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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.

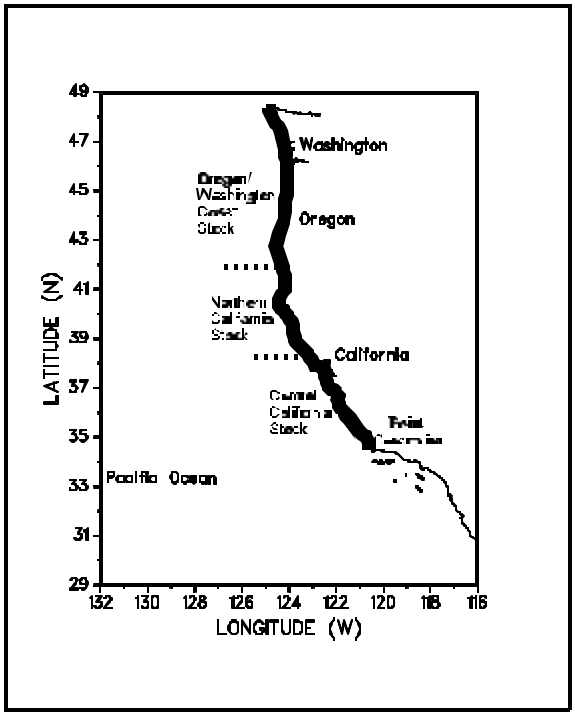

Figure 1. Stock boundaries and distributional range of harbor porpoise along the U.S. west coast.

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. Other Pacific coast Marine Mammal Protection Act (MMPA) stock assessment reports for harbor porpoise 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 higher and 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). The above abundance estimates are likely to underestimate the total abundance of harbor porpoise by an unknown, but non-trivial amount.

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

An analysis of a 1986-95 time series of aerial surveys was conducted to examine trends in harbor porpoise abundance in central California (Forney 1999b). After controlling for the effects of sea state, cloud cover, and area on sighting rates, Forney (1999b) found a negative trend in population size, but that trend was not statistically significant (p=0.15) (Figure 2). Between 1986 and 1995, harbor porpoise abundance was negatively correlated with sea surface temperature (Forney 1999b), indicating 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.

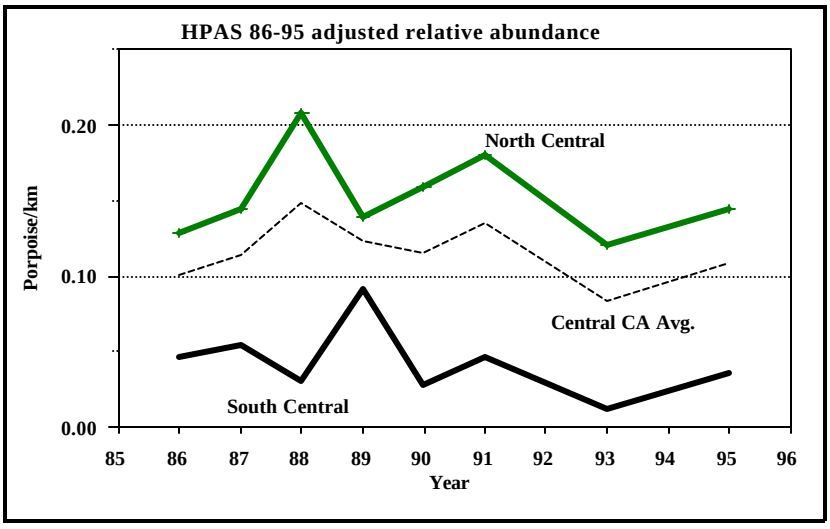

Figure 2. Harbor porpoise relative abundance in central California from 1986-95 aerial surveys (corrected for effects of sea state and cloud cover, Forney 1999b).

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. We therefore conclude that the current and maximum net productivity rates are unknown for the central California population of harbor porpoise.

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 with 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 set gillnet fisheries 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 of Barlow et al. (1997). A summary of estimated fishery mortality and injury for this stock of harbor porpoise is given in Table 1, based on analyses of entanglement rate data for a 1990-94

observer program (Julian 1997, Cameron 1998, Julian and Beeson 1998). These data indicate that an average of 24 harbor porpoise (range 13-49, CV=0.27) have been killed in all of central California (including both Morro Bay and Monterey Bay regions) each year for the period 1993-1997. However, since 1994, there has been a shift in set gillnet effort, with more effort in areas of high harbor porpoise density (Monterey Bay) and less effort in the lower density regions around Morro Bay, where no harbor porpoise mortalities were observed after 1990. Therefore, the mortality estimates presented below (Table 1) may be negatively biased. In a more recent preliminary analysis of mortality using effort and entanglement data only for the Monterey Bay region and including additional 1987-90 entanglement data for the areas presently being fished, Forney (1998) suggests that mortality could be substantially higher. Average annual estimates of mortality for 1993-97 in that study are 107 harbor porpoise (range 49 to 202; CV=0.12) using a stratified analysis, or 99 harbor porpoise (range 62-160, CV=0.19) using an unstratified analysis for the entire Monterey Bay region. An observer program was initiated this area in April 1999, and more accurate data are expected to be available in the near future.

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 (Barlow and Hanan 1995; Julian 1997, Cameron 1998, Julian and Beeson 1998). 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 1993-97 (CV in parentheses)
CA angel shark / halibut and other species large mesh (>3.5") set gillnet fishery	1993 1994 1995 1996 1997	NMFS observer data	15.4% 7.7% 0.0% 0.0% 0.0%	2 1 - - -	13 (0.64) 14 (0.96) 14 (0.64) [1] 32 (0.28) [1] 49 (0.27) [1]	24 (0.27)
CA set and drift gillnet fishery that use a stretched mesh size of 3.5" or less (white croaker)	1980s	CDFG observer data	n/a	1 in 200 sets	n/a	n/a
Total annual takes						24 (0.27)

[1] The CA set gillnets were not observed after 1994; mortality was extrapolated from effort estimates and previous entanglement rates.

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 mortality rate over the last five years (24) is less than the calculated PBR (42) for central California harbor porpoise; therefore, the central California harbor porpoise population is not "strategic" under the MMPA. The Pacific Scientific Review Group (established by the MMPA) recommended that this stock be considered strategic because it was thought to be declining. Because the apparent decline in the population is likely to be natural and is no longer statistically significant, the NMFS does not believe that a strategic status is justified at this time. However, this determination should be reviewed after additional mortality data become available at the end of 1999 for the Monterey Bay area set gillnet fishery, because true mortality may be higher than the currently published estimates. Research activities will continue to monitor the population size and to investigate population trends. The average gillnet mortality for the last 5 years (24 porpoise per year) is greater than 10% of 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.

REFERENCES

Barlow, J. 1988. Harbor porpoise (*Phocoena phocoena*) abundance estimation in California, Oregon and Washington: I. Ship surveys. Fish. Bull. 86:417-432.

Barlow, J. and P. Boveng. 1991. Modeling age-specific mortality for marine mammal populations. Marine Mammal Sci. 7(1):84-119.

Barlow, J., R. W. Baird, J. E. Heyning, K. Wynne, A. M. Manville, II, L. F. Lowry, D. Hanan, J. Sease, and V. N. Burkanov. 1994. A review of cetacean and pinniped mortality in coastal fisheries along the west coast of the U.S. and Canada and the east coast of the Russian Federation. Rep. Int. Whal. Commn, Special Issue 15:405-425.

Barlow, J. and K. A. Forney. 1994. An assessment of the 1994 status of harbor porpoise in California. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-205. 17pp.

Barlow, J. and D. Hanan. 1995. An assessment of the status of harbor porpoise in central California. Rept. Int. Whal., Special Issue 16:123-140.

Barlow, J., K. A. Forney, P. S. Hill, R. L. Brownell, Jr., J. V. Carretta, D. P. DeMaster, F. Julian, M. S. Lowry, T. Ragen, and R. R. Reeves. 1997. U.S. Pacific Marine Mammal Stock Assessments: 1996. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SWFSC-248. 223p.

Calambokidis, J. and J. Barlow. 1991. Chlorinated hydrocarbon concentrations and their use for describing population discreteness in harbor porpoises from Washington, Oregon, and California. pp. 101-110 In: J. E. Reynolds III and D. K. Odell (eds.) Marine mammal strandings in the United States. NOAA Technical Report NMFS 98.

Cameron, G. 1998. Cetacean mortality in California gill net fisheries: Preliminary estimates for 1997. Paper SC/50/SM02 presented to the International Whaling Commission, June 1998 (unpublished). 15 pp.

Forney, K. A. 1998. A review of 1990-97 set gillnet fisheries in the Monterey Bay area and revised estimates of mortality for harbor porpoise, *Phocoena phocoena*, and sea otters, *Enhydra lutris.* Background paper 98-PSRG-4 submitted to the Pacific Scientific Review Group Meeting, Seattle, WA, November 16-18, 1998.

Forney, K. A. 1999a. The abundance of California harbor porpoise estimated from 1993-97 aerial line-transect surveys. Admin. Rep. LJ-99-02. Available from Southwest Fisheries Center, P.O. Box 271, La Jolla, CA 92038. 16pp.

Forney, K. A. 1999b. Trends in harbor porpoise abundance off central California, 1986-95: Evidence for interannual changes in distribution? *Journal of Cetacean Research and Management* 1:73-80.

Gaskin, D. E. 1984. The harbour porpoise (*Phocoena phocoena* L.): regional populations, status, and information on direct and indirect catches. Rep. int. Whal. Commn 34:569-586.

Green, G. A., J. J. Brueggeman, R. A. Grotefendt, C. E. Bowlby, M. L. Bonnell, and K. C. Balcomb, III. 1992. Cetacean distribution and abundance off Oregon and Washington, 1989-1990. Ch. 1 In: J. J. Brueggeman (ed.). Oregon and Washington Marine Mammal and Seabird Surveys. Minerals Management Service Contract Report 14-12-0001-30426 prepared for the Pacific OCS Region.

Julian, F. 1997. Cetacean mortality in California gill net fisheries: Preliminary estimates for 1996. Paper SC/49/SM02 presented to the International Whaling Commission, September 1997 (unpublished). 13 pp.

Julian, F. and M. Beeson. 1998. Estimates for marine mammal, turtle, and seabird mortality for two California gillnet fisheries: 1990-95. Fishery Bulletin 96:271-284.

Laake, J. L., J. C. Calambokidis, S. D. Osmek, and D. J. Rugh. 1997. Probability of detecting harbor porpoise from aerial surveys: estimating g(0). Journal of Wildlife Management 61:63-75.

Polacheck, T., F. W. Wenzel, and G. Early. 1995. What do stranding data say about harbor porpoise (*Phocoena phocoena*)? Report International Whaling Commission, Special Issue 16:169-179.

Rosel, P. E. 1992. Genetic population structure and systematic relationships of some small cetaceans inferred from mitochondrial DNA sequence variation. Ph.D. Dissertation, Univ. Calif. San Diego. 191pp.

Rosel, P. E., A. E. Dizon, and M. G. Haygood. 1995. Variability of the mitochondrial control region in populations of the harbour porpoise, Phocoena phocoena, on inter-oceanic and regional scales. Can. J. Fish. and Aquat. Sci. 52:1210-1219.

Wade, P. R. and R. P. Angliss. 1997. Guidelines for Assessing Marine Mammal Stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. U. S. Dep. Commerce, NOAA Technical Memorandum NMFS-OPR-12. 93 pp.

Woodley, T. H. and A. J. Read. 1991. Potential rates of increase of a harbour porpoise (Phocoena phocoena) population

subjected to incidental mortality in commercial fisheries. Can. J. Fish. Aquat. Sci. 48:2429-2435.