6/5/2023 (New SAR)

HUMPBACK WHALE (*Megaptera novaeangliae kuzira*): Mexico-North Pacific Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

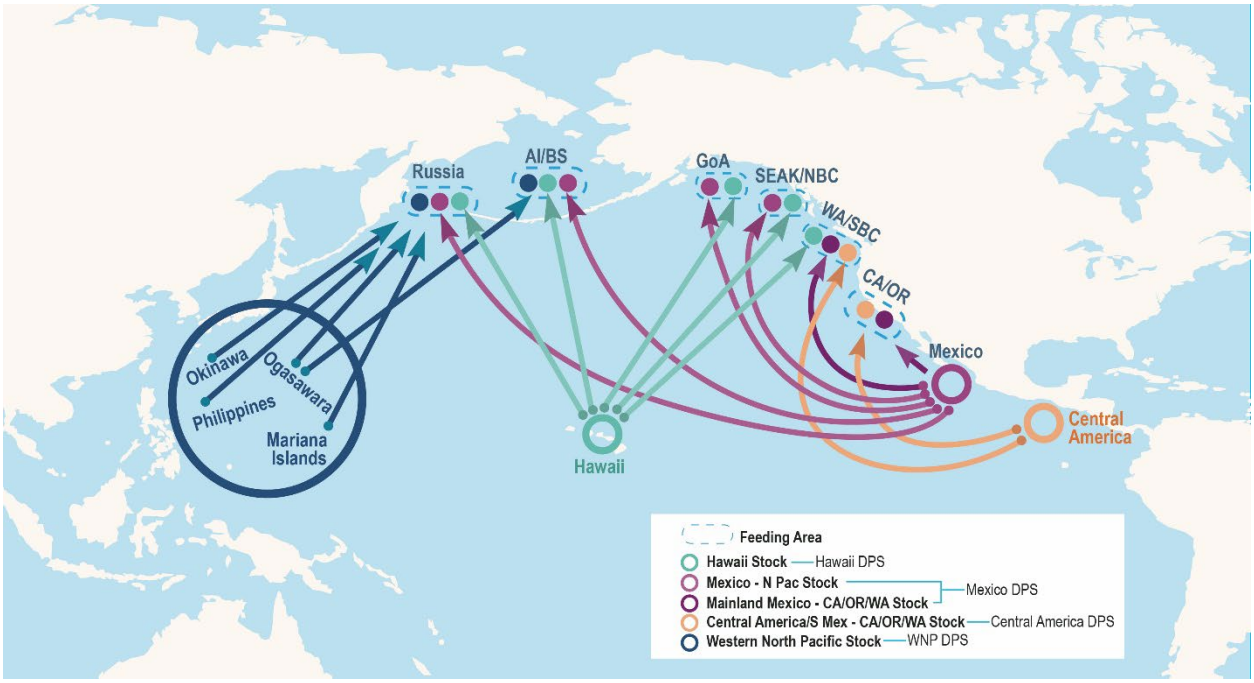

Figure 1. Pacific basin map showing wintering areas of five humpback whale stocks mentioned in this report. Also shown are summering feeding areas mentioned in the text. High-latitude summer feeding areas include Russia, Aleutian Islands / Bering Sea (AI/BS), Gulf of Alaska (GoA), Southeast Alaska / Northern British Columbia (SEAK/NBC), Washington / Southern British Columbia (WA/SBC), and California / Oregon (CA/OR).

Humpback whales occur worldwide and migrate seasonally from high latitude subarctic and temperate summering areas to low latitude subtropical and tropical wintering areas. Three subspecies are recognized globally (North Pacific, Atlantic, and Southern Hemisphere), based on restricted gene flow between ocean basins (Jackson et al. 2014). The North Pacific subspecies (*Megaptera novaeangliae kuzira*) occurs basin-wide, with summering areas in waters of the Russian Far East, Beaufort Sea, Bering Sea, Chukchi Sea, Gulf of Alaska, Western Canada, and the U.S. West Coast. Known wintering areas include waters of Okinawa and Ogasawara in Japan, Philippines, Mariana Archipelago, Hawaiian Islands, Revillagigedos Archipelago, Mainland Mexico, and Central America (Baker et al. 2013, Barlow et al. 2011, Calambokidis et al. 2008, Clarke et al. 2013, Fleming and Jackson 2011, Hashagen et al. 2009). In describing humpback whale population structure in the Pacific, Martien et al. (2020, 2023) note that "migratory whale herds", defined as groups of animals that share the same summering and wintering area, are likely to be demographically independent due to their strong, maternally-inherited fidelity to migratory destinations. Despite whales from multiple wintering areas sharing some summer feeding areas, Baker et al. (2013) reported significant genetic differences between North Pacific summering and wintering areas, driven by strong maternal site fidelity to feeding areas and natal philopatry to wintering areas. This differentiation is supported by photo ID studies showing little interchange of whales between summering areas (Calambokidis et al. 2001).

NMFS has identified 14 distinct population segments (DPSs) of humpback whales worldwide under the Endangered Species Act (ESA) (81 FR 62259, September 8, 2016), based on genetics and movement data (Baker et al. 2013, Calambokidis et al. 2008, Bettridge et al. 2015). In the North Pacific, 4 DPSs are recognized (with ESA listing status), based on their respective low latitude wintering areas: "Western North Pacific" (endangered), "Hawai'i" (not listed), "Mexico" (threatened), and "Central America" (endangered). The listing status of each DPS was determined following an evaluation of the ESA section 4(a)(1) listing factors as well as an evaluation of demographic risk factors. The evaluation is summarized in the final rule revising the ESA listing status of humpback whales (81 FR 62259, September 8, 2016).

In prior stock assessments, NMFS designated three stocks of humpback whales in the North Pacific: the California/Oregon/Washington (CA/OR/WA) stock, consisting of winter populations in coastal Central America and coastal Mexico which migrate to the coast of California and as far north as southern British Columbia in summer; 2) the Central North Pacific stock, consisting of winter populations in the Hawaiian Islands which migrate primarily to northern British Columbia/Southeast Alaska, the Gulf of Alaska, and the Bering Sea/Aleutian Islands; and 3) the Western North Pacific stock, consisting of winter populations off Asia which migrate primarily to Russia and the Bering Sea/Aleutian Islands. These stocks, to varying extents, were not aligned with the more recently identified ESA DPSs (e.g., some stocks were composed of whales from more than one DPS), which led NMFS to reevaluate stock structure under the Marine Mammal Protection Act (MMPA).

NMFS evaluated whether these North Pacific DPSs contain one or more demographically independent populations (DIPs), where demographic independence is defined as "*…the population dynamics of the affected group is more a consequence of births and deaths within the group (internal dynamics) rather than immigration or emigration (external dynamics)*" (NMFS 2023a). Evaluation of the four DPSs in the North Pacific by NMFS resulted in the delineation of three DIPs, as well as four "units" that may contain one or more DIPs (Martien et al. 2021, Taylor et al. 2021, Wade et al. 2021, Oleson et al. 2022, Table 1). Delineation of DIPs is based on evaluation of "strong lines of evidence" such as genetics, movement data, and morphology (Martien et al. 2019). From these DIPs and units, NMFS designated five stocks. North Pacific DIPs / units / stocks are described below, along with the lines of evidence used for each. In some cases, multiple units may be combined into a single stock due to lack of sufficient data and/or analytical tools necessary for effective management or for pragmatic reasons (NMFS 2019).

Table 1. DPS of origin for North Pacific humpback whale DIPs, units, and stocks. Names are based on their general winter and summering area linkages. The stock included in *this* report is shown in bold font. All others appear in separate reports.

DPS	ESA Status	DIPs / units	Stocks
Central America	Endangered	Central America - CA-OR-WA DIP	Central America / Southern Mexico - CA-OR-WA stock
Mexico	Threatened	Mainland Mexico - CA-OR-WA DIP	Mainland Mexico – CA-OR-WA stock
		Mexico - North Pacific unit	**Mexico - North Pacific stock**
Hawai'i	Not Listed	Hawai'i - North Pacific unit	Hawai'i stock
		Hawai'i - Southeast Alaska / Northern British Columbia DIP	
Western North Pacific	Endangered	Philippines / Okinawa - North Pacific unit	Western North Pacific stock
		Marianas / Ogasawara - North Pacific unit	

Delineation of the **Central America/Southern Mexico – California/Oregon/Washington DIP** is based on two strong lines of evidence indicating demographic independence: genetics and movement data (Taylor et al. 2021). The DIP was designated as a stock because available data make it feasible to manage as a stock and because there are conservation and management benefits to doing so (NMFS 2023a, NMFS 2019, NMFS 2022a). Whales in this stock winter off the Pacific coast of Nicaragua, Honduras, El Salvador, Guatemala, Panama, Costa Rica and likely southern coastal Mexico (Taylor et al. 2021). Summer destinations for whales in this DIP include the U.S. West Coast waters of California, Oregon, and Washington (including the Salish Sea, Calambokidis et al. 2017).

Delineation of the **Mainland Mexico – California/Oregon/Washington DIP** is based on two strong lines of evidence indicating demographic independence: genetics and movement data (Martien et al. 2021). The DIP was designated as a stock because available data make it feasible to manage as a stock and because there are conservation and management benefits to doing so (NMFS 2023a, NMFS 2019, NMFS 2022b). Whales in this stock winter off the mainland Mexico states of Nayarit and Jalisco, with some animals seen as far south as Colima and Michoacán. Summer destinations for whales in the Mainland Mexico DPS include U.S. West Coast waters of California, Oregon, Washington (including the Salish Sea, Martien et al. 2021), Southern British Columbia, Alaska, and the Bering Sea.

The **Mexico – North Pacific unit** is likely composed of multiple DIPs, based on movement data (Martien et al. 2021, Wade 2021, Wade et al. 2021). However, because currently available data and analyses are not sufficient to delineate or assess DIPs within the unit, it was designated as a single stock (NMFS 2023a, NMFS 2019, NMFS 2022b). Whales in this stock winter off Mexico and the Revillagigedo Archipelago and summer primarily in Alaska waters (Martien et al. 2021).

The **Hawai‘i stock** consists of one DIP - **Hawai‘i - Southeast Alaska / Northern British Columbia DIP** and one unit - **Hawai‘i - North Pacific unit,** which may or may not be composed of multiple DIPs (Wade et al. 2021). The DIP and unit are managed as a single stock at this time, due to the lack of data available to separately assess them and lack of compelling conservation benefit to managing them separately (NMFS 2023a, NMFS 2019, NMFS 2022c). The DIP is delineated based on two strong lines of evidence: genetics and movement data (Wade et al. 2021). Whales in the Hawai‘i - Southeast Alaska/Northern British Columbia DIP winter off Hawai‘i and largely summer in Southeast Alaska and Northern British Columbia (Wade et al. 2021). The group of whales that migrate from Russia, western Alaska (Bering Sea and Aleutian Islands), and central Alaska (Gulf of Alaska excluding Southeast Alaska) to Hawai‘i have been delineated as the **Hawai‘i-North Pacific unit** (Wade et al. 2021). There are a small number of whales that migrate between Hawai‘i and southern British Columbia/Washington, but current data and analyses do not provide a clear understanding of which unit these whales belong to (Wade et al. 2021).

The **Western North Pacific stock** consists of two units- the **Philippines / Okinawa - North Pacific unit** and the **Marianas / Ogasawara - North Pacific unit**. The units are managed as a single stock at this time, due to a lack of data available to separately assess them (NMFS 2023a, NMFS 2019, NMFS 2022d). Recognition of these units is based on movements and genetic data (Oleson et al. 2022). Whales in the Philippines /Okinawa - North Pacific unit winter near the Philippines and Ryukyu Archipelago and migrate to summer feeding areas primarily off the Russian mainland (Oleson et al. 2022). Whales that winter off the Mariana Archipelago, Ogasawara, and other areas not yet identified and then migrate to summer feeding areas off the Commander Islands, and to the Bering Sea and Aleutian Islands comprise the Marianas / Ogasawara - North Pacific unit.

In previous marine mammal stock assessments, most humpback whales that summer and feed in Alaska waters were treated as one stock (the “Central North Pacific stock”), with only whales that winter in Asia (a relatively small proportion of the whales in the Bering Sea, Aleutian Islands, and Gulf of Alaska) identified as belonging to a separate stock (the “Western North Pacific stock”). However, this meant that the Central North Pacific stock contained whales from both the Hawai‘i and Mexico DPSs, making that previous stock incompatible with the ESA DPSs. Therefore, humpback whales that summer in Alaska have now been placed in one of three separate stocks defined by their winter area, which are consistent with their ESA DPSs. Regarding the whales that summer in Alaska and winter in Mexico, as noted above, two stocks have been designated within the Mexico DPS. Humpback whales that winter along the Mexico Mainland coast and feed in summer along the west coast of the United States are part of the Mainland Mexico – California/Oregon/Washington stock.

This stock assessment report includes information on humpback whales that winter in Mexico and summer primarily in Alaska. This includes some of the humpback whales that winter along the mainland coast of Mexico that migrate to Alaska in summer. Additionally, none of the whales in the offshore Revillagigedo Archipelago in Mexico migrate to the west coast of the U.S.; they primarily migrate to Alaska in summer (with a small number migrating to Russia or to southern British Columbia/Washington). Therefore, this stock, the Mexico – North Pacific stock, includes humpback whales that winter off mainland Mexico and the Revillagigedo Archipelago and summer primarily in Alaska waters (Martien et al. 2021). This stock specifically excludes any whales that migrate from Mexico to California or Oregon.

POPULATION SIZE

Winter Areas

All of the humpback whales in the Revillagigedo Archipelago are part of this stock. Therefore, an estimate of abundance for the Revillagigedo Archipelago can serve as a partial estimate for the stock. Such estimates will be negatively biased to an unknown degree, as they will not include an estimate of the number of whales in this stock found along the mainland coast of Mexico. There is currently no method that would allow partitioning the abundance of humpback whales along the mainland Mexico coast to the two Mexican stocks.

Using a modified model of the Jolly-Seber population model, Urbán et al. (1999) estimated that in 1991 there were 1,813 (95% CI: 918-2505) whales in the coastal stock and 914 (95% CI: 590-1193) whales in the Revillagigedo Archipelago stock. During the SPLASH project in 2004-2006, a total of 562 unique individuals were identified in the Revillagigedo Archipelago (Table 6 in Calambokidis et al. 2008). Abundance estimates were also calculated from those same data using a Hilborn mark-recapture model. From what they identified as the best-fitting model (the non-Markov p(n) model), the estimate of abundance for the Revillagigedo Archipelago was 681 (no CV was estimated) (Calambokidis et al. 2008). Martinez-Aguilar (2011) conducted mark-recapture abundance estimates from photo-identification data from 3 regions in the Mexican Pacific, including the Revillagigedo Archipelago. A number of closed population models were fit to the data, with the best model being a Chao m(th) model specifying time-varying and individual heterogeneity in capture probability. That model resulted in an estimate for the years 1987-1990 of 571

(95% CI 465-729) for the Revillagigedo Archipelago. Martinez-Aguilar (2011) also analyzed data from the 2004-2006 SPLASH years from Mexico, and added an additional year of data (2003) from outside the SPLASH years. For that time period, the Chao m(th) model resulted in an estimate of 2,352 (95% CI 2,030-2,762, with CV~0.075) for the Revillagigedo Archipelago.

Summer Areas

Abundance estimates from a multi-strata mark-recapture analysis from the SPLASH data resulted in abundance estimates of 7,758 for the Bering Sea and Aleutian Islands (CV=0.20), 2,129 for the Gulf of Alaska (including the Shumagin Islands, CV=0.081), and 5,890 (CV=0.075) for Southeast Alaska and northern British Columbia (Wade 2021). In all of those areas those abundance estimates represent a mixture of whales from up to three winter areas, the western North Pacific (Asia), Hawai'i, and Mexico, and so cannot represent the abundance of just the Mexico-North Pacific stock in its summer areas. To determine the number of animals in these feeding areas belonging to the Mexico-North Pacific stock, the abundance estimate for each feeding area was multiplied by the probability of movement between that feeding area and the Mexican wintering area, as estimated by Wade (2021), and then added together. This resulted in an estimate of 918 animals (CV=0.217).

Minimum Population Estimate

Using the Chao m(th) model abundance estimate for 2003-2006 reported by Martinez-Aguilar (2011), which is 2,352 with ~CV=0.075, N_{MIN} for this population would be 2,241. Using the estimate of 918 animals (CV=0.217) derived from Wade's (2021) multi-strata analysis of 2004-2006 SPLASH data, the N_{MIN} for this population would be 766. Both of these estimates of abundance are based on data collected more than 15 years ago. NMFS' Guidelines for Assessing Marine Mammal Stocks suggest that the N_{MIN} estimate of the stock should be adjusted to account for potential abundance changes that may have occurred since the last survey and provide reasonable assurance that the stock size is at least as large as the estimate (NMFS 2023a). There is no basis for adjusting the abundance estimates because the abundance trend is unclear. Although there was evidence that the population in the Revillagigedo Archipelago was increasing between 1987-1990 and 2003-2006, there are no estimates of the population trend for that area since 2003-2006. Additionally, as discussed below in the Current Population Trend section, it is no longer clear that the trend of the population is increasing. Therefore, the minimum population estimate for this stock is considered unknown.

Current Population Trend

Calambokidis et al. (2008) noted that the abundance estimate for all areas in Mexico estimated from the SPLASH data suggested an increase relative to previous estimates. Specifically, they noted that "an increase from about 2,500 whales in the early 1990s to the SPLASH estimate of 5,928 would be consistent with a 6.9% rate of annual increase, but should be interpreted cautiously given the variability in the earlier estimates" (Calambokidis et al. 2008). A comparison of two mark-recapture estimates for the Revillagigedo Archipelago for 1987-1990 and 2003-2006 resulted in an estimate of an annual rate of increase of 8.8% (Table 9 in Martinez-Aguilar 2011). Estimates of annual rates of increase from the same years of data for other parts of Mexico were 10.5% for the Baja Peninsula, 8.7% for the mainland Mexico coast, and 8.9% for all areas in Mexico combined. This suggests that the portion of this stock along the mainland coast was also increasing over this time period.

Whales in this stock migrate to areas of Alaska, particularly the Aleutian Islands, Bering Sea, and Gulf of Alaska. There are no trend data for humpback whales in the Aleutian Islands and Bering Sea. For shelf waters of the northern Gulf of Alaska, Zerbini et al. (2006) estimated an annual rate of increase for humpback whales of 6.6% (95% CI: 5.2-8.6%) from 1987 to 2003. Teerlink et al. (2015) estimated an average annual rate of increase of 4.53% (95 % CI 3.28–5.79%) for 1978-2009 for humpback whales in Prince William Sound, Alaska. Although these areas are a mixture of whales from Hawaii, Mexico, and Asia, and so do not reflect the trend of a single stock, the data are still consistent with the evidence above suggesting humpback whales in Mexico were increasing.

Recently, however, the encounter rate of humpback whales and the number of calves declined in Prince William Sound after the marine heatwave in the Gulf of Alaska in 2014-2016, presumably due to disruption of lower trophic level prey (Arimitsu et al. 2021). A large whale Unusual Mortality Event in the western Gulf of Alaska in 2015-2016 (Savage 2017) suggested this was, at least partially, a true decline rather than just a shift in distribution. A similar decline in abundance and calf production rates of humpback whales in Glacier Bay and Icy Strait in Southeast Alaska (Neilson and Gabriele 2019) indicates this decline may have occurred widely throughout the Gulf of Alaska. Therefore, it is unknown if this population is currently increasing.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Zerbini et al. (2010) analyzed observed life history rates to estimate that rates of increase for humpback whales can theoretically be as high as 12%, and rates of increase approximately that high have been observed in several Southern Hemisphere populations. As mentioned above, Martinez-Aguilar (2011) estimated an annual increase of 8.8% (no CV or CI reported) for the Revillagigedo Archipelago over a 16-year period (1987-1990 to 2003-2006), based on point estimates of 571 and 2,352, respectively. Taking the upper confidence limit for the first time period (729) and the lower confidence limit of the second time period (2030) represents an annual rate of increase of at least 6.6%.

An estimated rate of increase for humpback whales in the northern Gulf of Alaska of 6.6% (95% CI: 5.2-8.6%) was estimated from ship survey data (Zerbini et al. 2006); although this represents a mixture of several stocks (including the Mexico—North Pacific stock), this value is consistent with the increase reported for the Revillagigedo Archipelago, and is a feeding area used by this stock.

There is no estimate of the maximum net productivity rate (R_{MAX}) for the entire stock (i.e., including both the Revillagigedo Archipelago and the whales along the mainland Mexico coast that migrate to Alaska). However, Martinez-Aguilar (2011) reports an annual rate of increase of 8.7% for coastal areas of Mexico. Therefore, it is reasonable to assume that R_{MAX} for this stock would be at least 6.6%. Until additional data become available for the Hawai‘i humpback whale stock, 6.6% will be used as R_{MAX} for this stock.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock would be calculated as the minimum population size times one half the estimated population growth rate for this stock of humpback whales (½ of 6.6%) times a recovery factor of 0.5, the default value for a stock part of a DPS listed as Threatened (NMFS 2023a). Due to a lack of quantitative data, it is assumed that this stock spends approximately half its time outside the U.S. Exclusive Economic Zone (EEZ), the PBR in U.S. waters would be ½ of the calculated value. However, because N_{MIN} is considered unknown, PBR is undetermined.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Information for each human-caused mortality, serious injury, and non-serious injury reported for NMFS-managed Alaska marine mammals between 2016 and 2020 is listed, by marine mammal stock, in Freed et al. (2022); however, only the mortality and serious injury data are included in the Stock Assessment Reports. Injury events lacking detailed injury information are assigned prorated values following injury determination guidelines described in NMFS (2023b). A summary of information used to determine whether an injury was serious or non-serious, as well as a table of prorate values used for large whale reports with incomplete information, is reported in Freed et al. (2022).

Human-caused mortality and serious injury of humpback whales observed in Alaska includes whales from three stocks: the Mexico-North Pacific stock, the Hawai‘i stock, and the Western North Pacific stock. Human-caused mortality and serious injury of the Mexico-North Pacific stock also occurs in Mexico, but those data are not currently available. To assess human-caused mortality and serious injury of the Hawai‘i stock in areas where multiple stocks overlap, mortality and serious injury is prorated using point estimates of the summering to wintering area movement probabilities reported by Wade (2021) (Table 2).

Table 2. Movement probabilities from Wade (2021) (and unpublished CVs) used for prorating human-caused mortality and serious injury to the Mexico-North Pacific stock.

Stock or DIP/Unit	Aleutian Islands/Bering Sea	Gulf of Alaska	Southeast Alaska
Mexico-North Pacific	0.071 (CV = 0.280)	0.106 (CV = 0.177)	0.024 (CV = 0.260)

Based on data described in the sections below, the minimum estimated mean annual level of human-caused mortality and serious injury for the Mexico-North Pacific stock of humpback whales between 2016 and 2020 in U.S. waters is 0.57 whales: 0.36 in U.S. commercial fisheries, 0.01 in recreational fisheries, 0.02 in Alaska subsistence fisheries, 0.05 in unknown (commercial, recreational, or subsistence) fisheries, 0.05 in marine debris, and 0.08 due to other causes (intentional unauthorized removal, vessel strikes, and entanglement in an Alaska Department of Fish and Game (ADF&G) salmon net pen and in mooring gear) (see text and tables below). This estimate is considered a minimum because observers have not been assigned to several fisheries that are known to interact with this stock.

Potential threats most likely to result in direct human-caused mortality or serious injury of this stock include vessel strikes and entanglement in fishing gear and marine debris.

Fisheries Information

U.S. Commercial Fisheries

Information for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is available in Appendix 3 of the Alaska Stock Assessment Reports (observer coverage) and in the NMFS List of Fisheries (LOF) and the fact sheets linked to fishery names in the LOF (observer coverage and reported incidental takes of marine mammals: https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-protection-act-list-fisheries, accessed May 2023).

Two humpback whale mortalities were observed in the Bering Sea/Aleutian Islands pollock trawl fishery between 2016 and 2020, resulting in a minimum estimated mean annual mortality and serious injury rate of 0.4 humpback whales, of which 0.03 were prorated to the Mexico-North Pacific stock (Table 3; Breiwick 2013; MML, unpubl. data).

In 2012 and 2013, the Alaska Marine Mammal Observer Program placed observers on independent vessels in the state-managed Southeast Alaska salmon drift gillnet fishery to assess mortality and serious injury of marine mammals. Areas around and adjacent to Wrangell and Zarembo Islands (ADF&G Districts 6, 7, and 8) were observed during the 2012 and 2013 programs (Manly 2015). In 2013, one humpback whale was seriously injured. Based on the one observed serious injury, 11 serious injuries were estimated for Districts 6, 7, and 8 in 2013, resulting in an estimated mean annual mortality and serious injury rate of 5.5 humpback whales in 2012 and 2013, of which 0.13 were prorated to the Mexico-North Pacific stock (Table 3). Because these three districts represent only a portion of the overall fishing effort in this fishery, this is considered to be a minimum estimate of mortality and serious injury for the fishery.

Table 3. Summary of incidental mortality and serious injury of humpback whales due to observed U.S. commercial fisheries between 2016 and 2020 (or the most recent data available) and the mean annual mortality and serious injury rate for Alaska fisheries (Breiwick 2013; Manly 2015; MML, unpubl. data). Mean annual mortality estimates are prorated to the Mexico-North Pacific stock by multiplying by the area-specific movement probabilities in Table 2. Methods for calculating percent observer coverage for Alaska fisheries are described in Appendix 3 of the Alaska Stock Assessment Reports.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality (CV)	Mean estimated annual mortality - overall (CV)	Mean estimated annual mortality of Mexico-North Pacific stock (CV)
Bering Sea/Aleutian Islands							
Bering Sea/Aleutian Is. pollock trawl	2016 2017 2018 2019 2020	obs data	99 99 99 98 91	0 0 1 0 1	0 0 1.0 (0.11) 0 1.1 (0.23)	0.4 (0.13)	0.03 (0.31)
Southeast Alaska							
Southeast Alaska salmon drift gillnet (Districts 6, 7, 8)	2012 2013	obs data	6.4 6.6	0 1	0 11	5.5 (1.0)	0.13 (1.1)
Minimum total estimated annual mortality						5.9 (0.93)	0.16 (0.88)

Mortality and serious injury in unobserved U.S. commercial fisheries reported to the NMFS Alaska Region marine mammal stranding network and through Marine Mammal Authorization Program (MMAP) fisherman self-reports between 2016 and 2020 resulted in a minimum mean annual mortality and serious injury rate of 1.90 humpback whales between 2016 and 2020 (Table 4; Freed et al. 2022), of which 0.20 were prorated to the Mexico-North Pacific stock. These mortality and serious injury estimates result from an actual count of verified human-caused deaths and

serious injuries and are minimums because not all entangled animals strand or are self-reported nor are all stranded animals found, reported, or have the cause of death determined.

In summary, the minimum estimate of the mean annual mortality and serious injury rate incidental to U.S. commercial fisheries for the Mexico-North Pacific stock between 2016 and 2020 (or the most recent data available) is 0.36 humpback whales, based on observer data from Alaska (Table 3: 0.16) and reports (in which the commercial fishery is confirmed) to the NMFS Alaska Region stranding network (Table 4: 0.20).

Other Fisheries

Reports to the NMFS Alaska Region marine mammal stranding network of swimming, floating, or beachcast humpback whales entangled in fishing gear or with injuries caused by interactions with gear within the range of the Mexico-North Pacific stock between 2016 and 2020 included: two (each with a serious injury prorated as 0.75) entanglements in recreational pot fisheries gear, resulting in a minimum mean annual mortality and serious injury rate of 0.3 humpback whales, of which 0.01 were prorated to the Mexico-North Pacific stock; entanglements in Alaska subsistence crab pot gear and in unidentified Alaska subsistence gillnet (each with a serious injury prorated as 0.75), resulting in a minimum mean annual mortality and serious injury rate of 0.3 humpback whales, of which 0.02 were prorated to the Mexico-North Pacific stock; and entanglements in unknown (commercial, recreational, or subsistence) fishing gear, resulting in a minimum mean annual mortality and serious injury rate of 0.85 humpback whales, of which 0.05 were prorated to the Mexico-North Pacific stock (Table 4; Freed et al. 2022).

Fisheries Summary

The minimum estimate of the mean annual mortality and serious injury rate due to interactions with all fisheries between 2016 and 2020 is 0.44 Mexico-North Pacific humpback whales (0.36 in commercial fisheries + 0.01 in recreational fisheries + 0.02 in Alaska subsistence fisheries + 0.05 in unknown fisheries). These estimates of mortality and serious injury levels should be considered minimums. Observers have not been assigned to several fisheries that are known to interact with this stock, making the estimated mortality and serious injury rate an underestimate of actual mortality and serious injury.

Alaska Native Subsistence/Harvest Information

Subsistence hunters in Alaska are not authorized to take humpback whales from this stock. An intentional unauthorized take of a humpback whale by Alaska Natives in Toksook Bay in 2016 resulted in a mean annual mortality and serious injury rate of 0.2 whales between 2016 and 2020 (0.01 prorated to the Mexico-North Pacific stock; Table 4).

Other Mortality

In 2015, increased mortality of large whales was observed along the western Gulf of Alaska (including the areas around Kodiak Island, Afognak Island, Chirikof Island, the Semidi Islands, and the southern shoreline of the Alaska Peninsula) and along the central British Columbia coast (from the northern tip of Haida Gwaii to southern Vancouver Island). NMFS declared an Unusual Mortality Event (UME) for large whales that occurred from 22 May to 31 December 2015 in the western Gulf of Alaska and from 23 April 2015 to 16 April 2016 in British Columbia (https://www.fisheries.noaa.gov/national/marine-life-distress/active-and-closed-unusual-mortality-events, accessed May 2023). Forty-six large whale deaths attributed to the UME included 12 fin whales and 22 humpback whales in Alaska and 5 fin whales and 7 humpback whales in British Columbia. Based on the findings from the investigation, the UME was likely caused by ecological factors (i.e., the 2015 El Niño, Warm Water Blob, and Pacific Coast Domoic Acid Bloom).

Entanglements in marine debris, an ADF&G salmon net pen, and mooring gear reported to the NMFS Alaska Region marine mammal stranding network resulted in minimum mean annual mortality and serious injury rates of 1.15, 0.15, and 0.15 humpback whales (prorated as 0.05, 0.004, and 0.004 Mexico-North Pacific stock humpback whales), respectively, between 2016 and 2020 (Table 4; Freed et al. 2022). The mean minimum annual morality and serious injury due to vessel strikes and other interactions with vessels unrelated to fisheries between 2016 and 2020 is 1.93 humpback whales (prorated as 0.06 Mexico-North Pacific stock humpback whales; Table 4). Neilson et al. (2012) summarized 108 large whale vessel-strike events in Alaska from 1978 to 2011, 25 of which are known to have resulted in the whale's death. Eighty-six percent of these reports involved humpback whales. Most vessel strikes of humpback whales are reported from Southeast Alaska; however, there are also reports from the south-central, Kodiak Island, and Prince William Sound areas of Alaska (Freed et al. 2022). It is not known whether the difference in vessel-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.

Table 4. Summary of mortality and serious injury of humpback whales within the range of the Mexico-North Pacific stock, by year and type, reported to the NMFS Alaska Region marine mammal stranding network and by Marine Mammal Authorization Program (MMAP) fisherman self-reports between 2016 and 2020 (Freed et al. 2022). Injury events lacking detailed injury information are assigned prorated values following injury determination guidelines described in NMFS (2023b). A summary of information used to determine whether an injury was serious or non-serious, as well as a table of prorate values used for large whale reports with incomplete information, is reported in Freed et al. (2022). Total mean annual mortality estimates are prorated to the Mexico-North Pacific stock by multiplying by the area-specific movement probabilities from Table 2. Mean annual estimates are rounded but total estimates are based on unrounded estimates.

Cause of injury	2016	2017	2018	2019	2020	Mean annual mortality - total	Mean estimated annual mortality of Mexico-North Pacific stock
Bering Sea/Aleutian Islands							
Entangled in Bering Sea/Aleutian Is. commercial Pacific cod pot gear	0	1	0	0	0.75[a]	0.35	0.16
Entangled in marine debris	1	0	0	0	0	0.2	0.01
Intentional unauthorized take	1	0	0	0	0	0.2	0.01
Gulf of Alaska							
Entangled in subsistence crab pot gear	0	0	0	0.75	0	0.15	0.02
Entangled in shrimp pot gear*	0	0	0	0.75	0	0.15	0.02
Entangled in unidentified fishing gear*	0	0	1	0	0	0.2	0.02
Entangled in marine debris	1	0	0	0	0	0.2	0.02
Vessel strike by AK/WA/OR/CA commercial passenger fishing vessel	0	0.52	0	0	0	0.1	0.01
Vessel strike by recreational vessel	0.2	0	0	0	0	0.04	0.004
Southeast Alaska							
Entangled in Southeast Alaska commercial salmon drift gillnet (in ADF&G Districts that were not observed in 2012 and 2013)	2.25	0	1.5	0	1.75 + 0.75[b]	1.25	0.03
Entangled in Southeast Alaska commercial pot gear	0	0	0	0	0.75	0.15	0.00
Entangled in unidentified commercial longline gear	0	0	0	0	0.75	0.15	0.00
Entangled in Southeast Alaska recreational shrimp pot gear	0	0	0.75	0	0	0.15	0.00
Entangled in unidentified recreational pot gear	0	0	0	0.75	0	0.15	0.00
Entangled in unidentified subsistence gillnet	0.75	0	0	0	0	0.15	0.00
Entangled in shrimp pot gear*	0	0	0	0.75	0	0.15	0.00
Entangled in unidentified fishing gear*	0	1	0	0.75	0	0.35	0.01
Entangled in marine debris	2.25	0.75	0	0.75	0	0.75	0.02
Entangled in ADF&G salmon net pen	0.75	0	0	0	0	0.15	0.00
Entangled in mooring gear	0.75	0	0	0	0	0.15	0.00
Vessel strike	1	1.34	3	3	0.4	1.75	0.04

Cause of injury	2016	2017	2018	2019	2020	Mean annual mortality - total	Mean estimated annual mortality of Mexico-North Pacific stock
Vessel strike by AK/WA/OR/CA commercial passenger fishing vessel	0	0.2	0	0	0	0.04	0.001
TOTALS							
Total in commercial fisheries						1.90	0.20
Total in recreational fisheries						0.30	0.01
Total in Alaska subsistence fisheries						0.30	0.02
*Total in unknown (commercial, recreational, or subsistence) fisheries						0.85	0.05
Total in marine debris						1.15	0.05
Total due to other causes (entangled in salmon net pen, entangled in mooring gear, vessel strike)						2.23	0.08

[a] Known to be Mexico-North Pacific stock based on known wintering and summering areas.

[b] Animal was entangled in both AK SEAK salmon drift gillnet gear and AK salmon troll gear.

* Unknown if fishery is commercial, recreational, or subsistence.

Historic whaling

Whaling for humpback whales in the North Pacific occurred for centuries, with known hunting areas including Japan, Russia, Alaska, and the west coast of North America (Reeves and Smith 2006). The great majority of catches were made by modern whaling (after 1900), with most catches of humpback whales occurring during two periods, first from 1906 to 1928, and then during the post-World War II years from 1948 to 1966 (Ivashchenko and Clapham 2016). Until recently, the catch record was incomplete because of extensive illegal takes by the USSR (Ivashchenko et al. 2013), but recent work has allowed for the completion of a nearly complete catch record. Approximately 37,000-41,000 humpback whales in total were taken from the North Pacific during whaling from 1656 until 1972, with about 31,000 of those taken during the 20th century (1900-1972) (Ivashchenko and Clapham 2021). Mexico was the only breeding ground which had relatively high catches and was also connected to feeding areas with high catches, making it likely that the breeding populations in Mexico were over-exploited. A total of at least 1,264 whales were caught in the Revillagigedo Archipelago, with all known takes occurring between 1859-1868 and between 1914-1935 (Ivashchenko and Clapham 2021).

Catches of North Pacific humpbacks were prohibited beginning in the 1966 season, but catches were already very low by that time, and it was assumed that all or most North Pacific populations had been greatly over-exploited at that point. Illegal takes of humpbacks in the North Pacific by the USSR continued until 1972 (Ivashchenko and Clapham 2016). Preliminary modeling analyses as part of a Comprehensive Assessment of North Pacific humpback whales by the Scientific Committee of the International Whaling Commission suggest that most breeding populations in the North Pacific were depleted as of 1972 (Ivashchenko et al. 2016), but definitive conclusions cannot be reached until that Comprehensive Assessment is completed.

STATUS OF STOCK

The Mexico-North Pacific stock of humpback whales is one of two stocks that make up the "Mexico DPS" of humpback whales, which are listed as threatened under the ESA (Bettridge et al. 2015, Martien et al. 2021), and is therefore considered "depleted" and "strategic" under the MMPA. Total annual human-caused serious injury and mortality of Mexico-North Pacific humpback whales is the sum of U.S. commercial fisheries (0.36/year), recreational fisheries (0.01/year), Alaska subsistence fisheries (0.02/year), unknown (commercial, recreational, or subsistence) fisheries (0.05/year), marine debris (0.05/year), and other causes (intentional unauthorized removal, vessel strikes, and entanglement in an Alaska Department of Fish and Game (ADF&G) salmon net pen and in mooring gear) (0.08/year), or 0.57 humpback whales annually. PBR is unknown, so it cannot be determined if total commercial fishery mortality and serious injury (0.36/yr) is less than PBR or less than 10% of PBR for this stock. There is no estimate of the undocumented fraction of anthropogenic injuries and deaths to humpback whales in Alaska or in Mexico; on the U.S. West Coast, a comparison of observed vs. estimated annual vessel strikes suggests that approximately 10% of vessel strikes are documented, so reports of such vessel strikes may also be underreported for this stock. The abundance of humpback whales in the Revillagigedo Archipelago, which represents a substantial portion of this stock, was estimated to have increased at an annual rate of 8.8% between 1987-1990 and 2003-2006 (Table 9 in Martinez-Aguilar 2011); no more recent trend data are available for that area.

There are key uncertainties in the assessment of the Mexico-North Pacific stock of humpback whales. The stock is likely composed of multiple DIPs, but currently available data and analyses are not sufficient to delineate or assess DIPs within the stock. There is no current estimate of abundance or trend for this stock and PBR is undetermined. The estimates of human-caused mortality and serious injury from stranding data and fisherman self-reports are underestimates because not all animals strand or are self-reported nor are all stranded animals found, reported, or have the cause of death determined.

HABITAT CONCERNS

Increasing levels of anthropogenic sound in the world's oceans (Andrew et al. 2002), such as those produced by shipping traffic, or Low Frequency Active sonar, is a habitat concern for whales, as it can reduce acoustic space used for communication (masking) (Clark et al. 2009, NOAA 2016). This can be particularly problematic for baleen whales that may communicate using low-frequency sound (Erbe 2016). Based on vocalizations (Richardson et al. 1995; Au et al. 2006), reactions to sound sources (Lien et al. 1990, 1992; Maybaum 1993), and anatomical studies (Hauser et al. 2001), humpback whales also appear to be sensitive to mid-frequency sounds, including those used in active sonar military exercises (U.S. Navy 2007).

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