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

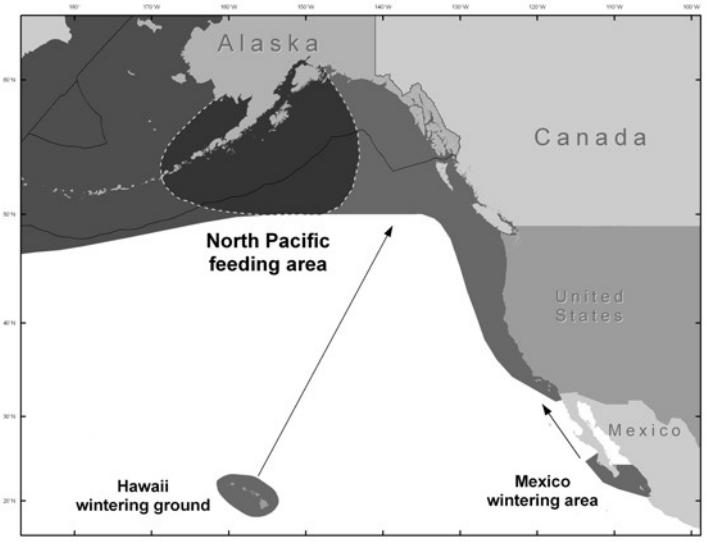
STOCK DEFINITION AND GEOGRAPHIC RANGE

The humpback whale is distributed worldwide in all ocean basins. In winter, most humpback whales occur in the subtropical and tropical waters of the Northern and Southern Hemispheres. Humpback whales in the high latitudes of the North Pacific are seasonal migrants that feed on euphausiids and small schooling fishes (Nemoto 1957, Clapham and Mead 1999). The historic feeding 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 and north of the Bering Strait (Zenkovich 1954, Nemoto 1957, Tomlin 1967, Johnson and Wolman 1984). A vessel few sightings occurred in the southeastern

Bering Sea, primarily outside Bristol Bay and north of the eastern Aleutian Islands (Moore et al. 2002). However, a NOAA survey conducted in 2005 found numerous humpback whales north of the central Aleutian Islands, reinforcing the idea that the Bering Sea is an important feeding area. The historical importance of this area is suggested by the fact that the U.S.S.R. is known to have killed hundreds of humpback whales in the Bristol Bay area during its illegal whaling operations in the 1960s. Analysis of whaling data show historical catches of humpback whales well into the Bering Sea and catches in the Bering Strait and Chukchi Sea from August-October in the 1930s (Mizroch and Rice in prep). The humpback whale population in much of this range was considerably reduced as a result of intensive commercial exploitation during the 20th century.

survey in the central Bering Sea in July of 1999 documented 17 humpback whale sightings, most of which were distributed along the eastern Aleutian Island chain and along the U.S.-Russia Convention Line south of St. Lawrence Island (Moore et al. 2000). A

Figure 39. Approximate distribution of humpback whales in the eastern North Pacific (shaded area). Feeding and wintering areas are presented above (see text). Area within the dotted line is known to be an area of overlap with Western North Pacific stock. See Figure 38 for distribution of humpback whales in the western North Pacific.



Aerial, vessel, and photo-identification surveys and genetic analyses indicate that within the U. S. Exclusive Economic Zone (EEZ) there are at least three relatively separate populations that migrate between their respective summer/fall feeding areas to winter/spring calving and mating areas (Calambokidis et al. 1997, Baker et al. 1998; Figs. 38 and 39): 1) winter/spring populations in coastal Central America and coastal Mexico which migrate to the coast of California to southern British Columbia in summer/fall (Calambokidis et al. 1989, Steiger et al. 1991, Calambokidis et al. 1993) - referred to as the California/Oregon/Washington and Mexico stock; 2) winter/spring populations of the Hawaiian Islands which migrate to northern British Columbia/Southeast Alaska and Prince William Sound west to Unimak Pass (Baker et al. 1990, Perry et al. 1990, Calambokidis et al. 1997) - referred to as the Central North Pacific stock; and 3) winter/spring populations off Asia which, based on photoidentification and Discovery mark data have been found in the Bering Sea, Eastern Aleutians, and British Columbia (Darling 1991, Darling and Cerchio 1993, Mizroch pers. comm., North Pacific Humpback Whale Working Group, unpublished data). Discovery-type mark

recovery data demonstrate long-distance migratory movements between Ogasawara and both the Gulf of Anadyr and the eastern Aleutians near Unimak Pass and between Okinawa and Unimak Pass. Mark recovery data suggest that whales may congregate in the eastern Aleutians early in the season (April-May) and late in the season (September) (Mizroch and Rice in prep). This latter population is referred to as the western North Pacific stock.

Breeding populations of humpback whales also occur in winter near Mexico's offshore islands in the Revillagigedo Archipelago. The migratory destination of these offshore Mexico whales is not well known (Calambokidis et al. 1993, Calambokidis et al. 1997), but whales photographed in the Revillagigedo Archipelago have also been photographed in California, Washington, British Columbia, Southeast Alaska, Prince William Sound, Kodiak and eastern Aleutians (Witteveen 2004, J. Straley, pers. comm., Mizroch pers. comm., North Pacific Humpback Whale Working Group, unpublished data). Movements between offshore Mexico and Hawaii have been documented (Darling and McSweeney 1985, Baker et al. 1986).

Movements between Japan and Hawaii (Darling and Cerchio 1993) have been documented, as well as movements between Japan and British Columbia, and Japan and the Kodiak Archipelago (Darling et al. 1996, Calambokidis et al. 1997).

Movements between Southeast Alaska and British Columbia have also been documented (J. Straley, Univ. Alaska Southeast, Sitka, AK; pers. comm.). Calambokidis et al. (2001) concludes that there are at least three subpopulations of humpback whales on the wintering grounds (Hawaii, Japan, and Mexico), and possibly as many as six subpopulations, with subdivisions in Mexico, Japan, and Central America.

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, three stocks of humpback whales are recognized within the U. S. EEZ of the North Pacific: one in the eastern North Pacific (the California/Oregon/Washington - Mexico 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. Data from a large-scale study throughout the North Pacific conducted in 2004-06 (the Structure of Populations, Levels of Abundance, and Status of Humpbacks, or SPLASH, project) are expected to provide a much more comprehensive understanding of humpback whale population structure in the North Pacific in the near future.

The central North Pacific stock of humpback whales consists of feeding aggregations along the northern Pacific Rim, and some humpbacks are present offshore in the Gulf of Alaska, Bering Sea and above the Bering Strait (Brueggeman et al. 1989; Mizroch and Rice, 2007abstract, Moore et al. 2002). There was a photoidentification match between the Bering Sea and Japan (Mizroch pers. comm., North Pacific Humpback Whale Working Group, unpublished data). Four feeding areas for the Central North Pacific stock have been studied using photo-identification techniques: southeast Alaska, Prince William Sound, Kodiak Island, and the eastern Aleutians/Shumagins area. There has been some exchange of individual whales between these locations. For example, five whales have been sighted in both Prince William Sound and southeast Alaska since studies began in 1977 (Perry et al. 1990; von Ziegesar et al. 1994; Mizroch et al. 2004); nine whales have been sighted between Kodiak Island, including the area adjacent to Kodiak along the Kenai Peninsula, and Prince William Sound; two whales have been sighted between Kodiak and southeast Alaska (Waite et al. 1999). Calambokidis et al. (2001) reports interchange between Kodiak, Prince William Sound, and southeast Alaska, although the number of individuals seen in multiple locations is small. Mizroch et al. (2004) examined photographs from 1979 to 1996 and reported that less than 1% of the individual whales photographed in either southeast Alaska or Prince William Sound moved between areas. Based on sightings across all Alaska feeding areas, fewer than 2% of the individuals were seen in more than one area (Mizroch et al. 2004). Fidelity to feeding areas is 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).

As noted above, there is very little interchange documented between the southeast Alaska feeding area and the Prince William Sound, Kodiak, and Shumagin Islands feeding areas to the north. Because of the documented lack of interchange, it is likely that a reduction in the population in the southeast Alaska feeding area would not be augmented by animals that normally use other feeding areas within a timeframe relevant to management. Thus, NMFS is considering whether the southeast Alaska feeding area, and possibly other feeding areas in the North Pacific, should be formally designated as separate stocks under the MMPA. In preparation for this decision, a PBR level and annual mortality rates will be calculated for the southeast Alaska feeding area and included in the report for the entire central North Pacific humpback whale stock in order to guide managers in prioritizing conservation actions.

POPULATION SIZE

The current abundance estimate of humpback whales in the North Pacific is based upon 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 multi-strata (1961) method, which uses data only from wintering areas, and averaging the 1991-92, 1992-93, and 1991-93 winter mark-recapture information results in an abundance estimate of 4,005 (CV = 0.095) for the entire central North Pacific humpback whale stock (Calambokidis et al. 1997).

Photo-identification methods were used to identify 315 individual humpback whales in Prince William Sound from 1977 to 2001 (von Ziegesar 1992, Waite et al. 1999, von Ziegesar et al. 2004). Waite et al. (1999) identified 127 individuals in the Kodiak area between 1991 and 1994, and calculated a total annual abundance estimate of 651 (95% CI: 356-1,523) for the Kodiak region. Witteveen et al. (2004) conducted a mark-recapture study near the Shumagin Islands from 1999-2002 and estimated a total population size of 410 (95% CI: 241-683). It is not known how many animals occurring in the Shumagin Islands belong to the western or central North Pacific stock. The Kodiak catalog currently has 738 individuals and the Shumagin catalog has 266 individuals (Witteveen, pers. comm., University of Central Florida, P.O. Box 160112, Orlando, FL 32816-0112).

The central North Pacific stock of humpback whales winters in Hawaiian waters (Baker et al. 1986). Baker and Herman (1987) used capture-recapture methods in Hawaii to estimate the population at 1,407 (95% CI: 1,1131,701), which they considered an estimate for the entire stock. However, the robustness of this estimate is questionable due to the opportunistic nature of the survey methods in conjunction with a small sample size. Further, the data used to produce this estimate were collected between 1980 and 1983. Mobley et al. (2001) conducted aerial surveys throughout the main Hawaiian Islands during 1993, 1995, 1998, and 2000. Abundance during these surveys was estimated as 2,754 (95% CI: 2,044-3,468), 3,776 (95% CI: 2,925-4627), 4,358 (95% CI: 3,261-5,454), and 4,491 (95% CI: 3,146-5,836). These estimates, which are based on line transect methods, are slightly more conservative than the estimates determined using mark-recapture techniques, perhaps due to computational problems associated with the assumption that there is a heterogeneous sighting probability across different regions of Hawaii. In the northern British Columbia region (primarily near Langara Island), 275 humpback whales were photo-identified from 1992 to 1998 (G. Ellis, Pacific Biological Station, pers. comm.). As of 2003, approximately 850-1,000 humpback whales have been identified in British Columbia (J. Ford, Department of Fisheries and Oceans, Canada, pers. comm.); the extent to which the range of these animals also includes U.S. waters is not known.

Different studies have used different approaches to estimate the abundance of animals in southeast Alaska. Baker et al. (1992) estimated an abundance of 547 (95% CI: 504-590) using data collected from 1979 to 1986. Straley (1994) recalculated the estimate using a different analytical approach (Jolly-Seber open model for capturerecapture data) and obtained a mean population estimate of 393 animals (95% CI: 331-455) using the same 1979 to 1986 data set. Using data from 1986 to 1992 and the Jolly-Seber approach, Straley et al. (1995) estimated that the annual abundance of humpback whales in Southeast Alaska was 404 animals (95% CI: 350-458). Straley et al. (in press) examined data for the northern portion of southeast Alaska from 1994 to 2000 and provided an updated abundance estimate of 961 (95% CI: 657-1,076).

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): $N_{MIN} = N/\exp(0.842H[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 4,005 (estimated in 1993; Calambokidis et al. 1997) and its associated CV(N) of 0.095, N_{MIN} for the entire central North Pacific humpback whale stock is 3,698. Although the southeast Alaska feeding aggregation is not being formally considered a stock, the calculation of a PBR for this area may be useful for management purposes. Using the population estimate (N) of 961 and its associated CV(N) of 0.12, N_{MIN} for this aggregation is 868. This is a minimum estimate based on part of the southeast Alaska/ northern British Columbia feeding aggregation.

Current Population Trend

Comparison of the estimate for the entire stock provided by Calambokidis et al. (1997) with the 1981 estimate of 1,407 (95% CI: 1,113-1,701) from Baker and Herman (1987) suggests that the stock 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 small sample size and opportunistic nature of the survey. Mizroch et al. (2004) calculate an annual population rate of increase of 10% (95% CI: 3%-16%). This is within the range of 8.8 to 14.4% reported by Best (1993) for humpback whales off South Africa, and is identical to the 10% value reported by Bannister and Hedley (2001) for humpback whales off western Australia. Mobley et al. (2001) estimated an annual increase of 7% for 1993-2000 using data from aerial surveys that were conducted in a consistent manner for several years across the main Hawaiian Islands and were developed specifically to estimate a trend for the central North Pacific stock. Zerbini et al. (2006) used line transect data from sequential surveys to estimate an increasing trend of 6.6% per year (95% CI: 4.7-8.4%).

The estimated number of animals in the southeast Alaska portion of this stock has increased. The 2000 estimate of 961 (Straley et al. in press) is substantially higher than estimates from the early and mid-1980s. A trend for the southeast Alaska portion of this stock cannot be estimated from the data, however, because of differences in methods and areas covered.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Using 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, although there are indications that this rate has slowed over the last decade (Clapham et al. 2003). Mobley et al. (2001) conducted annual surveys of the humpback whale breeding grounds in Hawaii and estimated a rate of increase of 7% for the period 1993-2000. Furthermore, it is clear that the abundance has increased in southeast Alaska in recent years. While 7% is the best available estimate of current rate of increase, and may or may not be the same as the stock's maximum net productivity rate, 0.07 is being used as a new, conservative estimate of the maximum net productivity rate (R_{MAX}).

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized 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 recommended value for cetacean stocks listed as endangered under the Endangered Species Act (Wade and Angliss 1997). The default value of 0.04 for the maximum net productivity rate is replaced by 0.07, which is the best estimate of the current rate of increase and is considered a conservative estimate of the maximum net productivity rate. Thus, using the abundance estimate calculated from 1993 surveys, the PBR for the entire central North Pacific stock of humpback whale would be calculated as 12.9 animals (3,698 × 0.035 × 0.1). The PBR level for the Southeast Alaska portion of this stock would be 3.0 animals (868 × 0.035 × 0.1), and the PBR level for the northern portion of the stock would be 9.9 animals (12.9 – 3.0). However, the 2005 revisions to the SAR guidelines (NMFS 2005) state that abundance estimates older than 8 years should not be used to calculate PBR due to a decline in confidence in the reliability of an aged abundance estimate. Therefore, the PBR for this stock is considered undetermined. Data collected between 2004-2006 during SPLASH surveys are currently being analyzed, and a new abundance estimate and PBR for this stock will be calculated from these data.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Until 2004, there were four different federally-regulated commercial fisheries in Alaska that occurred within the range of the central North Pacific humpback whale stock that were monitored for incidental mortality by fishery observers. As of 2004, changes in fishery definitions in the List of Fisheries have resulted in separating these four fisheries into 17 fisheries (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort, but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska. Between 2002 and 2006, there were incidental serious injuries and mortalities of central North Pacific humpback whales in the Bering Sea/Aleutian Islands sablefish pot fishery (Table 37). Estimates of marine mammal serious injury/mortality in observed fisheries are provided in Perez (2006) and Perez (unpubl. ms.).

Table 37. Summary of observer reported incidental mortalities and serious injuries of humpback whales (Central North Pacific stock) due to commercial fisheries from 2002 to 2006 and calculation of the mean annual mortality rate. Details of how percent observer coverage is measured is included in Appendix 6.

Fishery name	Years	Data type	Observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Bering Sea sablefish pot	2002 2003 2004 2005 2006	obs data	40.6 21.7 49.1 39.2 35.3	0 0 0 0 0	1[1] 0 0 0 0	0.20[2] (N/A)
Minimum total annual mortality				North: 0.2 SE: 0.0 Total: 0.2		

[1] Mortality was seen by an observer but not during an "observed set"; thus quantification of effort cannot be accomplished and the single record cannot be extrapolated to provide a total estimated mortality level.

[2] These mortalities occurred in an area of known overlap with the Western North Pacific stock of humpback whales. Since the stock identification is unknown, the mortalities are reflected in both stock assessments.

Reports of entangled humpback whales found swimming, floating, or stranded with fishing gear attached occur in both Alaskan and Hawaiian waters. All reports of mortalities or injuries of humpback whales from the central North Pacific stock from 2001 to 2005 are provided in Appendix 8 and a summary of the information is provided in Table 38. Overall, there were 54 reports of human-related mortalities or injuries during this 5-year period. Of these, there were 40 incidents which involved commercial fishing gear, and 15 of those incidents involved serious injuries or mortalities. This estimate is considered a minimum because not all entangled animals strand and not all stranded animals are found, reported, or cause of death determined.

Table 38. Summary of central North Pacific humpback whale mortalities and serious injuries caused by entanglement and ship strikes from stranding reports, 2001-2005. A summary of information used to determine whether an injury was serious or non-serious is included in Appendix 8. Fisheries with zero average annual mortality indicate historical marine mammal interactions.

Area	Human activity/fishery	Year	Mortality	Serious	Not determinable	Average annual serious injury/mortality rate (2001-2005)
North	Ship strike	2001 2002 2003 2004 2005	1 0 0 0 1	0 0 0 0 0	0 0 0 0 1	0.4
	Unspecified gear	2001 2002 2003 2004 2005	0 0 0 0 0	2 0 0 0 0	0 0 0 0 1	0.4

	Salmon set gillnet	2001 2002 2003 2004 2005	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0
	Unspecified gillnet	2001 2002	1 0	0 0	0 0	0.4

Area	Human activity/fishery	Year	Mortality	Serious	Not determinable	Average annual serious injury/mortality rate (2001-2005)
		2003 2004 2005	0 0 0	0 0 1	0 0 0	
	Purse seine	2001 2002 2003 2004 2005	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0.0
	Unspecified pot gear	2001 2002 2003 2004 2005	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0.0
	Crab pot gear	2001 2002 2003 2004 2005	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0.0
	Yakutat salmon set gillnet	2001 2002 2003 2004 2005	1 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0.2
	Cook Inlet salmon set gillnet	2001 2002 2003 2004 2005	N/A N/A N/A N/A 0	N/A N/A N/A N/A 1	N/A N/A N/A N/A 0	0.2

	Kodiak salmon purse seine	2001 2002 2003 2004 2005	N/A N/A N/A N/A 1	N/A N/A N/A N/A 0	N/A N/A N/A N/A 0	0.2
	Lower Cook Inlet salmon purse seine	2001 2002 2003 2004 2005	N/A N/A N/A N/A 1	N/A N/A N/A N/A 0	N/A N/A N/A N/A 0	0.2
	Average annual serious injury/mortality rate fishery only					1.6
	Average annual serious injury/mortality rate total					2.0
SE	Ship strike	2001 2002 2003 2004 2005	1 0 1 2 1	0 0 0 1 1	0 0 0 0 0	1.4
Area	**Human activity/fishery**	**Year**	**Mortality**	**Serious**	**Not determinable**	**Average annual serious injury/mortality rate (2001-2005)**
	Unspecified gear	2001 2002 2003 2004 2005	0 0 0 0 0	0 0 0 2 0	0 2 0 1 1	0.4
	Salmon set gillnet	2001 2002 2003 2004 2005	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0.0
	Unspecified gillnet	2001 2002 2003 2004 2005	0 0 0 0 0	0 0 0 0 1	0 0 0 0 1	0.2
	Purse seine	2001 2002 2003 2004 2005	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0.0

	Unspecified pot gear	2001 2002 2003 2004 2005	0 0 0 0 0	0 0 0 0 0	1 0 0 0 0	0.0
	Crab pot gear	2001 2002 2003 2004 2005	0 0 0 0 0	0 0 1 0 2	0 0 0 1 2	0.6
	SE salmon drift gillnet	2001 2002 2003 2004 2005	N/A N/A N/A N/A 1	N/A N/A N/A N/A 0	N/A N/A N/A N/A 0	0.2
	Average annual serious injury/mortality rate fishery only					1.4
	Average annual serious injury/mortality rate total					2.8
Hawaii	Unspecified gear	2001 2002 2003 2004 2005	0 0 0 0 0	0 0 0 0 0	1 0 0 0 0	0.0
	Average annual serious injury/mortality rate fishery only					0.0
	Average annual serious injury/mortality rate total					0.0

The overall U. S. commercial fishery-related minimum mortality and serious injury rate for the entire stock is 3.2 humpback whales per year, based on observer data from Alaska (0.2~~0~~), stranding records from Alaska (3.0), and stranding records from Hawaii (0). The estimated fishery-related minimum mortality and serious injury rate incidental to commercial fisheries for the northern portion of the stock is 1.8 humpback whales per year, based on observer data from Alaska (0.2), stranding records from Alaska (1.6) and stranding data from Hawaii (0) (Table 38). The estimated minimum mortality and serious injury rate incidental to the commercial fisheries in southeast Alaska is 1.4 humpback whales per year, based on stranding records from Alaska (1.4), and stranding data from Hawaii (0) (Table 38).

As mentioned previously, these estimates of serious injury/mortality levels 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 rate unreliable. Further, due to limited Canadian observer program data, mortality incidental to Canadian commercial fisheries (i.e., those similar to U.S. fisheries known to interact with humpback whales) is uncertain. Though interactions are thought to be minimal, data regarding the level of humpback whale mortality related to commercial fisheries in northern British Columbia are not available, again indicating that the estimated mortality incidental to commercial fisheries is underestimated for this stock.

Subsistence/Native Harvest Information

Subsistence hunters in Alaska are not authorized to take from this stock of humpback whales, and no takes have been reported.

Other Mortality

Ship strikes and other interactions with vessels unrelated to fisheries have also occurred to humpback whales. Those cases are included in Appendix 8 and summarized in Table 38. Of those, nine ship strikes constitute "other sources" of mortality or serious injury; seven of these ship strikes occurred in southeast Alaska and two occurred in the northern portion of this stock's range. It is not known whether the difference in ship strike rates between southeast Alaska and the northern portion of this stock is due to differences in reporting, amount of vessel traffic, densities of animals, or other factors. Averaged over the year period from 2001 to 2005, these account for an additional 1.8 humpback whale mortalities per year for the entire stock (0.4 ship strikes/year for the northern portion of the stock, and 1.4 strikes/year for the southeast portion).

HISTORICAL WHALING

Rice (1978) estimated that the number of humpback whales in the North Pacific may have been approximately 15,000 individuals prior to exploitation; however, this was based upon incomplete data and, given the level of known catches (legal and illegal) since World War II, may be an underestimate. Intensive commercial whaling removed more than 28,000 animals from the North Pacific during the 20th century. From 1961 to 1971, an additional 6,793 humpback whales were killed illegally by the U.S.S.R. Many animals during this period were taken from the Gulf of Alaska and Bering Sea (Doroshenko 2000); however, catches occurred across the North Pacific, from the Kuril Islands to the Queen Charlottes, and additional illegal catches in earlier years may have gone unrecorded. Humpback whales in the North Pacific were theoretically protected in 1965, but illegal catches by the U.S.S.R. continued until 1972 (Ivashchenko et al. 2007).

STATUS OF STOCK

As the estimated annual mortality and serious injury rate for the entire stock (5.0; 3.2 of which were fishery-related; Table 39) is considered a minimum, it is unclear whether the level of human-caused mortality and serious injury exceeds the PBR level (12.9) for the entire stock. The estimated annual mortality and serious injury rate in southeast Alaska (2.8, of which 1.4 were fishery-related) is less than the PBR level if calculated only for the southeast Alaska portion of the population (3.0). The minimum estimated U. S. commercial fishery-related mortality and serious injury for this stock is not less that 10% of the calculated PBR for either the entire stock or the portion of the stock in southeast Alaska 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. However, the status of the entire stock relative to its Optimum Sustainable Population size is unknown.

Table 39. Summary of serious injury (SI) and mortality (M) levels for the central North Pacific (CNP) stock of humpback whales.

Area	Data types for fishery-related information				Ship strikes	Total	"PBR"
	Observer data	AK Strand.	HI Strand.	Total fish.			
Northern	0.2	1.6	0	1.8	0.4	2.2	9.9
Southeast	N/A	1.4	0	1.4	1.4	2.8	3.0
TOTAL	0.2	3.0	0[1]	3.2[2]	1.8	5.0	12.9

[1] The average annual SI/M in HI is 0. [2] This is the sum of the observed SI/M (0.2), the AK strandings (3.0), and the average HI stranding rate (0).

Habitat Concerns

This stock is the focus of a large whale watching industry in its wintering grounds (Hawaii) and a growing whale watching 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 whale watching. Additional concerns have been raised about the impact of jet skis and similar fast waterborne tourist-related traffic, notably in nearshore areas inhabited by mothers and calves. In 2001, NMFS issued regulations to prohibit most approaches to humpback whales in Alaska within 100 yards (91.4 m; 66 FR 29502;

31 May 2001). The growth of the whale watching industry, however, is a concern as preferred habitats may be abandoned if disturbance levels are too high.

Elevated levels of sound from the Acoustic Thermometry of Ocean Climate (ATOC) program, the U.S. Navy's Low Frequency Active (LFA) sonar program, and other anthropogenic sources (i.e., shipping and whale watching) in Hawaii waters is of potential concern for this stock. Results from experiments in 1996 off Hawaii indicated only subtle responses of humpback whales to ATOC-like transmissions (Frankel and Clark 1998). Frankel and Clark (2002) indicated that there were also slight shifts in humpback whale distribution in response to ATOC. Efforts are underway to evaluate the relative contribution of sound (e.g., experiments with LFA sound sources) to Hawaii's marine environment, although reports summarizing the results of recent research are not available.

CITATIONS

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

Baker, C. S., A. Perry, and L. M. Herman. 1987. Reproductive histories of female humpback whales (*Megaptera novaeangliae*) in the North Pacific. Mar. Ecol. Prog. Ser. 41:103-114.

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

Baker, C. S., J. M. Straley, and A. Perry. 1992. Population characteristics of individually identified humpback whales in southeastern Alaska: summer and fall 1986. Fish. Bull., U.S. 90:429-437.

Baker, C. S., L. Medrano-Gonzalez, J. Calambokidis, A. Perry, F. Pichler, H. Rosenbaum, J. M. Straley, J. UrbanRamirez, M. Yamaguchi, and O. von Ziegesar. 1998. Population structure of nuclear and mitochondrial DNA variation among humpback whales in the North Pacific. Mol. Ecol. 7(695-707).

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

Bannister, J. L., and S. L. Hedley. 2001. Southern Hemisphere group IV humpback whales: their status from recent aerial surveys. Memoirs of the Queensland Museum. 47:578-598.

Barlow, J., and P. J. Clapham. 1997. A new birth-interval approach to estimating demographic parameters of humpback whales. Ecol. 78(2):535-546.

Best, P. B. 1993. Increase rates in severely depleted stocks of baleen whales. ICES J. Mar. Sci. 50:169-186.

Brueggeman, J. J., G. A. Green, R. A. Grotefendt, and R. W. Tressler. 1989. Marine mammal habitat use on the north Aleutian Basin, St. George Basin, and Gulf of Alaska. Pp. 97-108 *In* L. E. Jarvela and L. K. Thorsteinson (eds.), Proceedings of the Gulf of Alaska, Cook Inlet, and North Aleutian Basin Information Update Meeting. U.S. Dep. Commer., NOAA, NOS, Office of Ocean. and Mar. Assess., 222 W. Eighth Ave., Anchorage, AK.

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

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

Calambokidis, J., G. H. Steiger, J. M. Straley, L. M. Herman, S. Cerchio, D. R. Salden, J. Urban R., J. K. Jacobsen, O. von Ziegesar, K.C. Balcomb, C. M. Gabriele, M. E. Dahlheim, S. Uchida, G. Ellis, Y. Miyamura, P. Ladrón de Guevara P., M. Yamaguchi, F. Sato, S. A. Mizroch, L. Schlender, K. Rasmussen, J. A. Y. Barlow and T. J. Quinn, II. 2001. Movements and population structure of humpback whales in the North Pacific. Mar. Mammal Sci. 17(4): 769-794.

Calambokidis, J., G. H. Steiger, J. M. Straley, T. Quinn, L. M. Herman, S. Cerchio, D. R. Salden, M. Yamaguchi, F. Sato, J. R. Urban, J. Jacobson, O. Von Ziegesar, K. C. Balcomb, C. M. Gabriele, M. E. Dahlheim, N. Higashi, S. Uchida, J. K. B. Ford, Y. Miyamura, P. Ladrón de Guevara, S. A. Mizroch, L. Schlender, and K. Rasmussen. 1997. Abundance and population structure of humpback whales in the North Pacific basin.

Final Contract Report 50ABNF500113 to Southwest Fisheries Science Center, P.O. Box 271, La Jolla, CA 92038. 72 pp.

Calambokidis, J., G. H. Steiger, J. M. Straley, L. M. Herman, S. Cerchio, D. R. Salden, J. Urban, J. K. Jacobsen, O. von Ziegesar, K. C. Balcomb, C. M. Gabriele, M. E. Dahlheim, S. Uchida, G. Ellis, Y. Miyamura, P. Ladrón de Guevara, M. Yamaguchi, F. Sato, S. A. Mizroch, L. Schlender, K. Rasmussen, J. Barlow, and T. J. Quinn II. 2001. Movements and population structure of humpback whales in the North Pacific. Mar. Mamm. Sci. 17(4): 769-794.

Clapham, P.J., Barlow, J., Bessinger, M., Cole, T., Mattila, D., Pace, R., Palka, D.. Robbins, J. & Seton, R. 2003. Abundance and demographic parameters of humpback whales from the Gulf of Maine, and stock definition relative to the Scotian Shelf. J. Cet. Res. Manag. 5:13-22.

Clapham, P. J., and J. G. Mead. 1999. *Megaptera novaeangliae*. Mamm. Species 604:1-9.Calambokidis, J., G. H. Steiger, J. C. Cubbage, K. C. Balcomb III, and P. Bloedel. 1989. Biology of humpback whales in the Gulf of the Farallones. Report to Gulf of the Farallones National Marine Sanctuary, San Francisco, CA by Cascadia Research Collective, 218½ West Fourth Avenue, Olympia, WA. 93 pp.

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

Darling, J. D., J. Calambokidis, J., K. C. Balcomb, P. Bloedel, K. Flynn, A. Mochizuki, K. Mori, F. Sato, and M. Yamaguchi. 1996. Movement of a humpback whale (*Megaptera novaeangliae*) from Japan to British Columbia and return. Mar. Mammal Sci. 12(2):281-287.

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

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

Darroch, J. N. 1961. The two-sample capture-recapture census when tagging and sampling are stratified. Biometrika 48:241-260.

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

Doroshenko, N. V. 2000. Soviet catches of humpback whales (*Megaptera novaeangliae*) in the North Pacific. *In* A. V. Yablokov and V. A. Zemsky (eds.), Soviet whaling data (1949-1979), Center for Russian Environmental Policy, Marine Mammal Council, Moscow, 96-103.

Frankel, A. S., and C. W. Clark. 1998. Results of low-frequency playback of M-sequence noise to humpback whales, *Megaptera novaeangliae*, in Hawai'i. Can. J. Zool. 76:521-535.

Frankel, A.S., and C. W. Clark. 2002. ATOC and other factors affecting the distribution and abundance of humpback whales (*Megaptera novaeangliae*) off the North Shore of Hawaii. Mar. Mamm. Sci. 18(3):644-662.

Ivashchenko, Y. V., P. J. Clapham, and R. L. Brownell Jr. (eds.). 2007. Scientific reports of Soviet whaling expeditions, 1955-1978. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-175. 36 pp. [Translation: Y. V. Ivashchenko] + Appendix.

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

Martin, A. R., S. K. Katona, D. Mattila, D. Hembree, and T. D. Waters. 1984. Migration of humpback whales between the Caribbean and Iceland. J. Mamm. 65:330-333.

Mizroch, S. A., L. M. Herman, J. M. Straley, D. Glockner-Ferrari, C. Jurasz, J. Darling, S. Cerchio, C. Gabriele, D. Salden, O. von Ziegesar. 2004. Estimating the adult survival rate of central North Pacific humpback whales. J. Mammal. 85(5):963-972.

Mizroch, S. A. and D. W. Rice. In prep. Distribution and movements of humpback whales (*Megaptera novaeangliae*) in the North Pacific Ocean. Abstract presented at the 17th Biennial Conference on the Biology of Marine Mammals, Cape Town, South Africa.

Mobley, J. M., S. Spitz, R. Grotefendt, P. Forestell, A. Frankel, and G. Bauer. 2001. Abundance of humpback whales in Hawaiian waters: Results of 1993-2000 aerial surveys. Report to the Hawaiian Islands Humpback Whale National Marine Sanctuary. 16 pp.

Moore, S. E., J. M. Waite, L. L. Mazzuca, and R. L. Hobbs. 2000. Mysticete whale abundance observations of prey associations on the Central Bering Sea Shelf. J. Cet. Res. and Manage. 2(3): 227-234.

Moore, S. E., J. M. Waite, N. A. Friday and T. Honkalehto. 2002. Distribution and comparative estimates of cetacean abundance on the central and south-eastern Bering Sea shelf with observations on bathymetric and prey associations. Progr. Oceanogr. 55(1-2):249-262.

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

NMFS. 2005. Guidelines for Preparing Stock Assessment Reports Pursuant to Section 117 of the Marine Mammal Protection Act, SAR Guidelines Revisions, June 2005, 24 pp.

Perez, M. A. 2006. Analysis of marine mammal bycatch data from the trawl, longline, and pot groundfish fisheries of Alaska, 1998-2004, defined by geographic area, gear type, and target groundfish catch species. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-167.

Perez, M. A. Unpubl. ms. Bycatch of marine mammals by the groundfish fisheries in the U.S. EEZ of Alaska, 2005. Available NMML-AFSC, 7600 Sand Point Way NE, Seattle, WA 98115.

Perez, M. A. Unpubl. ms. Bycatch of marine mammals by the groundfish fisheries in the U.S. EEZ of Alaska, 2006, 67 pp. Available NMML-AFSC, 7600 Sand Point Way NE, Seattle, WA 98115.

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

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

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

Straley, J. M. 1994. Seasonal characteristics of humpback whales (*Megaptera novaeangliae*) in southeastern Alaska. Master's thesis, University of Alaska - Fairbanks, Fairbanks, Alaska, 99775. 121 pp.

Straley, J. M., C. M. Gabriele, and C. S. Baker. 1995. Seasonal characteristics of humpback whales (*Megaptera novaeangliae*) in southeastern Alaska. Pp. 229-237 *In* D. R. Engstrom, ed. Proceedings of the Third Glacier Bay Science Symposium, 1993. National Park Service, Anchorage, AK.

Straley, J M., C. M. Gabriele and T. J. Quinn II. in press. Assessment of mark recapture models to estimate the abundance of a humpback whale feeding aggregation in Southeast Alaska. J. Biogeogr.

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

von Ziegesar, O. 1992. A catalogue of Prince William Sound humpback whales identified by fluke photographs between the years 1977 and 1991. North Gulf Oceanic Society, P. O. Box 15244, Homer, AK. 29 pp.

von Ziegesar, O., B. Goodwin, and R. Devito. 2004. A catalog of humpback whales in Prince William Sound Alaska, 1977-2001. Eye of the Whale Research, Fritz Creek, Alaska. von Ziegesar, O., E. Miller, and M. E. Dahlheim. 1994. Impacts on humpback whales in Prince William Sound.

Pp. 173-191 *In* T. R. Loughlin (ed.), Marine Mammals and the *Exxon Valdez*. Academic Press Inc., San Diego, CA. Wade, P. R., and R. Angliss. 1997. Guidelines for assessing marine mammal stocks: report of the GAMMS workshop April 3-5, 1996, Seattle, Washington. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, 93 pp.

Wade, P. R., and R. Angliss. 1997. Guidelines for assessing marine mammal stocks: report of the GAMMS workshop April 3-5, 1996, Seattle, Washington. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR12, 93 pp.

Waite, J. M., M. E. Dahlheim, R. C. Hobbs, S. A. Mizroch, O. von Ziegesar-Matkin, J. M. Straley, L. M. Herman, and J. Jacobsen. 1999. Evidence of a feeding aggregation of humpback whales (*Megaptera novaeangliae*) around Kodiak Island, Alaska. Mar. Mammal Sci. 15:210-220.

Witteveen, B. H., J. M. Straley, O. Ziegesar, D. Steel, and C. S. Baker. 2004. Abundance and mtDNA differentiation of humpback whales (*Megaptera novaeangliae*) in the Shumagin Islands, Alaska. Can. J. Zool. 82:1352-1359.

Zenkovich B. A. 1954. Vokrug sveta za kitami, Vol. Gosudarstvennoe Izdatel'stvo Geograficheskoi Literatury, Moscow.

Zerbini, A. N., J. M. Waite, J. L. Laake and P. R. Wade. 2006. Abundance, trends and distribution of baleen whales off western Alaska and the central Aleutian Islands. Deep Sea Res. Part I:1772-1790.