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HARBOR PORPOISE (*Phocoena phocoena*): Morro Bay 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 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. Subsequent 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).

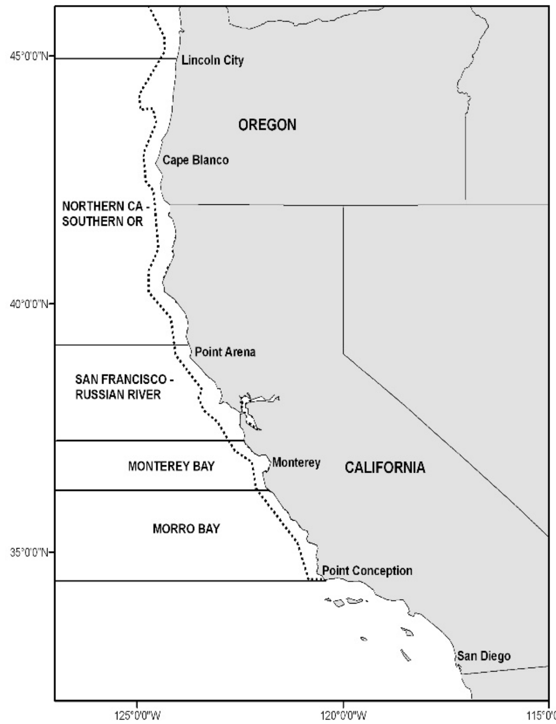

Figure 1. Stock boundaries and distributional range of harbor porpoise along the California and southern Oregon coasts. Dashed line represents harbor porpoise habitat (0-200 m) in this region.

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 was 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 more recent genetic findings (Chivers *et al.*, 2002, 2007), California coast stocks were re-evaluated, and significant genetic differences were found among 4 identified sampling sites. Revised stock boundaries are presented here based on these genetic data and density discontinuities identified from aerial surveys, resulting in six California/Oregon/Washington stocks where previously there had been four (Carretta *et al.* 2001a). The stock boundaries for animals that occur in California/southern Oregon waters are shown in Figure 1. For the Marine Mammal Protection Act (MMPA) Stock Assessment Reports, Pacific coast harbor porpoise stocks include: 1) a Monterey Bay stock, 2) a San Francisco-Russian River stock, 3) a northern California/southern Oregon stock, 4) a northern 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. Stock assessment reports for harbor porpoise stocks within waters of California, Oregon, and Washington 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 1999). 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). Since 1999, aerial surveys have extended farther offshore (to the 200 m depth contour or a minimum of 10 nmi from shore in the region of the Morro Bay stock) to provide a more complete abundance estimate (Forney *et al.* 2014). A recent analysis of long-term trends in the Morro Bay harbor porpoise population (Forney *et al.* 2019) between 1986 and 2012 estimated a population size of 4,255 (CV=0.562) porpoises during 2012. This estimate includes a correction factor of 3.42 (1/*g*(0); g(0)=0.292, CV=0.366) (Laake *et al*. 1997) to adjust for groups missed by aerial observers, and it is the most recent estimate available for this stock.

Minimum Population Estimate

The minimum population estimate for the Morro Bay harbor porpoise stock is taken as the lower 20th percentile of the log-normal distribution of the abundance estimated from the 2012 aerial surveys, or 2,737 animals.

Current Population Trend

A hierarchical Bayesian analysis of harbor porpoise trends between 1986 and 2012 (Forney *et al.* 2019) showed a marked increase in population size after 1991, when gillnet bycatch was largely eliminated within the range of the Morro Bay stock (Figure 2). This study also concludes that unmonitored harbor porpoise bycatch extending back as far as the 1950s likely decimated this population to a greater extent than previously understood.

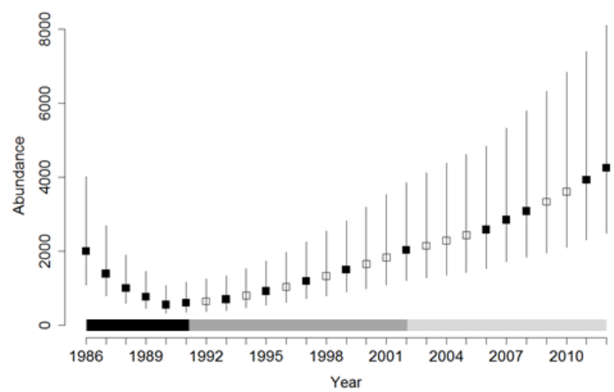

Figure 2. Population trends for the Morro Bay harbor porpoise stock, 1986-2012 (from Forney *et al.* 2019). Estimates represent median abundance (with 95% credible intervals) for years with survey effort (solid symbols) and without survey effort (open symbols). Shaded bars along the x-axis reflect the relative level of gillnet bycatch: high (black), low to moderate (dark gray), or none (light gray).

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 based on a human survivorship curve (Barlow and Boveng 1991). This is very similar to the growth rate of 9.7% per year (95% credible interval: 6.4% - 13.2%) estimated by Forney *et al.* (2019) for the Morro Bay harbor porpoise stock between 1991 and 2012, based on long-term aerial surveys. This estimated growth rate can be considered a maximum net productivity rate, because this stock was estimated to include only 560-600 porpoises when gillnet bycatch was reduced to low levels in 1991, and by 2012 the population had increased to over 4,000 individuals.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (2,737) <u>times</u> one half the estimated maximum net growth rate for this stock of harbor porpoise (½ of

9.7%) times a recovery factor of 0.5 (for a stock of unknown status; Wade and Angliss 1997), resulting in a PBR of 66.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Gillnet fisheries for halibut and white seabass that historically operated in the vicinity of Morro Bay were eliminated in this stock's range in 2002 by a ban on gillnets inshore of 60 fathoms (~110 m) from Point Arguello to Point Reyes, California. The large-mesh drift gillnet fishery for swordfish and thresher shark operates too far offshore to interact with harbor porpoise in this region. In the most recent five-year period (2013-2017), one fishery-related stranding of harbor porpoise was documented south of this stock's primary range (in 2013, Table 1, Carretta *et al.* 2019). The responsible fishery has not been identified.

Table 1. Summary of available data on incidental mortality and serious injury of Morro Bay Stock harbor porpoise in commercial fisheries that might take this species. Mean annual takes are based on 2007-2011 data, Carretta *et al.* (2019). n/a indicates that data are not available.

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed Mortality	Kill/Day	Estimated Mortality (CV in parentheses)	Mean Annual Takes (CV in parentheses)
Unidentified net fishery	2013-2017	Stranding	n/a	1	n/a	≥1	≥ 0.2 (n/a)
Minimum total annual takes							≥ 0.2 (n/a)

Other Mortality

One harbor porpoise that was entangled in marine debris (a plastic bag) stranded in San Diego County and was attributed to the Morro Bay stock (Carretta *et al.* 2019), resulting in an average of ≥ 0.2 non-fishery, human-caused harbor porpoise deaths per year.

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 (including Morro Bay, Monterey Bay, and San Francisco-Russian River stocks) 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. Although Forney *et al*. 2019 documented a marked increase in the Morro Bay harbor porpoise stock, the carrying capacity of this stock is not known and the population status relative to Optimum Sustainable Population (OSP) levels must be treated as unknown.

Because the known human-caused mortality or serious injury (≥ 0.4 harbor porpoise per year) is less than the PBR (66), this stock is not considered a "strategic" stock under the MMPA, and fishery mortality can be considered insignificant and approaching zero mortality and serious injury rate. Harbor porpoises are sensitive to disturbance by a variety of anthropogenic sound sources, and the limited range of several U.S. West Coast harbor porpoise stocks makes them particularly vulnerable to potential impacts (see overview in Forney *et al*. 2017). A recent habitat concern along the U.S. West coast includes the use of acoustic deterrent devices ('seal bombs') that are used in commercial fishing activities off California (Simonis *et al*. 2020), especially in the Monterey Bay region.

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