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# HARBOR PORPOISE (*Phocoena phocoena*): Central California 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 are at least nine genetically distinct populations, including two within the present central California stock range (S. Chivers, pers. comm.).

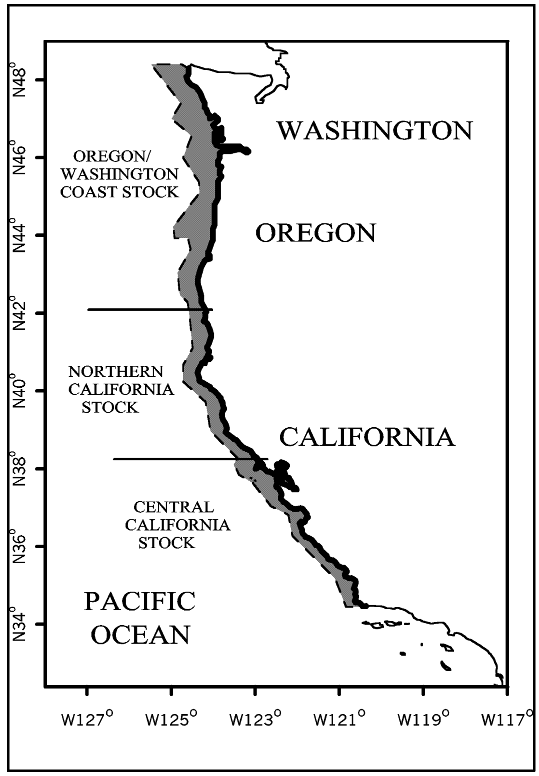


**Figure 1**. Stock boundaries and distributional range of harbor porpoise along the U.S. west coast. Shaded area represents harbor porpoise habitat (0-200 m) along the U.S. west coast.

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. Following the guidance of Barlow and Hanan (1995), we will consider the harbor porpoise in central California as a separate stock. However, based on recent genetic findings (Chivers, pers. comm.), it appears likely that the central California stock will be further subdivided into two stocks (with a division somewhere between Monterey Bay and San Francisco) once the ongoing analyses have been finalized and peer-reviewed. Other U.S. West coast stocks are also likely to be re-evaluated at that time. For the 2000 Marine Mammal Protection Act (MMPA) Stock Assessment Reports, other Pacific coast harbor porpoise stocks include: 1) a northern California stock 2) an Oregon/Washington coast stock, 3) an Inland Washington stock, 4) a Southeast Alaska stock, 5) a Gulf of Alaska stock, and 6) a Bering Sea stock. Stock assessment reports for northern California and the Oregon and Washington stocks appear in this volume. The three Alaska harbor porpoise stocks are reported separately in the Stock Assessment Reports for the Alaska Region.

## POPULATION SIZE

Forney (1999a) estimates the abundance of central California harbor porpoise to be 5,732 (CV=0.39) based on aerial surveys in 1993-97. This estimate is not significantly different from the estimate of 4,120 (CV=0.22) presented by Barlow and Forney (1994). The more recent estimate is less precise, because it was calculated using a more recently developed correction factor for submerged animals (3.42 = 1/g(0) with g(0)=0.292, CV=0.366; Laake et al. 1997); this correction factor is slightly higher than and has a larger estimated variance than the one used by Barlow and Forney (1994; g(0)=0.324, CV=0.173). Both of these estimates only include the region between the coast and the 50-fathom (91m) isobath. Barlow (1988) found that the vast majority of harbor porpoise in California were within this 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 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). Therefore, an unknown number of animals from the central California population may have been in waters deeper than those covered by the surveys in 1993-97, and the above abundance estimate may underestimate the total population size by an unknown amount. Additional aerial surveys are planned in 1999 to cover waters deeper than 50 fathoms (91 m), and the results are expected to shed light on the magnitude of this potential bias.

### Minimum Population Estimate

The minimum population estimate for harbor porpoise in central California is taken as the lower 20th percentile of the log-normal distribution of the abundance estimated from the 1993-97 aerial surveys (Forney 1999a) or 4,172.

### Current Population Trend

Analyses of a 1986-95 time series of aerial surveys have been conducted to examine trends in harbor porpoise abundance in central California (Forney, 1995; 1999b). After controlling for the effects of sea state, cloud cover, and area on sighting rates, Forney (1995) found a negative trend in population size; however, that trend was no longer significant when sea surface temperature (a proxy measure of oceanographic conditions) was included in an updated non-linear trend analysis (Forney 1999b). The negative correlation between harbor porpoise sighting rates and sea surface temperatures indicates that apparent trends could be caused by changing oceanographic conditions and movement of animals into and out of the study area. Encounter rates for the 1997 survey, however, were very high (Forney 1999a) despite the warmer sea surface temperatures caused by strong El Niño conditions. These observations suggest that patterns of harbor porpoise movement are not directly related to sea surface temperature, but rather to the more complex distribution of potential prey species in this area.

## 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 central California harbor porpoise, it is recommended that the cetacean maximum theoretical net productivity rate ($R_{MAX}$) of 4% (Wade and Angliss 1997) be employed.

## POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (4,172) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a species of unknown status and a mortality rate CV#0.30; Wade and Angliss 1997), resulting in a PBR of 42.

## HUMAN-CAUSED MORTALITY

### Fishery Information

The incidental capture of harbor porpoise is largely limited to the halibut set gillnet fishery in central California (coastal setnets are not allowed in northern California, and harbor porpoise do not occur in southern California). Detailed information on this fishery is provided in Appendix 1. A summary of estimated fishery mortality and injury for this stock of harbor porpoise is given in Table 1. The mortality estimate for 1994 is based on actual 1994 observer data (Julian and Beeson 1998). At the end of 1994, however, the observer program was discontinued, and mortality estimates for 1995-98 are therefore based on total estimated fishing effort and prior-year entanglement rate data. Forney et al. (in press) evaluated uncertainties in estimating mortality for unobserved years, and presented several alternate analyses of harbor porpoise mortality for this fishery. Their analysis ‘C’, which includes data from both a 1987-90 California Department of Fish and Game observer program and a 1990-94 National Marine Fisheries Service observer program, best captures the range of variability in entanglement rates and is most consistent with the patterns observed more recently in the 1999 observer program (for which only preliminary results are available at this time; Table 1). Analysis ‘C’ is also stratified to reflect regional differences in bycatch rates between Monterey Bay and Morro Bay. Table 1 includes the 1995-98 mortality estimates from analysis ‘C’ in Forney et al. (in press), as was recommended by the Pacific Scientific Review Group at their December 1999 meeting. Although mortality estimates for the most recent five years (1994-98) are presented in Table 1, average annual takes in the setnet fishery are calculated using only 1996-98 data, because fishing effort approximately doubled after 1995, and the majority of recent effort has taken place in the southern areas of Monterey Bay, where very little effort took place prior to 1996.

**Table 1.** Summary of available information on incidental mortality and injury of harbor porpoise (central CA stock) in commercial fisheries that might take this species (Julian and Beeson 1998; Forney et al., in press; NMFS/SWFSC, unpublished data). Mean annual takes are based on 1994-98 data unless noted otherwise. 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) |
|---|---|---|---|---|---|---|
| **CA angel shark / halibut and other species large mesh (>3.5") set gillnet fishery** | 1994 | observer data | 7.7% | 1 | 14 (0.96) | 62 (0.19) [1] |
| | 1995<br>1996<br>1997<br>1998 | 1987-90<br>and<br>1990-94<br>observer data | 0%<br>0%<br>0%<br>0% | -<br>-<br>-<br>- | 42 (0.19)<br>48 (0.19)<br>80 (0.19)<br>57 (0.19) | |
| | 1999 | Prelim. 1999 observer data | 22.0% | 27 | approx. 123 (n/a) for Jan-September | |
| **Unknown fishery** | 1994-98 | Strandings | - | 3 (in 1998) | n/a | $0.60 (n/a) |
| **Minimum total annual takes** | | | | | | 63 (0.19) |

Only 1996-98 mortality estimates are included in the average because of changes in the distribution and amount of fishing effort after 1995 (see text).

The revised mortality data indicate that an average of 63 harbor porpoise (CV= 0.19) have been killed each year in central California during the period 1996-98. An observer program was initiated in the Monterey Bay area in April 1999, and the preliminary mortality estimate for January-September 1999 is 123 harbor porpoise (27 mortalities observed in 22% of total effort; NMFS, unpublished data). Thus, it appears that entanglement rates have increased substantially since the early 1990's.

Two harbor porpoise mortalities were inaccurately reported in Marine Mammal Authorization Permit (MMAP) fisher self-reports for the California drift gillnet fishery during 1996-98. Both of the mortalities occurred on an observed fishing trip and were actually short-beaked common dolphins (NMFS, Southwest Fisheries Science Center, unpublished data). This fishery has not previously been known to take harbor porpoise.

Three fishery-related harbor porpoise strandings were reported in central California in 1998, north of the known set gillnet fishing areas: two near Bodega Head and one inside San Francisco Bay (NMFS, Southwest Region, unpublished data). These mortalities were probably taken from the central California harbor porpoise stock, although it is possible that the northern two animals were taken from the northern California stock and drifted southward to the stranding location. Efforts are underway to identify possible fisheries responsible for these mortalities. Based on experience with other fisheries (e.g. the set gillnet fishery), the proportion of incidentally killed animals that strand is generally only a fraction of the total mortality, and therefore these unidentified fisheries are likely to have taken more than the three observed harbor porpoise.

## STATUS OF STOCK

Harbor porpoise in California are not listed as threatened or endangered under the Endangered Species Act nor as depleted under the Marine Mammal Protection Act. Barlow and Hanan (1995) calculate the status of harbor porpoise relative to historic carrying capacity (K) using a technique called back-projection. They calculate that the central California population could have been reduced to between 30% and 97% of K by incidental fishing mortality, depending on the choice of input parameters. They conclude that there is no practical way to reduce the range of this estimate. New information does not change this conclusion, and the status of harbor porpoise relative to their Optimum Sustainable Population (OSP) levels in central California must be treated as unknown. The average annual mortality for 1996-98 (63 harbor porpoise) is greater than the calculated PBR (42) for central California harbor porpoise; therefore, the central California harbor porpoise population is "strategic" under the MMPA. Based on the success of pingers for reducing harbor porpoise mortality in east coast fisheries (Kraus et al. 1997; Trippel et al. 1999), efforts are presently underway to encourage voluntary use of pingers in the central California halibut set gillnet fishery. The observer program is scheduled to continue and will provide information on the success of any voluntary measures. *On September 13, 2000, the California Department of Fish and Game (CDFG) restricted fishing in the central California halibut set gillnet fishery to waters deeper than 60 fathoms, citing concerns over the continued mortality of common murres and decline of the southern sea otter population. The closure area extends from Point Reyes to Yankee Point in Monterey County and from Point Arguello to Point Sal in Santa Barbara County. The area from Yankee Point to Point Sal will remain open to halibut fishing outside of 30 fathoms. This closure is effective for 120 days and may be extended or reissued by the CDFG. The exclusion of this fishery from inshore waters less than 60 fathoms is expected to considerably reduce the mortality of harbor porpoise in Monterey Bay.* Research activities will continue to monitor the population size and to investigate population trends. The average gillnet mortality for 1996-98 (63 porpoise per year) is greater than the calculated PBR; therefore, the fishery mortality cannot be considered insignificant and approaching zero mortality and serious injury rate. There are no known habitat issues that are of particular concern for this stock.

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