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HARBOR PORPOISE (*Phocoena phocoena*): Monterey 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 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).

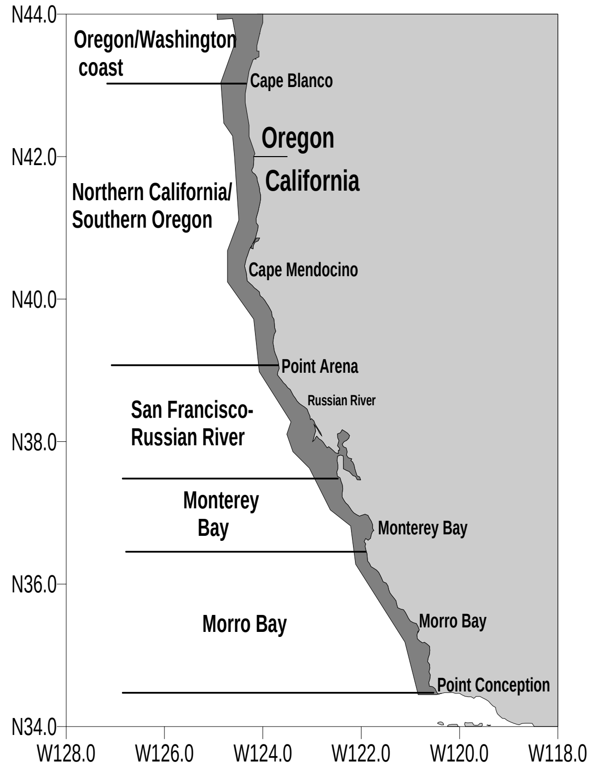

Figure 1. Stock boundaries and distributional range of harbor porpoise along the California/southern Oregon coast. Shaded area represents harbor porpoise habitat (0-200 m) along the U.S. west coast.

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. Based on recent genetic findings (Chivers, *et al*. 2002), 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 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 2002 Marine Mammal Protection Act (MMPA) Stock Assessment Reports, other Pacific coast harbor porpoise stocks include: 1) a Morro Bay stock, 2) a San Francisco-Russian River stock, 3) a northern California/southern Oregon stock, 4) an Oregon/Washington coast stock, 5) a Washington Inland waters stock, 6) a Southeast Alaska stock, 7) a Gulf of Alaska stock, and 8) a Bering Sea stock. Stock assessment reports for Morro Bay, San Francisco-Russian River, northern California/southern Oregon, Oregon/Washington coast, and Inland Washington waters 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). In 1999, aerial surveys extended farther offshore (to the 200m depth contour or a minimum of 15 nmi from shore in the region of the Monterey Bay stock) to provide a more complete abundance estimate. Based on aerial surveys from 1997-99 under good survey conditions (Beaufort ≤ 2, cloud cover $\leq 25\%$) the estimate of abundance for this stock is 1,603 animals (CV = 0.42) (Carretta 2003).

Minimum Population Estimate

The minimum population estimate for the Monterey Bay harbor porpoise stock is taken as the lower 20th percentile of the log-normal distribution of the abundance estimated from the 1997-99 aerial surveys, or 1,142 animals.

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. Although encounter rates during the 1999 aerial survey were again higher than in past years, the trend in relative abundance (following methods of Forney 1995) is not statistically significant (p=0.12, Figure 2). More detailed studies of encounter rate patterns in relation to satellite-derived sea surface temperature during 1993-99 are planned to shed light on potential oceanography-related movement patterns of harbor porpoise in this region.

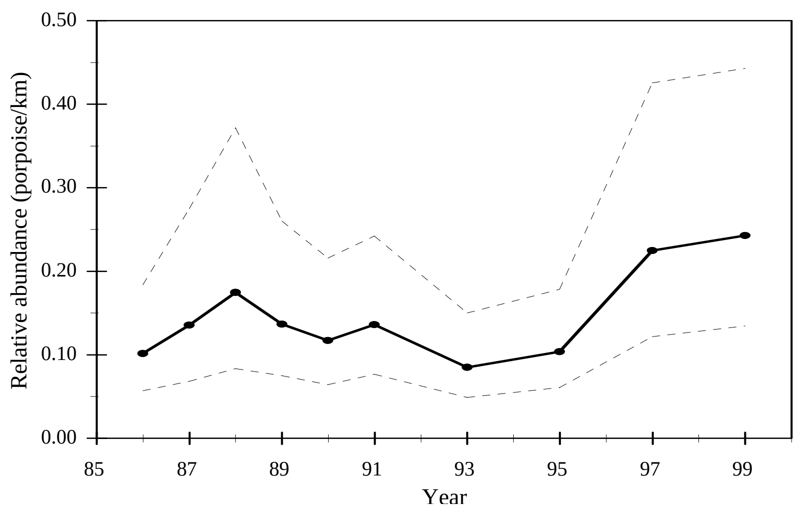

Figure 2. Relative abundance (+/- one standard error) of central California harbor porpoise, 1986-99, adjusted for sea state and cloud cover (following methods of Forney 1995). The trend shown includes the range of three California stocks (Morro Bay, Monterey Bay, and San Francisco-Russian River)

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 Monterey Bay 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 (1,143) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.5 (for a species of unknown status; Wade and Angliss 1997), resulting in a PBR of 11.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

The incidental capture of Monterey Bay harbor porpoise is largely limited to the halibut angel shark set gillnet fishery. 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. Mortality estimates for 1997-98 are based on total estimated fishing effort and prior-year entanglement rate data (Julian and Beeson 1998), because no observer program was in place during those years. Mortality estimates for 1999-2001 are based on a National Marine Fisheries Service monitoring program in Monterey Bay (Cameron and Forney 2000, Carretta 2001; Carretta 2002). Although mortality estimates for the most recent five years (1997-2001) are presented in Table 1, average annual takes in the setnet fishery are estimated using only 2001 data, because the fishery was largely closed under emergency regulations after September 2000. The closure was made permanent in September 2002. An average of 3 harbor porpoise (CV= 0.50) were killed in this fishery in Monterey Bay during 2001.

Table 1. Summary of available on incidental mortality and injury of harbor porpoise (central CA stock 1997-98; Monterey Bay stock 1999-2001) in commercial fisheries that might take this species (Cameron and Forney 2000, Carretta 2001, Carretta 2002, Forney et al., 2001). Mean annual takes are based on 2001 data because of fishery restrictions implemented in late 2000. 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)
CA angel shark / halibut and other species large mesh (>3.5") set gillnet fishery	1997	1990-94 observer data	0%	-	-	80 (0.19)	3 (0.77)[1]
	1998		0%	-	-	57 (0.19)	
	1999	observer data	23.0%	28[2]	0.17	133 (0.23)[2]	
	2000		27.0%	7	0.10	26 (0.50)	
	2001	2000 observer data	0%	-	0.10	3 (0.77)	
	2002	Fishery closed					
Minimum total annual takes							3 (0.77)[1]

[1]Only 2001 mortality estimates are included in the average because the fishery was largely closed under emergency regulations in September 2000. The closure was made permanent in September 2002.

[2] This includes one unidentified cetacean that was almost certainly a harbor porpoise; without this animal the mortality estimate would be 128 (CV=0.23).

All central California nearshore gill and trammel net fisheries were restricted by a series of emergency closures beginning in September 2000, because of concern over mortality of Common Murres and a decline in the southern sea otter population. During the emergency closures, fishing was prohibited in waters less than 60 fathoms in the region of the Monterey Bay harbor porpoise stock. Following a brief lapse in the closure in late 2001, the restrictions were reinstated in January 2002. A permanent ban on the use of gill and trammel nets in all ocean waters 60 fathoms or less between Point Reyes (Marin County) and Point Arguello (Santa Barbara County) was implemented on September 4,

2002. The ban is expected to virtually eliminate bycatch of Monterey Bay harbor porpoise in these gillnet fisheries, because this species is primarily found in waters shallower than 60 fathoms.

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.

Five fishery-related stranding mortalities of harbor porpoise were documented within the range of the Monterey Bay harbor porpoise stock: one in 1998 near Watsonville, two in 1999 near Seaside and Pacific Grove, and two in 2000 at Año Nuevo State Reserve and near Santa Cruz. These mortalities probably originated from the halibut set gillnet fishery in Monterey Bay, and are thus accounted for in the mortality estimates for this fishery.

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 annual mortality for 2001, after implementation of the emergency closure for central California gillnet fisheries, was 3 harbor porpoise, which is less than the calculated PBR (11) for Monterey Bay harbor porpoise; therefore, the Monterey Bay harbor porpoise population is not considered "strategic" under the MMPA. A permanent set gillnet closure inside of 60 fathoms was implemented in September 2002, effectively eliminating set gillnets from most harbor porpoise habitat in the region of this stock. This is expected to virtually eliminate gillnet mortality of Monterey Bay harbor porpoise. Although in recent years the average fishery mortality exceeded the PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and injury rate, it is likely that this goal will be met following the 2002 permanent gillnet closure. Research activities will continue to monitor the population size and to investigate population trends. There are no known habitat issues that are of particular concern for this stock.

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