Revised 10/31/2002 (new stock)

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 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).

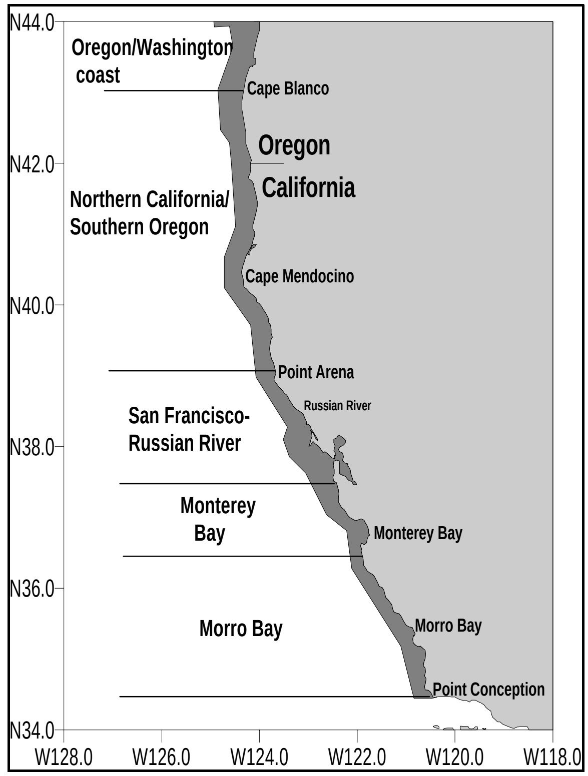

Figure 1. Stock boundaries and distributional range of harbor porpoise along the California/southern Oregon coast. Shaded area represents harbor porpoise habitat (0-200 m) along the U.S. west coast.

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 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 2002 Marine Mammal Protection Act (MMPA) Stock Assessment Reports, other 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) 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. Stock assessment reports for Monterey 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 15 nmi distance, whichever is farther) 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 932 animals (CV = 0.41).

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 1997-99 aerial surveys, or 669 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.

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 Morro Bay harbor porpoise, we use the default maximum net productivity rate (R_{MAX}) of 4% for cetaceans (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 (669) <u>times</u> one half the default maximum net growth rate for cetaceans (½ of 4%) <u>times</u> a recovery factor of 0.5 (for a stock of unknown status; Wade and Angliss 1997), resulting in a PBR of 7.

HUMAN-CAUSED MORTALITY

Fishery Information

The set gillnet fishery for halibut and angel shark operates in the vicinity of Morro Bay and fishing effort here has steadily increased in recent years. California Department of Fish and Game (CDFG) estimated fishing effort for 1996-2001 is 32, 88, 139, 121, 284, and 375 days respectively. The preliminary 2001 estimate of 375 days represents the first three calendar quarters only. Mortality rates of harbor porpoise in the set gillnet fishery in this region are available only from 43 trips observed between 1990-94 (Julian and Beeson 1998), in which one harbor porpoise was killed. This represents a kill rate of 0.023 porpoise/day fished (bootstrap CV = 0.97). Applying this kill rate to the 2001 estimate of fishing effort results in a mortality estimate of 9 porpoise (0.023 * 375 days) through the first three quarters of 2001, which exceeds PBR. Projected mortality levels based on this kill rate and effort levels for 1996-2001 are summarized in Table 1. It should be noted that this kill rate includes sets made in less than 30 fathoms of water, where the potential to entangle porpoise is probably higher. The fishery is now prohibited from fishing inside of 30 fathoms and thus the kill rate may be biased upward if current fishing effort is in compliance with this area closure. However, the kill rate of 0.023 porpoise/day still represents the best available information since the fishery has not been observed in this region since 1994. The white seabass set gillnet fishery also operates in the vicinity of Morro Bay and this fishery has been documented to take harbor porpoise in the past (Norris and Prescott 1961). Effort in the white seabass fishery in the vicinity of Morro Bay for the last five years (1997-2001) has been 0, 26, 7, 61, and 132 days respectively.

In September 2000, the CDFG issued emergency regulations which 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 extended from Point Reyes (N38) to Yankee Point (N36.5) in Monterey County and from Point Arguello (N34.6) to Point Sal (N34.9) in Santa Barbara County (the area from Yankee Point to Point Sal remained open to fishing outside of 30 fathoms). In April 2001, CDFG proposed permanent year-round regulations to eliminate set gillnet fishing inshore of 60 fathoms from Point Reyes to Point Arguello. The emergency closure inside of 60 fathoms has since lapsed and at least several vessels have moved to the Morro Bay area from Monterey since the initial closure. CDFG intends to make permanent a 60-fathom closure for the set gillnet fishery from Point Reyes to Point Arguello by May 2002.

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.

STATUS OF STOCK

Based on the last 5 years of fishing effort (1996-2000), mean annual takes are 3.2 porpoise per year, which is less than the PBR of 7 animals, resulting in a “non-strategic” classification. However, fishing effort more than doubled between 1999 and 2000 and has continued to increase in 2001. With current levels of fishing effort, estimated porpoise mortality in 2000 and 2001 would meet or exceed PBR (7 and 9 animals respectively, see Table 1). However, confidence in any mortality estimate for this stock is low, as the kill rate is based on only 43 observed trips between 1990-94 and one observed porpoise mortality in 1990, when the fishery was still permitted to operate inshore of 30 fathoms. With increasing fishing

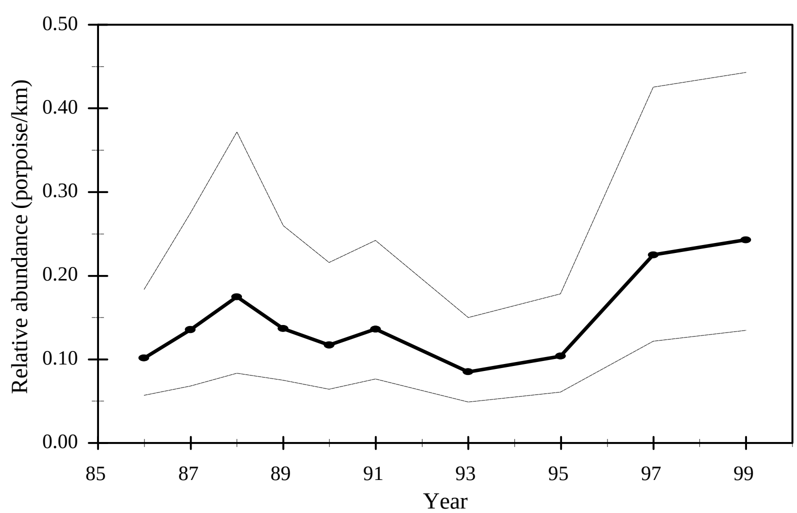

Figure 2. Relative abundance (+/- one standard error) of central California (Pt. Conception to Russian River) harbor porpoise, 1986-99, adjusted for sea state and cloud cover (following methods of Forney 1995). The trend shown includes the range of three California stocks (Morro Bay, Monterey Bay, and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

effort and no observer program in place, the total fishery mortality for this stock cannot be considered to be insignificant and approaching zero mortality and serious injury rate. A permanent set gillnet closure inside of 60 fathoms is expected to be in place by May 2002 which would effectively eliminate set gillnets from most harbor porpoise habitat and reduce mortality to near zero. 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.

Table 1. Summary of available information on incidental mortality and injury of harbor porpoise (Morro Bay stock) in commercial fisheries that might take this species (Cameron and Forney 2000, Carretta 2001, Forney et al., 2001; NMFS/SWFSC, unpublished data). Mean annual takes are based on 1996-2000 data unless noted otherwise.

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	1996 1997 1998 1999 2000 2001[1]	1990-94 observer data	0% 0% 0% 0% 0% 0%	- - - - - -	0.023[2]	1 (0.97) 2 (0.97) 3 (0.97) 3 (0.97) 7 (0.97) 9 (0.97)[1]	3.2 (0.97)[3]
Minimum total annual takes							3.2 (0.97)[3]

[1]Estimate of mortality is based on preliminary effort estimates for the first three calendar quarters of 2001.
[2]Mortality rate is based on 1 observed mortality from 43 observed trips in this region between 1990-94.
[3]Mean annual takes are based on 1996-2000 effort data and 1990-94 kill rates. Mean annual takes using 1997-2001 data would be 5.0 animals.

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