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# HARBOR PORPOISE (*Phocoena phocoena*): Gulf of 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, the harbor porpoise ranges 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). 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).

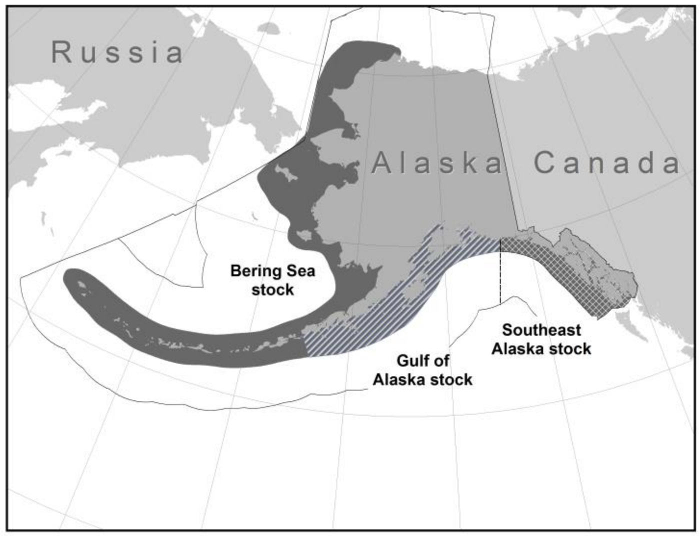


**Figure 1.** Approximate distribution of harbor porpoise in Alaska waters. The U.S. Exclusive Economic Zone is delineated by the solid black line.

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. This is consistent with low movement suggested by genetic analysis of harbor porpoise specimens from the North Atlantic (Rosel et al. 1999). Numerous stocks have been delineated with clinal differences over areas as small as the waters surrounding the British Isles (Walton 1997). In a molecular 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 would be prudent to assume that regional populations exist and that they should be managed independently (Rosel et al. 1995, Taylor et al. 1996). Accordingly, from the above information, three harbor porpoise stocks in Alaska were specified, recognizing that the boundaries of these three stocks were inferred primarily based upon geography or perceived areas of low porpoise density: 1) the Southeast Alaska stock - occurring from Dixon Entrance to Cape Suckling, Alaska, 2) the Gulf of Alaska stock - occurring from Cape Suckling to Unimak Pass, and 3) the Bering Sea stock - occurring throughout the Aleutian Islands and all waters north of Unimak Pass (Fig. 1). There have been no analyses to assess the validity of these stock designations or to assess possible substructure within these stocks.

## POPULATION SIZE

In June and July of 1998 and 1999, an aerial survey covered the waters of the western Gulf of Alaska from Cape Suckling to Unimak Island, offshore to the 1,000 fathom depth contour. Two types of corrections were needed for these aerial surveys: one to correct for animals available but not counted because they were not detected by the observers (perception bias) and another to correct for porpoise that were submerged and not available at the surface (availability bias). The 1998 survey resulted in an abundance estimate for the Gulf of Alaska harbor porpoise stock of 10,489 porpoise (CV = 0.12) (Hobbs and Waite 2010), which includes a correction factor (1.372; CV = 0.07) for perception bias. Laake et al. (1997) estimated the availability bias correction factor for aerial surveys of harbor porpoise in Puget Sound to be 2.96 (CV = 0.18); the use of this correction factor is preferred to other published correction factors (e.g., Barlow et al. 1988, Calambokidis et al. 1993) because it is an empirical estimate of availability bias. Applying this correction factor to the 1998 estimate results in a corrected abundance of 31,046 porpoise (10,489 × 2.96 = 31,046; CV = 0.21) for the Gulf of Alaska stock (Hobbs and Waite 2010).

This latest estimate of abundance (31,046) is considerably higher than the estimate reported in the 1999 stock assessment (8,271; CV = 0.31), which was based on surveys conducted in 1991-1993. This disparity largely stems from changes in the area covered by the two surveys and differences in harbor porpoise density encountered in areas added to, or dropped from, the 1998 survey relative to the 1991-1993 surveys. The survey area in 1998 (119,183 $km^2$) was greater than the area covered in the combined portions of the 1991, 1992, and 1993 surveys (106,600 $km^2$). The 1998 survey included selected bays, channels, and inlets in Prince William Sound, the outer Kenai Peninsula, the south side of the Alaska Peninsula, and the Kodiak Archipelago, whereas, the earlier survey included only open water areas. Several of the bays and inlets covered by the 1998 survey had higher harbor porpoise densities than observed in the open waters. In addition, the 1998 estimate provided by Hobbs and Waite (2010) empirically estimates the perception bias and uses this in addition to the correction factor for availability bias. Finally, the 1998 estimate extrapolates available densities to estimate the number of porpoise which would likely be found in unsurveyed inlets within the study area. For these reasons, the 1998 survey result is probably more representative of the size of the Gulf of Alaska harbor porpoise stock.

### Minimum Population Estimate

The minimum population estimate ($N_{MIN}$) for this stock is calculated using Equation 1 from the potential biological removal (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 31,046 and its associated coefficient of variation (CV) of 0.21, $N_{MIN}$ for the Gulf of Alaska stock of harbor porpoise is 26,064. However, because the survey data are now more than 8 years old, $N_{MIN}$ is considered unknown.

### Current Population Trend

There is no reliable information on trends in abundance for the Gulf of Alaska stock of harbor porpoise since survey methods and results are not comparable.

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate ($R_{MAX}$) is not available for the Gulf of Alaska stock of harbor porpoise. Until additional data become available, the cetacean maximum theoretical net productivity rate of 4% will be used (Wade and Angliss 1997).

## POTENTIAL BIOLOGICAL REMOVAL

PBR is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.5, the value for cetacean stocks with unknown population status (Wade and Angliss 1997). However, the 2016 guidelines for preparing Stock Assessment Reports (NMFS 2016) 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.

## 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 in 2012-2016 is listed, by marine mammal stock, in Helker et al. (in press); however, only the mortality and serious injury data are included in the Stock Assessment Reports. The total estimated annual level of human-caused mortality and serious injury for Gulf of Alaska harbor porpoise in 2012-2016 is 72 porpoise: 72 in U.S. commercial fisheries and 0.2 in unknown (commercial, recreational, or subsistence) fisheries; however, this estimate is considered a minimum because of the absence of observer placements in all of the salmon and herring fisheries operating within the range of this stock. 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 on U.S. commercial fisheries in Alaska waters (including observer programs, observer coverage, and observed incidental takes of marine mammals) is presented in Appendices 3-6 of the Alaska Stock Assessment Reports.

No incidental mortality or serious injury of the Gulf of Alaska stock of harbor porpoise was observed in U.S. federal commercial fisheries in 2012-2016 (Breiwick 2013; MML, unpubl. data). Alaska Marine Mammal Observer Program (AMMOP) observers monitoring the State of Alaska-managed Prince William Sound salmon drift gillnet fishery in 1990 and 1991 recorded 1 mortality in 1990 and 3 in 1991, which extrapolated to 8 (95% CI: 1-23) and 32 (95% CI: 3-103) for the entire fishery, resulting in a mean annual mortality and serious injury rate of 20 porpoise (CV = 0.60) when averaged over 1990 and 1991 (Table 1; Wynne et al. 1991, 1992). The Prince William Sound salmon drift gillnet fishery has not been observed since 1991 and no additional data are available for that fishery.

In 1999 and 2000, AMMOP observers were placed on state-managed Cook Inlet salmon set and drift gillnet vessels. One harbor porpoise mortality was observed in 2000 in the Cook Inlet salmon drift gillnet fishery (Manly 2006). This single mortality extrapolates to an estimated mortality and serious injury rate of 31 porpoise for that year and an average of 16 porpoise per year when averaged over the 2 years of observer data (Table 1).

In 2002 and 2005, AMMOP observers were placed on state-managed Kodiak Island set gillnet vessels. Harbor porpoise mortality observed in this fishery (2 each in both 2002 and 2005) (Manly 2007) extrapolates to an estimated mean annual mortality and serious injury rate of 36 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.

**Table 1.** Summary of incidental mortality and serious injury of Gulf of Alaska harbor porpoise due to state-managed fisheries from 1990 through 2005 and calculation of the mean annual mortality and serious injury rate (Wynne et al. 1991, 1992; Manly 2006, 2007). Methods for calculating percent observer coverage are described in Appendix 6 of the Alaska Stock Assessment Reports.

| Fishery name | Years | Data type | Percent observer coverage | Observed mortality | Estimated mortality | Mean estimated annual mortality |
|---|---|---|---|---|---|---|
| Prince William Sound salmon drift gillnet | 1990<br>1991 | obs data | 4<br>5 | 1<br>3 | 8<br>32 | 20<br>(CV = 0.60) |
| Cook Inlet salmon drift gillnet | 1999<br>2000 | obs data | 1.6<br>3.6 | 0<br>1 | 0<br>31 | 16<br>(CV = 1.00) |
| Cook Inlet salmon set gillnet | 1999<br>2000 | obs data | 0.16-1.1<br>0.34-2.7 | 0<br>0 | 0<br>0 | 0 |
| Kodiak Island salmon set gillnet | 2002<br>2005 | obs data | 6.0<br>4.9 | 2<br>2 | 32<br>39 | 36<br>(CV = 0.68) |
| Minimum total estimated annual mortality | | | | | | 72<br>(CV = 0.44) |

Strandings of marine mammals with fishing gear attached or with injuries caused by interactions with fishing gear are another source of mortality data. In 2012-2016, Gulf of Alaska harbor porpoise mortality in Prince William Sound commercial salmon drift gillnet (1 in 2016) and Cook Inlet commercial salmon drift gillnet (1 in 2013) was reported to the NMFS Alaska Region stranding network and harbor porpoise mortality in Kodiak Island commercial salmon set gillnet (3 in 2012) was reported by Marine Mammal Authorization Program fisherman self-reports (Helker et al. in press). However, extrapolated estimates derived from AMMOP observer data are used to determine the mean annual mortality and serious injury rates for all of these fisheries (Table 1). An additional harbor porpoise mortality from this stock, due to entanglement in unidentified fishing net near Homer, Alaska, was reported to the NMFS Alaska Region stranding network in 2014, resulting in a minimum mean annual mortality and serious injury rate of 0.2 harbor porpoise in unknown (commercial, recreational, or subsistence) fisheries in 2012-2016 (Table 2; Helker et al. in press). This mortality and serious injury estimate results from an actual count of verified human-caused deaths and serious injuries and is a minimum because not all entangled animals strand nor are all stranded animals found, reported, or have the cause of death determined.

**Table 2.** Summary of incidental mortality and serious injury of Gulf of Alaska harbor porpoise, by year and type, reported to the NMFS Alaska Region marine mammal stranding network in 2012-2016 (Helker et al. in press). Only cases of serious injury were recorded in this table; animals with non-serious injuries have been excluded.

| Cause of Injury | 2012 | 2013 | 2014 | 2015 | 2016 | Mean annual mortality |
|---|---|---|---|---|---|---|
| Entangled in unidentified net* | 0 | 0 | 1 | 0 | 0 | 0.2 |
| *Total in unknown (commercial, recreational, or subsistence) fisheries | | | | | | 0.2 |

A complete estimate of the total mortality and serious injury incidental to U.S. commercial fisheries is unavailable for this stock because of the absence of an observer program for all of the salmon and herring fisheries operating within the range of this stock. Based on observed mortality and serious injury in four commercial fisheries (Table 1) and a report to the NMFS Alaska Region stranding network (Table 2), the minimum estimated mean annual mortality and serious injury rate incidental to all fisheries in 2012-2016 is 72 harbor porpoise from this stock (72 in U.S. commercial fisheries + 0.2 in unknown fisheries).

**Alaska Native Subsistence/Harvest Information**

Porpoise in the Gulf of Alaska were hunted by prehistoric societies from Kodiak Island and areas around Cook Inlet and Prince William Sound (Shelden et al. 2014). Subsistence hunters have not been reported to harvest from this stock of harbor porpoise since the early 1900s (Shelden et al. 2014).

## STATUS OF STOCK

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 abundance estimate for this stock is unknown because the existing estimate is more than 8 years old and so the PBR level is considered undetermined. Because the PBR is undetermined and fisheries observer coverage is limited and aged, it is unknown if the minimum estimate of the mean annual mortality and serious injury rate (72 porpoise) in U.S. commercial fisheries can be considered insignificant and approaching zero mortality and serious injury rate. NMFS considers this stock strategic because the level of mortality and serious injury would likely exceed the PBR level if we had a newer abundance estimate and complete fisheries observer coverage. Population trends and status of this stock relative to its Optimum Sustainable Population are unknown.

There are key uncertainties in the assessment of the Gulf of 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. The most recent surveys were more than 8 years ago and, given the lack of information on population trend, the abundance estimates are not used to calculate an $N_{MIN}$ and the PBR level is undetermined. 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. 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**

Harbor porpoise are mostly found in nearshore areas, bays, tidal areas, and river mouths (Dahlheim et al. 2000, 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).

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