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 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 (Nemoto 1957, Tomlin 1967, Johnson and Wolman 1984). A recent vessel 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). These recent sightings clearly demonstrate that the Bering Sea remains an important feeding area. 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 the 20th century.

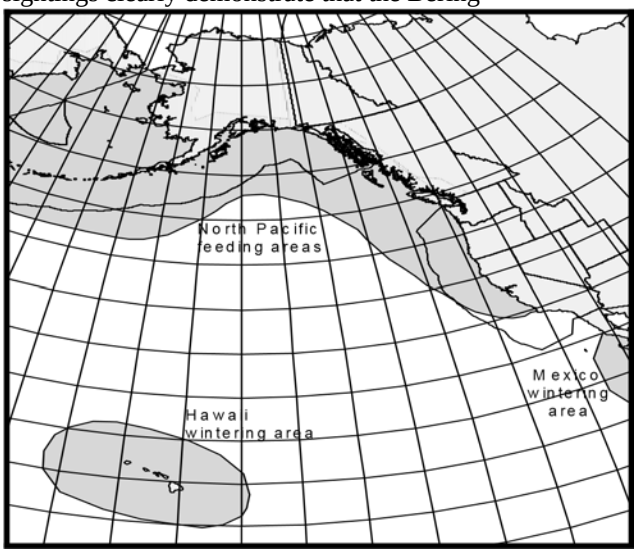

Figure 34. Approximate distribution of humpback whales in the eastern North Pacific (shaded area). Feeding and wintering areas are presented above (see text). See Figure 33 for distribution of humpback whales in the western North Pacific.

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. 33 and 32): 1) winter/spring populations in coastal Central America and Mexico which migrate to the coast of California4 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 Kodiak (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 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. Winter/spring populations of humpback whales also occur in Mexico's offshore islands. The migratory destination of these whales is not well known (Calambokidis et al. 1993, Calambokidis et al. 1997). 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, 3 management units of humpback whales (as described above) 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.

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 (although further study will be required to determine conclusively whether the Kodiak Island animals belong to the Central stock). 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 et al., unpubl. data, Mizroch et al. in review); 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 have been sighted between Kodiak and southeastern Alaska (Waite et al. 1999). 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). The humpback whales in the central North Pacific stock show fidelity to either the southeast Alaska and Prince William Sound feeding areas; Mizroch et al. (in review) examined photographs taken from 1979-96, and reports that under 1% of the individual whales photographed in these areas moved between areas.

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. 1999). The abundance of the Prince William Sound feeding aggregation is thought to be less than 200 whales (Waite et al. 1999). Straley et al. (1995) indicated that the annual abundance of humpback whales in southeastern Alaska is 404 animals (95% CI:350-458). 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. In the Northern British Columbia region (primarily near Langara Island), 275 humpback whales were identified from 1992 to 1998 (G. Ellis, pers. comm., Pacific Biological Station, Nanaimo, BC, V9R 5K6). These estimates represent minimum estimates for these 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 where photo-identification effort is typically low, such as the waters 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 1,530) 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) suggests 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 small sample size and opportunistic nature of the survey. 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

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 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). Thus, for the Central North Pacific stock of humpback whale, PBR = 7.4 animals ($3,698 \times 0.02 \times 0.1$).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY Fisheries Information

Four 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 1990-99: Bering Sea/Aleutian Island groundfish trawl, Gulf of Alaska groundfish trawl, longline, and pot fisheries. One humpback whale mortality was observed in the Bering Sea/Aleutian Islands groundfish trawl fishery in 1998 and one in 1999. Average annual mortality from the observed fisheries in Alaska was 0.4 humpbacks from this stock (Table 27a). Note, however, that the stock identification is uncertain and the mortality may have been attributable to the western stock of humpback whales. Thus, this mortality is assigned to both the central and western stocks. Fishery observers also monitored the Hawaii swordfish, tuna, billfish, mahi mahi, wahoo, oceanic shark longline/setline fishery during the same period. The range of observer coverage for this fishery, as well as the annual observed and estimated mortalities, are presented in Table 27a. 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 4-5% 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 during 1993 (E. Nitta, pers. comm., National Marine Fisheries Service). This report was never confirmed and the fate of this animal is also unknown. The estimated mean annual mortality rate in all observed fisheries during the 5-year period from 1994-98 is 0.2 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. Logbook data are available for part of 1989-94, after which incidental mortality reporting requirements were modified. Under the new system, logbooks are no longer required; instead, fishers provide selfreports. Data for the 1994-95 phase-in period is fragmentary. After 1995, the level of reporting dropped dramatically, such that the records are considered incomplete and estimates of mortality based on them represent minimums (see Appendix 7 for details). 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 27a. 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. Together, these two mortalities result in an annual mortality of 0.4 (0.2 + 0.2) humpback whales based on self-reported fisheries information (Table 27a). This is considered to be a minimum estimate because logbook records (fisher selfreports required during 1990-94) are most likely negatively biased (Credle et al. 1994).

Table 27a. Summary of incidental mortality of humpback whales (Central North Pacific stock) due to commercial fisheries from 1990 through 2000 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	90-00	obs data	<1-5%	0, 1, 0, 0, 0, 0, 0, 0, 0, 0	0, 1, 0, 0, 0, 0, 0, 0, 0, 0	0
Bering Sea/Aleutian Is. (BSAI) groundfish trawl	90-00	obs data	53-74%	0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0	0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0	0.4 (CV = 0.61)
Observer program total						0.4
				Reported mortalities		
Southeast Alaska salmon drift gillnet	90-00	self reports	n/a	0, 0, 0, 0, n/a, n/a, 1, n/a, n/a, n/a, n/a	n/a	[0.2]
Southeast Alaska salmon purse seine	90-00	self reports	n/a	0, 0, 0, 0, 1, n/a, n/a, n/a, n/a, n/a, n/a	n/a	[0.2]
Southeast Alaska salmon purse seine	92-00	stranding records		1 in 2000	n/a	[0.2]
Southeast Alaska salmon drift gillnet	92-00	stranding records	n/a	0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0	n/a	[0.2]
Crustacean pot		stranding records	n/a	1 each in 1998 and 1999	n/a	[0.4]
Minimum total annual mortality						[1.6]

Reports of entangled humpback whales found swimming, floating, or stranded with fishing gear attached occur in both Alaskan and Hawaiian waters. Two such reports from Alaska are included in Table 27a because they could be attributed to a particular fishery, namely the Southeast Alaska salmon drift gillnet fishery. An entanglement of a humpback whale occurred in this fishery in 1992 but 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. Given the location of this animal (Chatham Strait), the mortality was attributed to the Southeast Alaska salmon drift gillnet fishery. Details of other strandings that occurred between 1992 and 1999 in these areas are presented in Table 27b. Fishery-related strandings from Hawaii and Alaska during 1994-99 as listed in Table 27b result in an estimated annual mortality of 2.2 humpback whales from this stock. 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 27b. Human-related strandings and entanglements of humpback whales (central North Pacific stock), 1996-2000.
An asterisk in the "number" column indicates cases that were not considered serious injuries.

Year	Number	Area	Condition	Description
1996	1*	"Hawaiian waters"	Released alive	Disentangled from non-fishing gear
1996	1	Oahu, HI	Injured; status unknown	Ship strike
1996	1	Oahu, HI	Injured; status unknown	Partial disentanglement from Hawaiian crab fishery gear; some gear around pectoral fin and mouth still attached
1996	1	Sand Point, AK	Injured; status unknown	Released from fishing gear, but appeared injured; thought to have died
1996	1*	Alitak Beach, Kodiak Island, AK	Released alive	Released from commercial purse seine net
1997	1*	Island of Hawaii	Released alive	Alaska crab pot floats removed by U.S. Coast Guard
1997	1*	57 30 N 135 13 W NW Shelter Island	Alive	Collision with skiff
1997	1	Peril Straits, AK	Injured	Entangled in line; attempt to disentangle failed
1997	1	58 18 N 134 24 W NW Shelter Island	Injured	Tail wrapped in crab pot line
1997	1	58 21N 134 57 W NW Admiralty Island	Alive; entangled	Line and 2' diameter buoy attached
1998	1	Maalaea Bay, Lanai	Alive; entangled	Disentangled from gear, but some line still attached

1998	1	Sitka, AK	Alive; entangled	Commercial gillnet around flippers
1998	1*	Jakolof Bay	Alive	Disentangled from personal use pot gear
1998	1	Ketchikan, AK	Injury; status unknown	Salmon purse seiner net (commercial) torn through, thought to have died
1998	1	Juneau, AK	Injured	Ship strike (8/11)
1998	1	Juneau, AK	Entangled	No details available
1998	1*	Wrangell, AK	Alive	Commercial crab pot buoy removed
1998	1*	Homer, AK	Alive	Tanner crab pot cut loose
1998	1	Juneau, AK	Injured	Ship strike (9/24)
1998	1*	Sitka, AK	Alive	Commercial crab pot line cut free
1998	1	Ketchikan	Entangled	Swimming freely with pot gear attached
1999	1	Homer	Entangled	In crab pot gear; released
1999	1	Prince of Wales Island	Entangled	In unknown pot gear, released
1999	1	Metlakatla	Injury; status unknown	Ship strike
2000	1*	Lynn Canal	Entangled, released alive, status unknown	Purse seine gear
2000	1*	Skagway	Entangled, released alive	Shrimp pot gear
2000	1	Uyak Bay	Entangled	Unknown gear

The estimated minimum mortality rate incidental to commercial fisheries is 4.1 humpback whales per year, based on observer data (0.4), and self-reported fisheries information (0.4) , stranding records traceable to a specific fishery (0.8) and other stranding records indicating mortality or serious injury (Table 27b) (2.5). 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 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, 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. These cases are included in Table 27b. Of those, four ship strikes (one in 1996, two in 1998, and one in 1999) constitute "other sources" of mortality. No humpback whales from this stock were reported struck in 2000. Averaged over the 5 year period from 1996-00, these account for an additional 0.8 humpback mortalities per year.

HISTORIC WHALING

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 (4.3; 3.5 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 (0.7) 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. In 2001, NMFS issued regulations to prohibit most approaches to humpback whales in Alaska within 100 yards (91.4m; (66 FR 29502; May 31, 2001)). The growth of the whalewatching industry, however, is a concern as preferred habitats may be abandoned if disturbance levels are too high.

Noise 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 whalewatching) 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 (Frankel and Clark 1998). Efforts are underway to evaluate the relative contribution of noise (e.g., experiments with LFA sound sources) to Hawaii's marine environment, although reports summarizing the results of recent research are not available.

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