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

NOTE – December 2015: In areas outside of Alaska, studies of harbor porpoise distribution have indicated that stock structure is likely more fine-scaled than is reflected in the Alaska Stock Assessment Reports. No data are available to define stock structure for harbor porpoise on a finer scale in Alaska. However, based on comparisons with other regions, it is likely that several regional and sub-regional populations exist. Should new information on harbor porpoise stocks become available, the harbor porpoise Stock Assessment Reports will be updated.

STOCK DEFINITION AND GEOGRAPHIC RANGE

In the eastern North Pacific Ocean, harbor porpoise range from Point Barrow and offshore areas of the Chukchi Sea, along the Alaska coast, and down the west coast of North America to Point Conception, California (Gaskin 1984, Christman and Aerts 2015). Harbor porpoise primarily frequent the coastal waters of the Gulf of Alaska and Southeast Alaska (Dahlheim et al. 2000, 2009), typically occurring in waters less than 100 m deep; however, occasionally they occur in deeper waters (Hobbs and Waite 2010). Within the inland waters of Southeast Alaska, harbor porpoise distribution is clumped with greatest densities observed in the Glacier Bay/Icy Strait region and near Zarembo and Wrangell Islands and the adjacent waters of Sumner Strait (Dahlheim et al. 2009, 2015). The average density of harbor porpoise in Alaska appears to be less than that reported off the west coast of the continental U.S., although areas of high densities do occur in Glacier Bay and the adjacent waters of Icy Strait, Yakutat Bay, the Copper River Delta, Sitkalidak Strait (Dahlheim et al. 2000, 2009, 2015; Hobbs and Waite 2010), and lower Cook Inlet (Shelden et al. 2014).

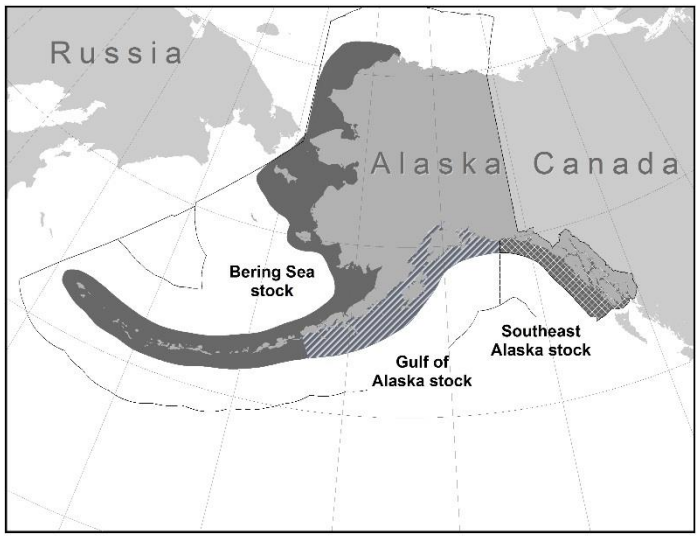

Figure 1. Approximate distribution of harbor porpoise in Alaska waters. The U.S. Exclusive Economic Zone is delineated by a black line.

Stock discreteness in the eastern North Pacific was analyzed using mitochondrial DNA from samples collected along the west coast (Rosel 1992), including one sample from Alaska. Two distinct mitochondrial DNA groupings or clades were found. One clade is present in California, Washington, British Columbia, and the single sample from Alaska (no samples were available from Oregon), while the other is found only in California and Washington. Although these two clades are not geographically distinct by latitude, the results may indicate a low mixing rate for harbor porpoise along the west coast of North America. Investigation of pollutant loads in harbor porpoise ranging from California to the Canadian border also suggests restricted harbor porpoise movements (Calambokidis and Barlow 1991); these results are reinforced by a similar study in the northwest Atlantic (Westgate and Tolley 1999). Further genetic testing of the same samples mentioned above, along with a few additional samples including eight more from Alaska, found differences between some of the four areas investigated, California, Washington, British Columbia, and Alaska, but inference was limited by small sample size (Rosel et al. 1995). Those results demonstrate that harbor porpoise along the west coast of North America are not panmictic and that movement is sufficiently restricted to result in genetic differences (Walton 1997). This is consistent with low movement suggested by genetic analysis of harbor porpoise specimens from the North Atlantic (Rosel et al. 1999). In a genetic analysis of small-scale population structure of eastern North Pacific harbor porpoise, Chivers et al. (2002) included 30 samples from Alaska, 16 of which were from the Copper River Delta, 5 from Barrow, 5 from Southeast Alaska, and 1 sample each from St. Paul, Adak, Kodiak, and Kenai. Unfortunately, no conclusions could be drawn about the genetic structure of harbor porpoise within Alaska because of the insufficient number of samples from each region. Accordingly, harbor porpoise stock structure in Alaska is defined by geographic areas.

Although it is difficult to determine the true stock structure of harbor porpoise populations in the northeast Pacific, from a management standpoint it is prudent to assume that regional populations exist and that they should be managed independently (Rosel et al. 1995, Taylor et al. 1996). Based on the above information, three harbor porpoise stocks in Alaska are currently specified, recognizing that the boundaries of these three stocks are identified primarily based upon geography or perceived areas of porpoise low density: 1) the Southeast Alaska stock - occurring from Dixon Entrance to Cape Suckling, including inland waters (Fig. 1), 2) the Gulf of Alaska stock - occurring from Cape Suckling to Unimak Pass, and 3) the Bering Sea stock - occurring throughout the Aleutian Islands and all waters north of Unimak Pass. There have been no analyses to assess the validity of these stock designations and research to assess substructure is ongoing only within a portion of the Southeast Alaska stock. Preliminary results from the analysis of environmental DNA (eDNA) samples suggested significant genetic differentiation between porpoise concentrations found in Glacier Bay/Icy Strait and around Zarembo/Wrangell Islands (Parsons et al. 2018). Dahlheim et al. (2015) proposed that harbor porpoise in these regions potentially represent different subpopulations based on analogy with other west coast harbor porpoise populations, differences in trends in abundance of the two concentrations, and a possible hiatus in distribution between the two areas. Because eDNA samples were obtained in only one area in the northern region and one area in the southern region, further sampling is needed to better understand substructure within Southeast Alaska, including the connectivity of subpopulations in inland waters and those in adjacent coastal waters. NMFS will consider whether concentrations of harbor porpoise in Glacier Bay/Icy Strait and around Zarembo/Wrangell Islands should be considered "prospective stocks" in a future Stock Assessment Report. Incidental takes from commercial fisheries within a small region (e.g., Wrangell and Zarembo Islands area) are of concern because of the potential impact on undefined localized stocks of harbor porpoise.

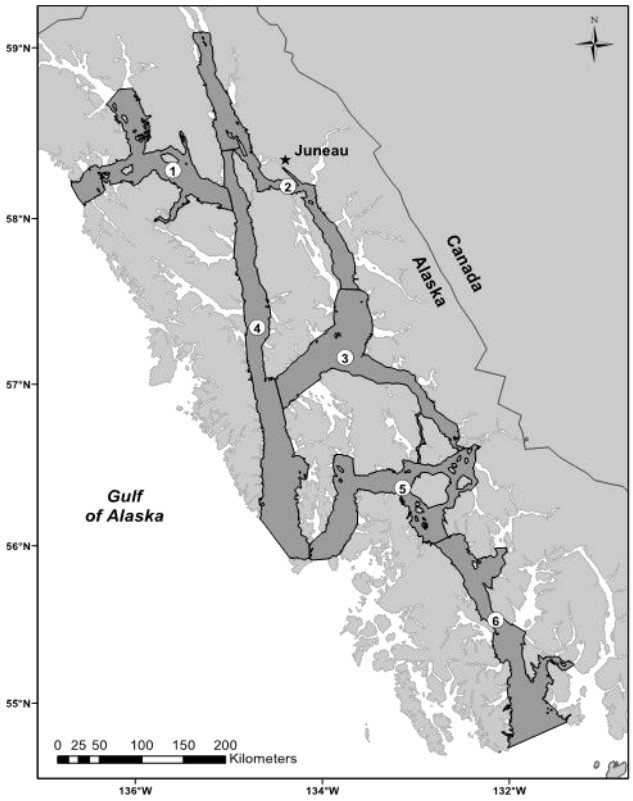

Figure 2. Survey strata defined for line-transect survey effort allocation in Southeast Alaska (as illustrated in Fig. 1 of Dahlheim et al. 2015). The northern region (Areas 1, 2, and 4) includes Cross Sound, Icy Strait, Glacier Bay, Lynn Canal, Stephens Passage, and Chatham Strait; the southern region (Areas 3, 5, and 6) includes Frederick Sound, Sumner Strait, Wrangell and Zarembo Islands, and Clarence Strait as far south as Ketchikan.

POPULATION SIZE

Information on harbor porpoise abundance and relative abundance has been collected for coastal and inside waters of Southeast Alaska by the Alaska Fisheries Science Center's Marine Mammal Laboratory (MML) using both aerial and shipboard surveys. Aerial surveys of this stock were conducted in June and July 1997 and resulted in an observed abundance estimate of 3,766 harbor porpoise (CV = 0.16) (Hobbs and Waite 2010); the surveys included a subset of smaller bays and inlets. Correction factors for observer perception bias and porpoise availability at the surface were used to develop an estimated corrected abundance of 11,146 harbor porpoise (3,766 × 2.96; CV = 0.24) in the coastal and inside waters of Southeast Alaska (Hobbs and Waite 2010).

Relative abundance of harbor porpoise was computed from line-transect surveys carried out in the inland waters of Southeast Alaska in the summers of 1991-1993, 2005-2006, and 2010-2012 (Dahlheim et al 2015). Because these surveys only covered a portion of the inland waters and not the entire range of this stock, they were not used to compute stock-specific estimates of abundance. Relative abundance was found to vary across the 22-year survey period. Abundance estimated in 1991-1993 (N = 1,076; 95% CI = 910-1,272) was higher than the estimate obtained for 2006-2007 (N = 604; 95% CI = 468-780) but comparable to the estimate for 2010-2012 (N =

975; 95% CI = 857-1,109; Dahlheim et al. 2015). There is insufficient information to estimate the probability of detection (g(0)) from the ship surveys in Southeast Alaska; therefore, the abundance estimates above assume the probability of detection directly on the trackline to be unity (g(0) = 1). This assumption is typically violated in harbor porpoise surveys because observers tend to miss animals on the survey trackline. Therefore, the abundances provided by Dahlheim et al. (2015) were corrected using an estimate of g(0) from ship surveys for harbor porpoise off the U.S. east coast (g[0] = 0.72, CV = 0.083: Palka 1995) because the methods used in these surveys (e.g., size of vessels, number of observers) more closely resembled the methods employed in the Southeast Alaska surveys. Estimates corrected for g(0) are N(1991-1993) = 1,494 (95% CI = 1,130-1,974), N(2006-2007) = 839 (95% CI = 494-1,184), and N(2010-2012) = 1,354 (95% CI = 753-1,197).

Using the 2010 to 2012 survey data for the inland waters of Southeast Alaska, Dahlheim et al. (2015) calculated abundance estimates for the concentrations of harbor porpoise in the northern (Areas 1, 2, and 4) and southern (Areas 3, 5, and 6) regions of the inland waters (Fig. 2). The resulting g(0)-corrected abundance estimates are 553 harbor porpoise (CV = 0.13) in the northern inland waters (including Cross Sound, Icy Strait, Glacier Bay, Lynn Canal, Stephens Passage, and Chatham Strait) and 801 harbor porpoise (CV = 0.15) in the southern inland waters (including Frederick Sound, Sumner Strait, Wrangell and Zarembo Islands, and Clarence Strait as far south as Ketchikan).

A line-transect vessel survey was carried out in the inland waters of Southeast Alaska in July/August 2019 and data analysis is underway to compute new estimates of harbor porpoise abundance in this area.

Minimum Population Estimate

For the Southeast Alaska stock of harbor porpoise, the minimum population estimate (N_{MIN}) for the 2010-2012 shipboard surveys is 1,224 porpoise calculated using Equation 1 from the potential biological removal (PBR) guidelines (NMFS 2016): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$, where N = 1,354 (assumes g(0) = 0.72) and CV = 0.12. Since this abundance estimate represents some portion of the total number of animals in the stock, using this estimate to calculate N_{MIN} results in a negatively-biased N_{MIN} for the stock. Although harbor porpoise in the northern and southern regions of the inland waters of Southeast Alaska have not been determined to be subpopulations or stocks, PBR calculations for these areas may provide a frame of reference for comparison to harbor porpoise mortality and serious injury in the portion of the Southeast Alaska salmon drift gillnet fishery that was monitored in 2012 and 2013. The pooled 2010 to 2012 abundance estimates of 553 (CV = 0.13; assumes g(0) = 0.72) for the northern region and 801 (CV = 0.15; assumes g(0) = 0.72) for the southern region results in N_{MINs} of 496 and 707, respectively. Alaska Department of Fish and Game (ADF&G) Districts 6, 7, and 8, where the Southeast Alaska salmon drift gillnet fishery was observed in 2012 and 2013 (Manly 2015), partially overlap porpoise survey areas (Areas 5 and 6: Dahlheim et al. 2015) in the southern region of the inland waters.

Current Population Trend

An analysis of the line-transect vessel survey data collected throughout the inland waters of Southeast Alaska between 1991 and 2010 suggested high probabilities of a population decline ranging from 2 to 4% per year for the whole study area and highlighted a potentially important conservation issue (Zerbini et al. 2011). However, when data from 2011 and 2012 were added to this analysis, the population decline was no longer significant (Dahlheim et al. 2015). It is unclear why a negative trend in harbor porpoise numbers was detected in inland waters of Southeast Alaska between 1991 and 2010 and reversed thereafter (Dahlheim et al. 2015). Regionally, abundance was relatively constant in the northern region of the inland waters of Southeast Alaska throughout the survey period, while declines and subsequent increases were documented in the southern region (Dahlheim et al. 2015).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate (R_{MAX}) is not available for the Southeast Alaska stock of harbor porpoise. Until additional data become available, the cetacean maximum theoretical net productivity rate of 4% will be used (NMFS 2016).

POTENTIAL BIOLOGICAL REMOVAL

PBR is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.5, the value for cetacean stocks with unknown population status (NMFS 2016). Using the N_{MIN} of 1,224 (based on the 2010 to 2012 abundance estimate for harbor porpoise in the inland waters of Southeast Alaska), PBR is 12 harbor porpoise ($1,224 \times 0.02 \times 0.5$).

Computing N_{MINs} and PBRs for harbor porpoise in the northern and southern regions of the inland waters of Southeast Alaska may provide a frame of reference for the observed mortality and serious injury of harbor porpoise in the portion of the Southeast Alaska salmon drift gillnet fishery that was monitored in 2012 and 2013. Based on the pooled 2010 to 2012 abundance estimates and corresponding N_{MINs}, the PBR calculations for the northern and southern regions of the inland waters of Southeast Alaska are 5.0 (N = 553; CV = 0.13; N_{MIN} = 496) and 7.1 (N = 801; CV = 0.15; N_{MIN} = 707) harbor porpoise, respectively.

ANNUAL 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 2014 and 2018 is listed, by marine mammal stock, in Young et al. (2020); however, only the mortality and serious injury data are included in the Stock Assessment Reports. The minimum estimated mean annual level of human-caused mortality and serious injury for Southeast Alaska harbor porpoise between 2014 and 2018 is 34 porpoise in U.S. commercial fisheries; however, this estimate is considered a minimum because not all of the salmon and herring fisheries operating within the range of this stock have been observed. Potential threats most likely to result in direct human-caused mortality or serious injury of this stock include entanglement in fishing gear.

Fisheries Information

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 December 2020).

No mortality or serious injury of harbor porpoise from the Southeast Alaska stock was observed incidental to federally-managed U.S. commercial fisheries in Alaska between 2014 and 2018.

In 2007 and 2008, the Alaska Marine Mammal Observer Program (AMMOP) placed observers in four regions where the state-managed Yakutat salmon set gillnet fishery operates (Manly 2009). These regions included the Alsek River area, the Situk area, the Yakutat Bay area, and the Kaliakh River and Tsiu River areas. Based on four mortalities and serious injuries observed during these 2 years, the estimated mean annual mortality and serious injury rate in the Yakutat salmon set gillnet fishery was 22 harbor porpoise (Table 1). Although these observer data are dated, they are considered the best available data on mortality and serious injury levels in these fisheries.

In 2012 and 2013, the AMMOP placed observers on independent vessels in the state-managed Southeast Alaska salmon drift gillnet fishery in ADF&G Management Districts 6, 7, and 8 to assess mortality and serious injury of marine mammals (Manly 2015). These Management Districts cover areas of Frederick Sound, Sumner Strait, Clarence Strait, and Anita Bay which include, but are not limited to, areas around and adjacent to Petersburg and Wrangell and Zarembo Islands. In 2013, four harbor porpoise were observed entangled and released: two were determined to be seriously injured and two were determined to be not seriously injured. Based on the two observed serious injuries, 23 serious injuries were estimated for Districts 6, 7, and 8 in 2013, resulting in an estimated mean annual mortality and serious injury rate of 12 harbor porpoise in 2012 and 2013 (Table 1). Since these three districts represent only a portion of the overall fishing effort in this fishery, this is a minimum estimate of mortality and serious injury for the fishery.

Table 1. Summary of incidental mortality and serious injury of Southeast Alaska harbor porpoise due to U.S. commercial fisheries between 2014 and 2018 (or the most recent data available) and calculation of the mean annual mortality and serious injury rate (Manly 2009, 2015). Methods for calculating percent observer coverage are described in Appendix 3 of the Alaska Stock Assessment Reports.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean estimated annual mortality
Yakutat salmon set gillnet	2007 2008	obs data	5.3 7.6	1 3	16.1 27.5	22 (CV = 0.54)
Southeast Alaska salmon drift gillnet (Districts 6, 7, and 8)	2012 2013	obs data	6.4 6.6	0 2	0 23	12 (CV = 1.0)
Minimum total estimated annual mortality						34 (CV = 0.77)

A complete estimate of the total mortality and serious injury incidental to U.S. commercial fisheries is not available for this stock because not all of the salmon and herring fisheries operating within the range of this stock have been observed. Based on observed mortality and serious injury in two commercial fisheries (Table 1), the minimum estimated mean annual mortality and serious injury rate incidental to U.S. commercial fisheries between 2014 and 2018 is 34 harbor porpoise.

Alaska Native Subsistence/Harvest Information

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

STATUS OF STOCK

Southeast Alaska harbor porpoise are not designated as depleted under the Marine Mammal Protection Act or listed as threatened or endangered under the Endangered Species Act. The minimum estimated mean annual level of human-caused mortality and serious injury for Southeast Alaska harbor porpoise (34 porpoise) exceeds the calculated PBR (12 porpoise), which means this stock is strategic. The minimum estimated mean annual U.S. commercial fishery-related mortality and serious injury rate (34 porpoise) is more than 10% of the calculated PBR (10% of PBR = 1.2 porpoise), so it is not considered insignificant and approaching a zero mortality and serious injury rate. However, the calculated PBR is likely biased low for the entire stock because it is based on estimates from the 2010 to 2012 surveys of only a portion (the inside waters of Southeast Alaska) of the range of this stock as currently designated. Population trends and status of this stock relative to its Optimum Sustainable Population are currently unknown.

There are key uncertainties in the assessment of the Southeast Alaska stock of harbor porpoise. This stock likely comprises multiple, smaller stocks based on analogy with harbor porpoise populations that have been the focus of specific studies on stock structure. Concentrations of harbor porpoise in the northern and southern regions of the inland waters of Southeast Alaska are identified, and N_{MINs} and PBR levels are calculated for these areas. The trend in abundance of harbor porpoise in these regions is unclear; an early decline appears to have reversed in recent years. Several commercial fisheries overlap with the range of this stock and are not observed or have not been observed in a long time; thus, the estimate of commercial fishery mortality and serious injury is expected to be a minimum estimate.

HABITAT CONCERNS

Harbor porpoise are mostly found in nearshore areas and inland waters, including bays, tidal areas, and river mouths (Dahlheim et al. 2000, 2009, 2015; Hobbs and Waite 2010). As a result, harbor porpoise are vulnerable to physical modifications of nearshore habitats resulting from urban and industrial development (including waste management and nonpoint source runoff) and activities such as construction of docks and other over-water structures, filling of shallow areas, dredging, and noise (Linnenschmidt et al. 2013).

Algal toxins are a growing concern in Alaska marine food webs, in particular the neurotoxins domoic acid and saxitoxin. While saxitoxin was not detected in harbor porpoise samples collected in Alaska, domoic acid was found in 40% (2 of 5) of the samples and, notably, in maternal transfer to a fetus (Lefebvre et al. 2016).

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