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HARBOR PORPOISE (*Phocoena phocoena*): Northern California/Southern Oregon Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

In the Pacific, harbor porpoise are found in coastal and inland waters from Point Conception, California to Alaska and across to Kamchatka and Japan (Gaskin 1984). Harbor porpoise appear to have more restricted movements along the western coast of the continental U.S. than along the eastern coast. Regional differences in pollutant residues in harbor porpoise indicate that they do not move extensively between California, Oregon, and Washington (Calambokidis and Barlow 1991). That study also showed some regional differences within California (although the sample size was small). This pattern stands as a sharp contrast to the eastern coast of the U.S. and Canada where harbor porpoise are believed to migrate seasonally from as far south as the Carolinas to the Gulf of Maine and Bay of Fundy (Polacheck et al. 1995). A phylogeographic analysis of genetic data from northeast Pacific harbor porpoise did not show complete concordance between DNA sequence types and geographic location (Rosel 1992). However, an analysis of molecular variance (AMOVA) of the same data with additional samples found significant genetic differences for four of the six pair-wise comparisons between the four areas investigated: California, Washington, British Columbia, and Alaska (Rosel et al. 1995). These results demonstrate that harbor porpoise along the west coast of North America are not panmictic or migratory, and movement is sufficiently restricted that genetic differences have evolved. Recent preliminary genetic analyses of samples ranging from Monterey Bay, California to Vancouver Island, British Columbia indicate that there is small-scale subdivision within the U.S. portion of this range Chivers *et al.*, 2002, 2007).

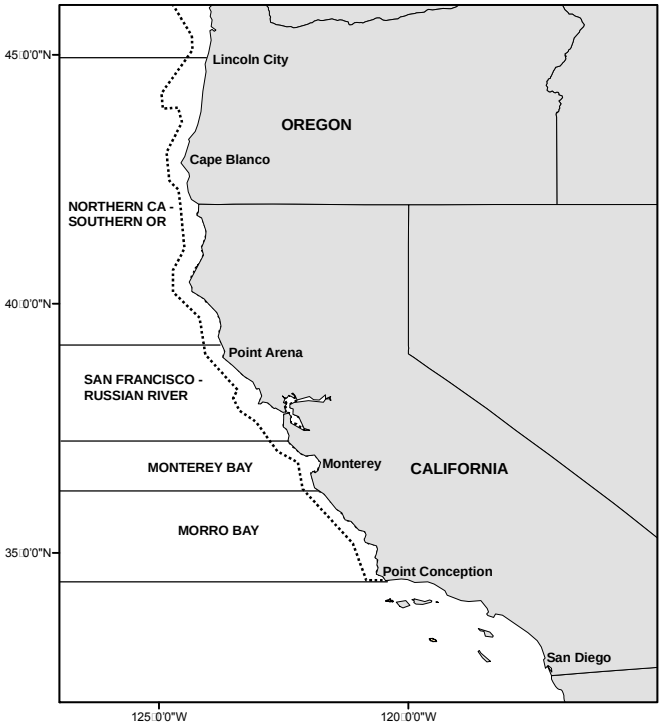

Figure 1. Stock boundaries and distributional range of harbor porpoise along the California/southern Oregon coasts. Dashed line represents harbor porpoise habitat (0-200 m) along the U.S. west coast.

In their assessment of harbor porpoise, Barlow and Hanan (1995) recommended that the animals inhabiting central California (defined to be from Point Conception to the Russian River) be treated as a separate stock. Their justifications for this were: 1) fishery mortality of harbor porpoise is limited to central California, 2) movement of individual animals appears to be restricted within California, and consequently 3) fishery mortality could cause the local depletion of harbor porpoise if central California is not managed separately. Although geographic structure exists along an almost continuous distribution of harbor porpoise from California to Alaska, stock boundaries are difficult to draw because any rigid line is (to a greater or lesser extent) arbitrary from a biological perspective. Nonetheless, failure to recognize geographic structure by defining management stocks can lead to depletion of local populations. Based on recent genetic findings (Chivers *et al.*, 2002, 2007), California coast stocks were re-evaluated and significant genetic differences were found among four identified sampling sites. Revised stock boundaries are presented here based on these genetic data and density discontinuities identified from aerial surveys, resulting in six west coast stocks where previously there had been four (Carretta *et al*. 2001a). These new stock boundaries are shown in Figure 1. The northern boundary of the Northern California/Southern

Oregon stock of harbor porpoise has been moved north to approximately the latitude of Lincoln City, Oregon, based on additional genetic analyses and a recommendation from the Pacific Regional Scientific Review Group to revise the boundary. For the 2002 Marine Mammal Protection Act (MMPA) Stock Assessment Reports, other Pacific coast harbor porpoise stocks include: 1) a Morro Bay stock, 2) a Monterey Bay stock, 3) a San Francisco-Russian River stock, 4) an Oregon/Washington coast stock, 5) an Inland Washington stock, 6) a Southeast Alaska stock, 7) a Gulf of Alaska stock, and 8) a Bering Sea stock. The stock assessment reports for Morro Bay, Monterey Bay, and San Francisco-Russian River, harbor porpoise appear in this volume. The three Alaska harbor porpoise stocks are reported separately in the Stock Assessment Reports for the Alaska Region.

POPULATION SIZE

Previous estimates of abundance for California harbor porpoise were based on aerial surveys conducted between the coast and the 50-fm isobath during 1988-95 (Barlow and Forney 1994, Forney 1999a). These estimates did not include an unknown number of animals found in deeper waters. Barlow (1988) found that the vast majority of harbor porpoise in California were within the 0-50-fm depth range; however, Green et al. (1992) found that 24% of harbor porpoise seen during aerial surveys of Oregon and Washington were between the 100m and 200m isobaths (55 to 109 fathoms). A systematic ship survey of depth strata out to 90 m in northern California showed that porpoise abundance declined significantly in waters deeper than 60 m (Carretta et al. 2001b). A recent analysis of harbor porpoise trends including oceanographic data suggests that the proportion of California harbor porpoise in deeper waters may vary between years (Forney 1999b; see Current Population Trend below). Since 1999, aerial surveys extended farther offshore (to the 200m depth contour or 15 nmi distance, whichever is farther) to provide a more complete abundance estimate. Based on pooled 2002-2007 aerial survey data including data from both inshore and offshore areas, an updated estimate of abundance for the northern California/southern Oregon harbor porpoise stock is 39,581 harbor porpoise (CV=0.39). This estimate represents a combined estimate of aerial surveys completed between 2002-2007 by SWFSC (Carretta et al.2009) and unpublished data from the National Marine Mammal Laboratory.

Minimum Population Estimate

The minimum population estimate for harbor porpoise in northern California/southern Oregon is taken as the lower 20th percentile of the log-normal distribution of the abundance estimate obtained from 2002-2007 aerial surveys, or 28,833 animals. . This estimate includes harbor porpoise within an area extending to the 200m isobath or 15 nmi, whichever is farther from shore.

Current Population Trend

Because the northern boundary of this stock has changed two times in recent years, trends in abundance have been examined only for the northern California portion of this stock. A possible increasing trend in abundance is apparent from surveys conducted between 1989 and 2007, but the trend is not statistically significant (Figure 2).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Based on what are argued to be biological limits of the species (i.e. females give birth first at age 4 and produce one calf per year until death), the theoretical, maximum-conceivable growth rate of a closed harbor porpoise population was estimated as 9.4% per year (Barlow and Boveng 1991). This maximum theoretical rate may not be achievable for any real population. [Woodley and Read (1991) calculate a maximum growth rate of approximately 5% per year, but their argument for this being a maximum (i.e. that porpoise survival rates cannot exceed those of Himalayan thar) is not well justified.] Population growth rates have not actually been measured for any harbor porpoise population. Because a reliable estimate of the maximum net productivity rate is not available for northern California harbor porpoise, we use the default maximum net productivity rate (R_{MAX}) of 4% for cetaceans (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (28,833) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 1.0 (for a species within its Optimal Sustainable Population; Wade and Angliss 1997), resulting in a PBR of 577 .

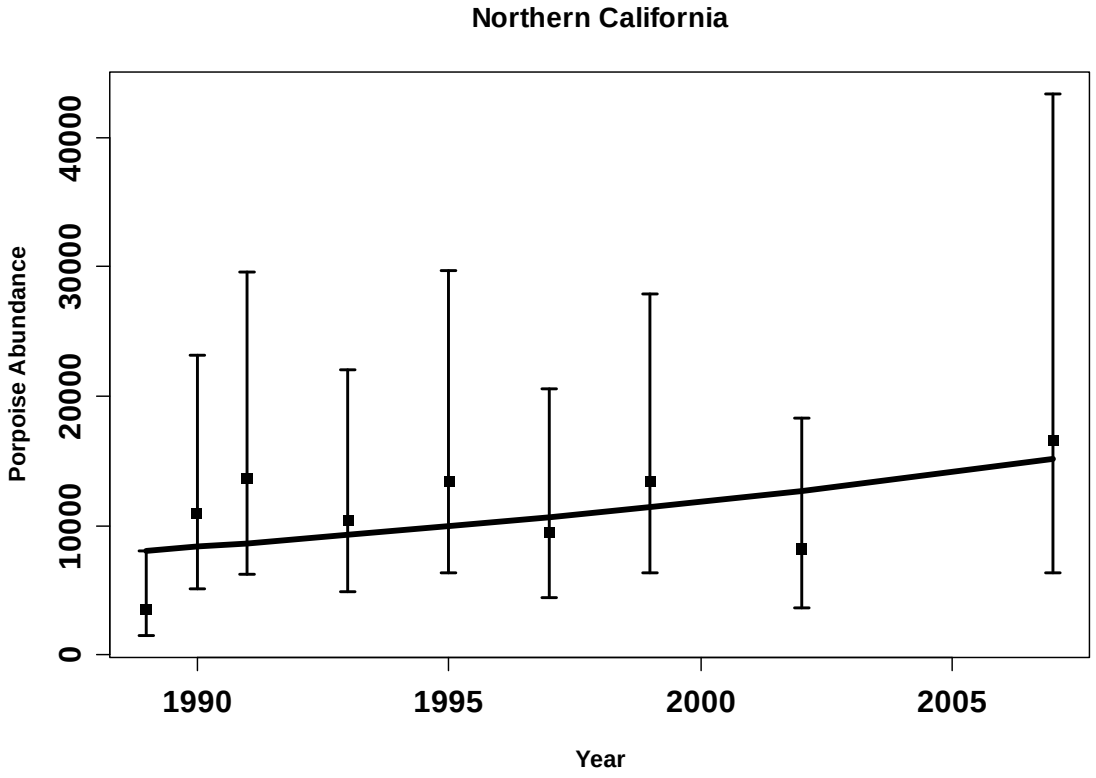

Figure 2. Aerial survey annual estimates of harbor porpoise abundance for the northern California inshore stratum, 1989-2007. Solid line represents a linear regression on the natural logarithim of abundance over time. The slope of this regression is not statistically significant ($p = 0.21$, $r^2=0.22$).

HUMAN-CAUSED MORTALITY

Fishery Information

There were 4 harbor porpoise strandings in this stock's range that showed evidence of interactions with entangling net fisheries between 2003 and 2007. At least two of these were reported to be entangled in river salmon gillnet gear. There has been documented harbor porpoise mortality in the Klamath River tribal salmon gillnet fisheries as recently as 1995. It is possible that recent gillnet-related strandings in this area are attributable to that fishery.

Table 1. Summary of available information on incidental mortality and injury of harbor porpoise (northern CA stock) in fisheries that might take this species. n/a indicates that data are not available.

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed Mortality	Estimated Mortality (CV in parentheses)	Mean Annual Takes (CV in parentheses)
Unknown fishery	2003-2007	Stranding	n/a	4	n/a	≥0.8 (n/a)
Minimum total annual takes						≥0.8 (n/a)

STATUS OF STOCK

Harbor porpoise in northern California/southern Oregon are not listed as threatened or endangered under the Endangered Species Act nor as depleted under the Marine Mammal Protection Act. There are no known habitat issues that are of particular concern for this stock. Because of the lack of recent or historical

sources of human-caused mortality, the harbor porpoise stock in northern California has been concluded to be within their Optimum Sustainable Population (OSP) level (Barlow and Forney 1994). Because the known human-caused mortality or serious injury (≥0.8 harbor porpoise per year) is less than the PBR (577), this stock is not considered a "strategic" stock under the MMPA. Because average annual fishery mortality is less than 10% of the PBR, the fishery mortality can be considered insignificant and approaching zero mortality and serious injury rate.

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