experiments in 1996 off Hawaii indicated only subtle responses of humpback whales to ATOC-like transmissions. However, there are no data to address the possible long-term effects to humpbacks if the system were to become operational. Again, preferred habitats may be abandoned if disturbance levels are too high.

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FIN WHALE (*Balaenoptera physalis*): Northeast Pacific Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

In the North Pacific Ocean, fin whales can be found from above the Arctic Circle to lower latitudes of approximately 20EN (Leatherwood et al. 1982). There are few data concerning the location of the winter grounds of fin whales because migrations from summer feeding areas back to their winter grounds tend to occur in the open ocean rather than near the coast (Mizroch et al. 1984). Within U. S. waters in the Pacific, fin whales are distributed seasonally off the coast of North America (Fig. 33) and occasionally near and around the waters of Hawaii.

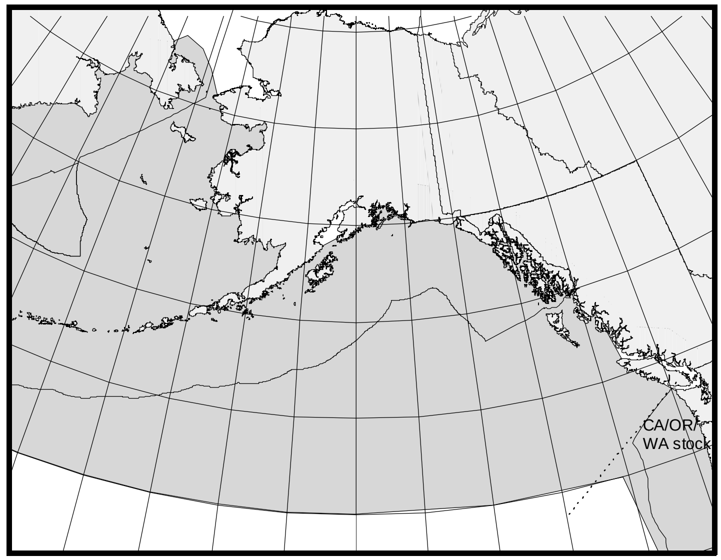

Figure 20. Approximate distribution of fin whales in the eastern North Pacific (shaded area).

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 the authors 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 though may intermingle around the Aleutian Islands. Tag recoveries reported by Rice (1974) indicate that animals wintering off the coast of southern California range from central California to the Gulf of Alaska during the summer months. Fin whales along the Pacific coast of North America have been reported during the summer months from the Bering Sea to as far south as central Baja California (Leatherwood et al. 1982). As a result, stock structure of fin whales is considered equivocal. Based on a conservative management approach, three stocks are recognized: 1) Alaska (Northeast Pacific), 2) California/Washington/Oregon, and 3) Hawaii. The California/Oregon/Washington and Hawaii fin whale stocks are reported separately in the Stock Assessment Reports for the Pacific Region.

POPULATION SIZE

Reliable estimates of current and historical abundance for the Northeast Pacific fin whale stock are currently not available. Ranges of population estimates for the entire North Pacific prior to exploitation and in the early 1970s are 42,000 to 45,000 and 14,620 to 18,630, respectively (Ohsumi and Wada 1974), representing 32% to 44% of the precommercial whaling population size (Braham 1984). These estimates were based on population modeling, which incorporated catch and observation data. These estimates also include whales from the California/Oregon/Washington stock for which a separate abundance estimate is currently available.

A survey conducted in August of 1994 covering 2,050 nautical miles of trackline south of the Aleutian Islands encountered only 4 fin whale groups (Forney and Brownell 1996). However, this survey did not include all of the waters off Alaska where fin whale sightings have been reported.

Minimum Population Estimate

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

Current Population Trend

Reliable information on trends in abundance for the Northeast Pacific stock of fin whales 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

A reliable estimate of the maximum net productivity rate is currently unavailable for the Northeast Pacific fin whale stock. Hence, until additional data become available, it is recommended that the cetacean maximum net productivity rate (R_{MAX}) of 4% be employed for this stock (Wade and Angliss 1997).

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 0.1, the value for cetacean stocks which are listed as endangered (Wade and Angliss 1997). 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 of fin whales related to commercial fishery operations in the North Pacific during this decade, from either observed fisheries or the self-reported fisheries information required of vessel operators by the MMPA. Therefore, based on the lack of reported mortalities, the estimated annual mortality rate incidental to commercial fisheries is zero. As a result, the annual human-caused mortality level is considered to be insignificant and approaching a zero mortality and serious injury rate.

Subsistence/Native Harvest Information

Subsistence hunters in Alaska and Russia have not been reported to take fin whales from this stock.

Other Mortality

In the North Pacific and Bering Sea, catches of fin whales ranged from 1,000 to 1,500 animals annually from the mid-1950s to the mid-1960s. Thereafter, catches declined sharply and ended altogether in 1976 when catches became prohibited (Mizroch et al. 1984). These mortality estimates likely underestimate the actual kill as a result of under-reporting of the Soviet catches (Yablokov 1994).

STATUS OF STOCK

The fin whale is listed as “endangered” under the Endangered Species Act of 1973, and therefore designated as “depleted” under the MMPA. As a result, the Northeast Pacific stock is classified as a strategic stock. Reliable estimates of the minimum population size, population trends, PBR, and status of the stock relative to its Optimum Sustainable Population size are currently not available. However, the estimated annual rate of human-caused mortality and serious injury seems minimal for this stock. There are no known habitat issues that are of particular concern for this stock.

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MINKE WHALE (*Balaenoptera acutorostrata*): Alaska Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE:

In the North Pacific, minke whales occur from the Bering and Chukchi Seas south to near the equator (Leatherwood et al. 1982). The following information was considered in classifying stock structure according to 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 180ºN, 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). Minke whales are known to penetrate loose ice during the summer, and some individuals venture north of the Bering Strait (Leatherwood et al. 1982). In the northern part of their range minke whales are believed to be migratory, whereas they appear to establish home ranges in the inland waters of Washington and along central California (Dorsey et al. 1990). Because the "resident" minke whales from California to Washington appear behaviorally distinct from migratory whales farther north, minke whales in Alaska are considered a separate stock from minke whales in California, Oregon, and Washington. Accordingly, two stocks of minke whales are recognized in U. S. waters: 1) Alaska, and 2) California/ Washington/Oregon (Fig. 34). The California/Oregon/Washington minke whale stock is reported separately in the Stock Assessment Reports for the Pacific Region.

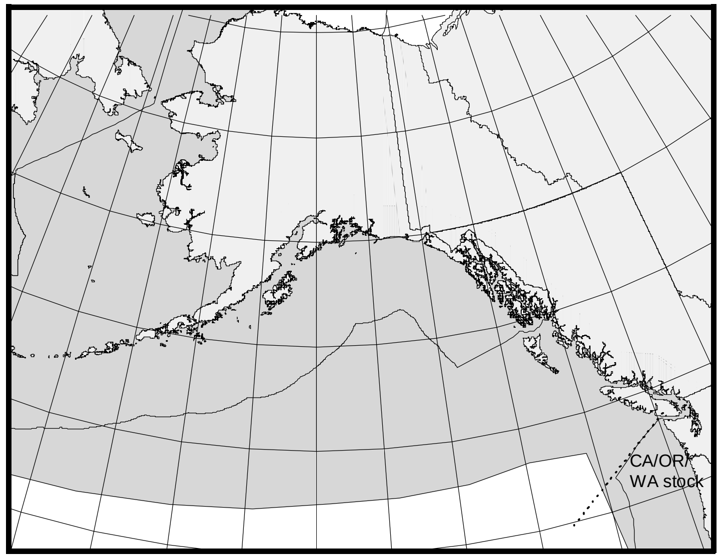

Figure 21. Approximate distribution of minke whales in the eastern North Pacific (shaded area).

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 within the waters of Alaska.

Minimum Population

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

There are no data on trends in minke whale abundance in Alaska waters.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

There are no estimates of the growth rate of minke whale populations in the North Pacific (Best 1993). Hence, until additional data become available, it is recommended that the cetacean maximum net productivity rate (R_{MAX}) of 4% be employed for this stock (Wade and Angliss 1997).

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 (Wade and Angliss 1997). However, because an estimate of minimum abundance is not available, it is not possible to estimate a PBR for the Alaska minke whale stock at this time.

ANNUAL HUMAN-CAUSED MORTALITY

Fishery Information

Six different commercial fisheries operating in Alaska waters within the range of the Alaska minke whale stock were monitored for incidental take by NMFS observers during 1990-95: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries, and Gulf of Alaska groundfish trawl, longline, and pot fisheries. No minke whale mortalities were observed for any of these fisheries. In 1989, one minke whale mortality (extrapolated to 2 mortalities) was observed in the Bering Sea/Gulf of Alaska joint-venture groundfish trawl fishery, the predecessor to the current Alaska groundfish trawl fishery.

In the past, minke whales have been caught in both coastal set gillnets and offshore drift gillnets (Small and DeMaster 1995). However, based on logbook reports maintained by vessel operators required by the MMPA interim exemption program during the 4-year period between 1990 and 1993, no injuries or mortalities of minke whales from interactions with commercial gear were reported for any Alaska fishery. Complete logbook data after 1993 are not available.

The estimated annual mortality rate incidental to commercial fisheries is zero. Therefore, the annual human-caused mortality level is considered to be insignificant and approaching a zero mortality and serious injury rate.

Subsistence/Native Harvest Information

No minke whales were ever taken by the modern shore-based whale fishery in the eastern North Pacific which lasted from 1905 to 1971 (Rice 1974). Subsistence takes of minke whales by Alaska Natives are rare, but have been known to occur. Only seven minke whales are reported the have been taken for subsistence by Alaska Natives between 1930 and 1987 (C. Allison, pers. comm., International Whaling Commission, The Red House, Station Road, Histon, Cambridge, UK). The most recent harvest (2 whales) in Alaska occurred in 1989 (RIWC 1991). Based on this information, the annual subsistence take averaged zero minke whales during the 3-year period from 1993 to 1995.

STATUS OF STOCK

Minke whales are not listed as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act. The greatest uncertainty regarding the status of the Alaska minke whale 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 minimal, this stock is not considered a strategic stock. Reliable estimates of the minimum population size, population trends, PBR, and status of the stock relative to OSP are currently not available.

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Revised 12/30/98

NORTHERN RIGHT WHALE (*Eubalaena glacialis*): North Pacific Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

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 (Fig. 35). Before right whales in the North Pacific were heavily exploited by commercial whalers, concentrations were found in the Gulf of Alaska, eastern Aleutian Islands, southcentral Bering Sea, Sea of Okhotsk, and Sea of Japan (Braham and Rice 1984). During 1958-82, there were only 32-36 sightings of right whales in the central North Pacific and Bering Sea (Braham 1986). In the eastern North Pacific, south of 50°N, only 29 reliable sightings were recorded between 1900 and 1994 (Scarff 1986, Scarff 1991, Carretta et al. 1994). Sightings have been reported as far south as central Baja California in the eastern North Pacific, as far south as Hawaii in the central North Pacific, and as far north as the sub-Arctic waters of the Bering Sea and Sea of Okhotsk in the summer (Herman et al. 1980, Berzin and Doroshenko 1982, NMFS 1991).

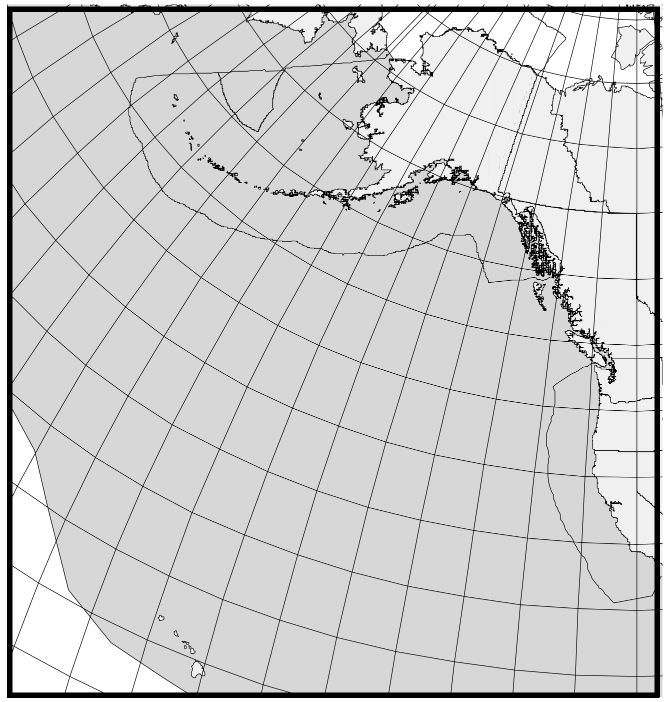

Figure 22. Approximate historical distribution of right whales in the eastern North Pacific (shaded area).

Right whales calve in coastal waters during the winter months. However, in the eastern North Pacific no such calving grounds were ever found (Scarff 1986). Migratory patterns of the North Pacific stock are unknown, although it is thought the whales spend the summer on high-latitude feeding grounds and migrate to more temperate waters during the winter (Braham and Rice 1984).

The following information was considered in classifying stock structure according to 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).

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., National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115). A reliable estimate of abundance for the North Pacific right whale stock is currently not available.

Several notable points concerning right whales in the North Pacific recently occurred. On April 2, 1996 a right whale was sighted off of Maui (D. Salden, pers. comm., Hawaii Whale Research Foundation, P. O. Box 1296, Lahaina, HI 96767). This was the first documented sighting of a right whale in Hawaiian waters since 1979 (Herman et al. 1980, Rowntree et al. 1980). More importantly, a group of 3-4 right whales was sighted in western Bristol Bay (July 30, 1996) which appears to have included a juvenile animal (Goddard and Rugh 1998). During July 1997, a group of 5-9 individuals was encountered in approximately the same Bristol Bay location (C. Tynan, pers. comm., National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115).

Minimum Population Estimate

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

Current Population Trend

A reliable estimate of trend in abundance is currently not available.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Due to insufficient information, it is recommended that the default cetacean maximum net productivity rate (R_{MAX}) of 4% be employed for this stock (Wade and Angliss 1997). 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: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.1, the value for cetacean stocks which are listed as endangered (Wade and Angliss 1997). 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

In June of 1983, a right whale was reported to be incidentally killed in a gillnet in Russian waters (NMFS 1991). Gillnets were also implicated in the death of another right whale off the Kamchatka Peninsula (Russia) in October of 1989 (Kornev 1994). No other incidental takes of right whales are known to have occurred in the North Pacific. Any mortality incidental to commercial fisheries would be considered significant.

Based on the lack of reported mortalities, the estimated annual mortality rate incidental to commercial fisheries is zero whales per year from this stock. Therefore, the annual human-caused mortality level is considered to be insignificant and approaching a zero mortality and serious injury rate.

Subsistence/Native Harvest Information

Subsistence hunters in Alaska and Russia are not reported to take animals from this stock.

Other Mortality

Right whales are large, slow-swimming, tend to congregate in coastal areas, and have a thick layer of blubber which enables them to float when killed. These attributes made them an easy and profitable species for early (pre-modern) whalers. By the time the modern (harpoon cannons and steam powered catcher boats) whale fishery began in the late 1800s, right whales were rarely encountered (Braham and Rice 1984). Between 1835 and 1935 over 15,200 right whales were estimated to have been taken from the North Pacific by commercial whalers, with a vast majority of those animals taken prior to 1875 (Brueggeman et al. 1986, IWC 1986). The estimated mortality likely underestimates the actual kill as a result of under-reporting of the Soviet catches (Yablokov 1994).

STATUS OF STOCK

The right whale is listed as "endangered" under the Endangered Species Act of 1973, and therefore designated as "depleted" under the MMPA. As a result, the stock is classified as a strategic stock. Reliable estimates of the minimum population size, population trends, and PBR are currently not available. Though reliable numbers are not known, the abundance of this stock is considered to represent only a small fraction of its precommercial whaling abundance (i.e., the stock is well below its Optimum Sustainable Population size). The estimated annual rate of human-caused mortality and serious injury seems minimal for this stock. The reason(s) for the apparent lack of recovery for this stock is(are) unknown. There are no known habitat issues that are of particular concern for this stock.

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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 (Braham 1984). For management purposes, five stocks are currently recognized by the International Whaling Commission (IWC 1992). Small stocks occur in the Sea of Okhotsk, Davis Strait, Hudson Bay, and Spitsbergen. These small bowhead stocks are comprised of only a few tens to a few hundreds of individuals (Braham 1984, Shelden and Rugh 1996). The largest remnant population, and only stock that is found within U. S. waters, is the Western Arctic stock (Fig. 36). The Western Arctic stock migrates annually 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 again to the Bering Sea in the fall (September through November) to overwinter (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 polynyas (Rugh and Cubbage 1980). As the whales travel east past Point Barrow, Alaska, 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 (Moore and DeMaster 1997). 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).

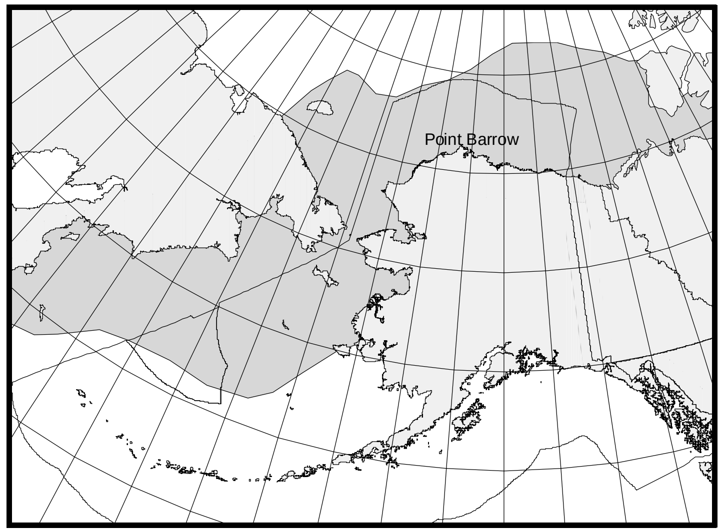

Figure 23. Approximate distribution of the Western Arctic stock of bowhead whales. The shaded area includes regions used during both the winter and summer by whales from this stock.

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 (Braham 1984). Woodby and Botkin (1993) summarized previous efforts to approximate how many bowheads there were prior to the onset of 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 methods, described in Clark et al. 1994), whales missed when no watch was in effect, 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 Point Barrow in spring, resulting in estimates which could be negatively biased. In 1993, unusually good counting conditions resulted in a population estimate for this stock of 8,000 (CV = 0.073) animals, with a 95% confidence interval from 6,900 to 9,200 (Zeh et al. 1994). A refined and larger sample of acoustic data from 1993 has resulted in an estimate of 8,200 animals (95% CI = 7,200-9,400), and is considered a better abundance estimate for the Western Arctic stock (RIWC 1996). The CV for this abundance estimate is 0.069 (Zeh et al. 1995).

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock is calculated from Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 8,200 and its associated CV(N) of 0.069, N_{MIN} for the Western Arctic stock of bowhead whales is 7,738.

Current Population Trend

Raftery et al. (1995) reported 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. This rate of increase takes into account whales that passed beyond the viewing range of the ice-based observers. Inclusion of the revised 1993 abundance estimate results in a similar, though slightly higher rate of population increase 3.2% (95% CI = 1.4-5.1%) during the 1978-93 period (IWC 1996).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The current estimate for the rate of increase for this stock of bowhead whales (3.2%) 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_{MAX}) of 4% be employed for the Western Arctic stock of bowhead whale (Wade and Angliss 1997).

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 rather than the default value of 0.1 for endangered species because population levels are increasing in the presence of a known take (see guidelines Wade and Angliss 1997). Thus, PBR = 77 animals (7,738 × 0.02 × 0.5) for the Western Arctic stock of bowhead whale. The development of a PBR for the Western Arctic bowhead stock is required by the MMPA even though the Alaska Eskimo subsistence harvest of bowhead whales is managed under the authority of the International Whaling Commission (IWC). Accordingly, the IWC bowhead whale quota takes precedence over the PBR estimate for the purpose of managing the Alaska Native subsistence harvest from this stock. The IWC quotas authorize Alaska Natives to strike up to 67 bowhead whales in 1996, 66 in 1997, and 65 in 1998 (IWC 1995).

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 occurring in bowhead habitat. There are no observer program records of bowhead whale mortality incidental to commercial fisheries in Alaska. In addition, the self-reported fisheries information required of vessel operators by the MMPA during the period between 1990-96 reported no injuries or mortalities of bowhead whales for any Alaska fishery. Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable for 1996 (see Appendix 4).

Based on the lack of reported mortalities, the estimated annual mortality rate incidental to commercial fisheries is zero whales per year from this stock. Therefore, the annual human-caused mortality level is considered to be insignificant and approaching a zero mortality and serious injury rate.

Subsistence/Native Harvest Information

Eskimos have been taking bowhead whales for at least 2,000 years (Marquette and Bockstoce 1980, Stoker and Krupnik 1993). Subsistence takes have been regulated by a quota system under the authority of the IWC since 1977. Alaska Native subsistence hunters take approximately 0.1-0.5% of the population per annum, primarily from 9 Alaska 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 estimates of bowhead whale abundance in recent years (Stoker and Krupnik 1993). The following statistics were compiled from animals taken in the subsistence harvest between 1973 and 1992: 1) the sex ratio of bowheads taken in the hunt was equal; 2) the proportion of adult females taken in the hunt increased from 5% in the early 1970s to over 20% in the late 1980s and early 1990s;

3) approximately 80% of the catch was immature animals prior to 1978 and since has been approximately 60%; and 4) modern Native whalers appear to harvest larger bowheads than precontact (prior to 1849) Native whalers (Braham 1995).

The total take by Alaska Natives, including struck and lost, was reported to be 51 whales in 1993 (Suydam et al. 1995), 46 in 1994 (IWC 1996), and 57 in 1995 (IWC 1997), and 44 in 1996 (Alaska Eskimo Whaling Commission, unpubl. data, AEWC, P. O. Box 570, Point Barrow, AK 99723). Canadian Natives are also known to take whales from this stock. Hunters from the western Canadian Arctic community of Aklavik killed one whale in 1991 and one in 1996. The annual average subsistence take (by Natives of Alaska and Canada) during the 3-year period from 1994 to 1996 is approximately 49 bowhead whales.

Other Mortality

Pelagic commercial whaling for bowheads principally occurred in the Bering Sea from 1848 to 1919. Within the first two decades of the fishery (1850-1870), over 60% of the stock was harvested although effort remained high into the 20th century (Braham 1984). It is estimated that the pelagic whaling industry harvested 18,684 whales from this stock (Woodby and Botkin 1993). During the same 1848-1919 period, shore-based whaling operations (including landings as well as struck and lost estimates from U. S., Canadian, and Russian shores) took an additional 1,527 animals (Woodby and Botkin 1993). An unknown percentage of the shore-based animals were harvested for subsistence, and not commercial purposes. The estimated mortality likely underestimates the actual kill as a result of under-reporting of the Soviet catches (Yablokov 1994).

STATUS OF STOCK

Based on currently available data, the estimated annual mortality rate incidental to commercial fisheries (0) not known to exceed 10% of the PBR (8) and, therefore, can be considered to be insignificant and approaching a zero mortality and serious injury rate. The level of human-caused mortality and serious injury (49) is not known to exceed the PBR (77) nor the IWC quota for 1996 (67). The Western Arctic bowhead whale stock has been increasing in recent years. However, the stock is classified as a strategic stock because bowhead whale is listed as “endangered” under the Endangered Species Act (ESA), and therefore designated as “depleted” under the MMPA. The development of criteria for classifying this stock under the ESA is currently underway and will be used in the next 5-year evaluation of stock status (Shelden and Rugh 1996).

Habitat Issues

Increasing oil and gas development in the Arctic will lead to an increased risk of various forms of pollution to bowhead whale habitat, including oil spills, toxic and non-toxic waste, and noise due to higher levels of traffic as well as exploration and drilling operations. Evidence indicates that bowhead whales are sensitive to noise from offshore drilling platforms and seismic survey operations (Richardson 1995, Davies 1997).

Another element of concern is the potential for Arctic climate change, which will probably affect high northern latitudes more than elsewhere. There is evidence that over the last 10-15 years, there has been a shift in regional weather patterns in the Arctic region (Tynan and DeMaster 1997). Ice-associated animals, such as the bowhead whale, may be sensitive to changes in Arctic weather, sea-surface temperatures, or ice extent. There are insufficient data to make reliable predictions of the effects of Arctic climate change on bowhead whales.

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APPENDICES

Appendix Table 1.--Summary of changes to 1998 stock assessments. Sections marked with an 'X' denote significant changes from the 1996 stock assessment for that stock.

Stock	Stock definition	Population size	PBR	Fishery mortality	Subsistence mortality	Status
Steller sea lion (western US)		X	X	X		
Steller sea lion (eastern US)		X	X	X	X	
Northern fur seal		X	X	X	X	
Harbor seal (SE Alaska)				X	X	
Harbor seal (GOA)		X	X	X	X	
Harbor seal (Bering Sea)				X	X	
Spotted seal						
Bearded seal						
Ringed seal						
Ribbon seal						
Beluga whale (Beaufort)						
Beluga whale (E. Chukchi)						
Beluga whale (E. Bering Sea)						
Beluga whale (Bristol Bay)						
Beluga whale (Cook Inlet)		X	X		X	
Killer whale (resident)	X	X	X	X		
Killer whale (transient)	X	X	X	X		
Pacific white-sided dolphin						
Harbor porpoise (SE Alaska)						
Harbor porpoise (GOA)						
Harbor porpoise (Bering Sea)						
Dall's porpoise						
Sperm whale						
Baird's beaked whale						
Cuvier's beaked whale						
Stejneger's beaked whale						
Gray whale						
Humpback whale (western)		X	X			
Humpback whale (central)		X	X	X		
Fin whale						
Minke whale						
Northern Right whale		X				
Bowhead whale					X	