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HARBOR SEAL (*Phoca vitulina richardsi*): California Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Harbor seals (*Phoca vitulina*) are widely distributed in the North Atlantic and North Pacific. Two subspecies exist in the Pacific: *P. v. stejnegeri* in the western North Pacific, near Japan, and *P. v. richardsi* in the eastern North Pacific. The latter subspecies inhabits near-shore coastal and estuarine areas from Baja California, Mexico, to the Pribilof Islands in Alaska. These seals do not make extensive pelagic migrations, but do travel 300-500 km on occasion to find food or suitable breeding areas (Herder 1986; D. Hanan unpublished data). In California, approximately 400-600 harbor seal haulout sites are widely distributed along the mainland and on offshore islands, including intertidal sandbars, rocky shores and beaches (Hanan 1996; Lowry et al. 2005).

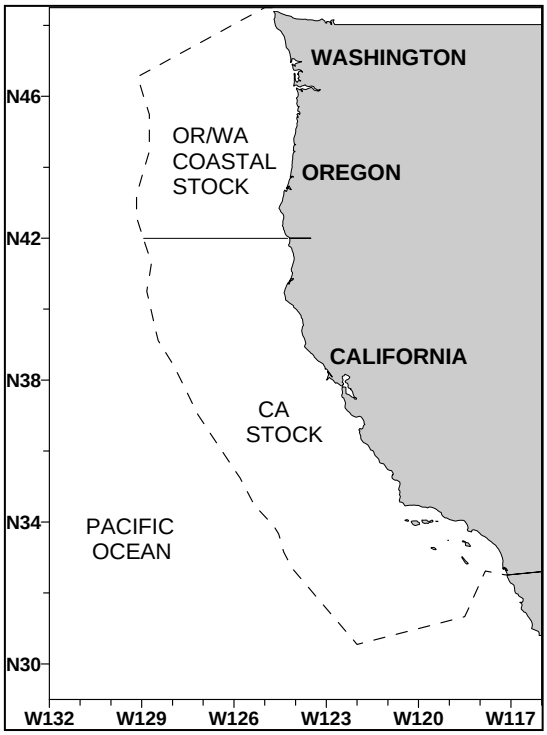

Figure 1. Stock boundaries for the California and Oregon/Washington coastal stocks of harbor seals. Dashed line represents the U.S. EEZ.

Within the subspecies *P. v. richardsi*, abundant evidence of geographic structure comes from differences in mitochondrial DNA (Huber et al. 1994; Burg 1996; Lamont et al. 1996; Westlake and O'Corry-Crowe 2002; O'Corry-Crowe et al. 2003), mean pupping dates (Temte 1986), pollutant loads (Calambokidis et al. 1985), pelage coloration (Kelly 1981) and movement patterns (Jeffries 1985; Brown 1988). LaMont (1996) identified four discrete subpopulation differences in mtDNA between harbor seals from Washington (two locations), Oregon, and California. Another mtDNA study (Burg 1996) supported the existence of three separate groups of harbor seals between Vancouver Island and southeastern Alaska. Although we know that geographic structure exists along an almost continuous distribution of harbor seals 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. Previous assessments of the status of harbor seals have recognized three stocks along the west coast of the continental U.S.: 1) California, 2) Oregon and Washington outer coast waters, and 3) inland waters of Washington. Although the need for stock boundaries for management is real and is supported by biological information, the exact placement of a boundary between California and Oregon was largely a political/jurisdictional convenience. An unknown number of harbor seals also occur along the west coast of Baja California, at least as far south as Isla Asuncion, which is about 100 miles south of Punta Eugenia. Animals along Baja California are not considered to be a part of the California stock because it is not known if there is any demographically significant movement of harbor seals between California and Mexico and there is no international agreement for joint management of harbor seals. Lacking any new information on which to base a revised boundary, the harbor seals of California will be again treated as a separate stock in this report (Fig. 1). Other Marine Mammal Protection Act (MMPA) stock assessment reports cover the five other stocks that are recognized along the U.S. west coast: Oregon/Washington outer coastal waters, Washington inland waters, and three stocks in Alaska coastal and inland waters.

POPULATION SIZE

A complete count of all harbor seals in California is impossible because some are always away from the haulout sites. A complete pup count (as is done for other pinnipeds in California) is also not possible because harbor seals are precocious, with pups entering the water almost immediately after birth.

Population size is estimated by counting the number of seals ashore during the peak haul-out period (May to July) and by multiplying this count by the inverse of the estimated fraction of seals on land. Boveng (1988) reviewed studies estimating the proportion of seals hauled out to those in the water and suggested that a correction factor for harbor seals is likely to be between 1.4 and 2.0. Huber (1995) estimated a mean correction factor of 1.53 (CV=0.065) for harbor seals in Oregon and Washington during the peak pupping season. Hanan (1996) estimated that 83.3% (CV=0.17) of harbor seals haul out at some time during the day during the May/June molt, and he estimated a correction factor of 1.20 based on those data. Neither correction factor is directly applicable to an aerial photographic count in California: the 1.53 factor was measured at the wrong time of year (when fewer seals are hauled out) and in a different area and the 1.20 factor was based on the fraction of seals hauled out over an entire 24-hour day (correction factors for aerial counts should be based on the fraction of seals hauled out at the time of the survey). Hanan (pers. comm.) revised his haul-out correction factor to 1.3 by using only those seals hauled out between 0800 and 1700 hrs which better corresponds to the timing of his surveys. Based on the most recent harbor seal counts (26,333 in May-July 2004; Lowry et al. 2005) and Hanan's revised correction factor, the harbor seal population in California is estimated to number 34,233.

Minimum Population Estimate

Because of the way it was calculated (based on the fraction of seals hauled out at any time during a 24 hr day), Hanan's (1996) correction factor of 1.2 can be viewed as a minimum estimate of the fraction hauled out at a given instant. A population size estimated using this correction factor provides a reasonable assurance that the true population is greater than or equal to that number, and thus fulfills the requirement of a minimum population estimate. The minimum size of the California harbor seal population is therefore 31,600.

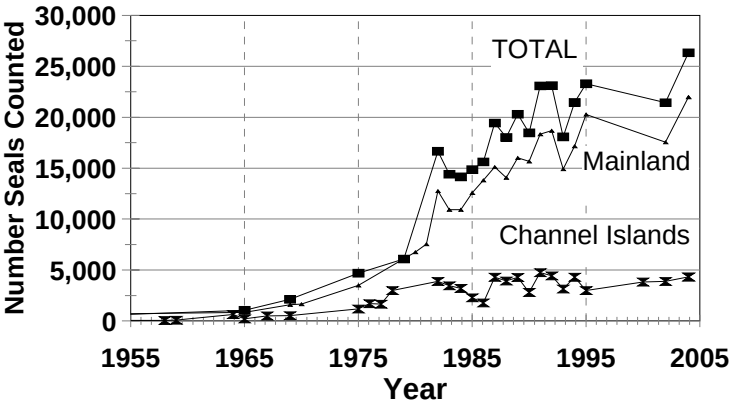

Figure 2. Harbor seal haulout counts in California during May/June (Hanan 1996; R. Read, CDFG unpubl. data; NMFS unpubl. data from 2002 and 2004 surveys).

Current Population Trend

Counts of harbor seals in California showed a rapid increase from approximately 1972 (when the MMPA was first passed) to 1990 (Fig. 2). Net production rates appeared to be decreasing from 1982 to 1994 (Fig. 3). Although earlier analyses were equivocal (Hanan 1996) and there has been no formal determination that the California stock has reached OSP (Optimal Sustainable Population level as defined by the MMPA), the decrease in population growth rate has occurred at the same time as a decrease in human-caused mortality and may indicate that the population is approaching its environmental carrying capacity. Population growth has also slowed or stopped for the harbor seal stock on the outer coasts of Oregon and Washington (see separate Stock Assessment Report).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A realized rate of increase was calculated for the 1982-1995 period (when annual counts were available) by linear regression of the natural logarithm of total count versus year. The slope of this regression line was 0.035 (s.e.=0.007) which gives an annualized growth rate estimate of 3.5%. The current rate of net production is greater than this observed growth rate because fishery mortality takes a fraction of the net production. Annual gillnet mortality may have been as high as 5-10% of the California harbor seal population in the mid-1980s; a kill this large would have depressed population growth rates appreciably. Net productivity was therefore calculated for 1980-1994 as the realized rate of population growth (increase in seal counts from year *i* to year *i*+1, divided by the seal count in year *i*) plus the human-caused mortality rate (fishery mortality in year *i* divided by population size in year *i*). Between 1983 and

1994, the net productivity rate for the California stock averaged 9.2% (Fig. 3). A regression shows a decrease in net production rates, but the decline is not statistically significant. Maximum net productivity rates cannot be estimated because measurements were not made when the stock size was very small.

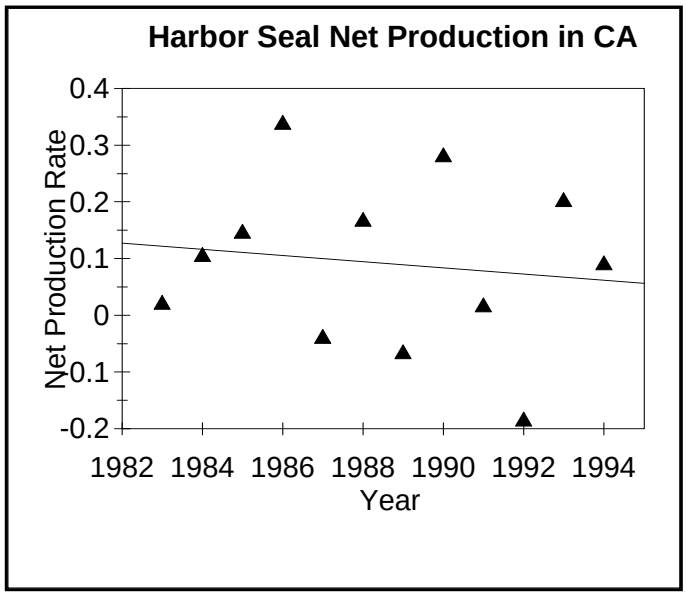

Figure 3. Net production rates and regression line estimated from haulout counts and fishery mortality.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (31,600) times one half the default maximum net productivity rate for pinnipeds (½ of 12%) times a recovery factor of 1.0 (for a stock of unknown status that is growing or for a stock at OSP, Wade and Angliss 1997), resulting in a PBR of 1,896.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Historical Takes

Prior to state and federal protection and especially during the nineteenth century, harbor seals along the west coast of North America were greatly reduced by commercial hunting (Bonnot 1928, 1951; Bartholomew and Boolootian 1960). Only a few hundred individuals survived in a few isolated areas along the California coast (Bonnot 1928). In the last half of this century, the population has increased dramatically.

Fishery Information

A summary of known fishery mortality and injury for this stock of harbor seals is given in Table 1. More detailed information on these fisheries is provided in Appendix 1. Because the vast majority of harbor seal mortality in California fisheries occurs in the set gillnet fishery, because that fishery has undergone dramatic reductions and redistributions of effort, and because the entire fishery has not been observed since 1994, average annual mortality cannot be accurately estimated for the recent years (1999-2003). Rough estimates for 1999-2003 have been made by extrapolation of prior kill rates using recent effort estimates and observations in the Monterey portion of the fishery from 1999 and 2000 (Table 1). Observations from the Monterey Bay portion of the fishery included 57 and 24 harbor seals taken in 1999 and 2000, respectively. Stranding data reported to the California Marine Mammal Stranding Network from 1999-2003 include harbor seal deaths and injuries caused by hook-and-line fisheries (four deaths, two injuries) and gillnet fisheries (two deaths, two injuries). The locations and timing of harbor seal strandings attributed to gillnet fisheries suggest that the halibut/angel shark or white seabass set gillnet fishery are responsible for the interactions (see Appendix 1 for fishery descriptions).

Other Mortality

The California Marine Mammal Stranding database maintained by the National Marine Fisheries Service, Southwest Region, contains the following records of human-related harbor seal mortalities and injuries in 1999-2003: (1) boat collision (eight mortalities, two injuries), (2) entrainment in power plants (26 mortalities), (3) shootings (15 mortalities), and (4) all-terrain vehicle (ATV) collision (one injury).

Table 1. Summary of available information on the mortality and serious injury of harbor seals (California stock) in commercial fisheries that might take this species (Cameron and Forney 2000; Carretta 2001, 2002; Carretta et al. 2003; Carretta and Chivers 2004). n/a indicates that data are not available. Mean annual takes are based on 1999-2003 data unless noted otherwise.

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed Mortality	Estimated Mortality (CV in parentheses)	Mean Annual Takes (CV in parentheses)
CA/OR thresher shark/swordfish drift gillnet fishery	1998-2003	observer data	20-23%	0	0,0,0,0,0	0[1]
CA angel shark/halibut and other species large mesh (>3.5") set gillnet fishery	1999 2000 2001 2002 2003	observer data extrapolated estimate	4.0%[3] 1.7%[3] 0.0%[3] 0.0%[3] 0.0%[3]	57 24 - - -	662 (0.10)[1] 415 (0.08)[1] 329 (0.09)[1] 337 (0.11)[1] 186 (0.09)[1]	386 (0.05)[1]
CA, OR, and WA salmon troll fishery	1990-92	logbook data	-		Avg. Annual take = 7.33	n/a
CA herring purse seine fishery	1990-92	logbook data	-		Avg. Annual take = 0	n/a
CA anchovy, mackerel, and tuna purse seine fishery	1990-92	logbook data	-		Avg. Annual take = 0.67	n/a
WA, OR, CA groundfish trawl	1999 2000 2001 2002 2003 1999-2003	observer data unmonitored hauls	68.6% 80.6% 96.2% 100% 100%	0 2 0 0 0 1	0 3 (0.21) 0 0 0 1	0.6 (0.21) 0.2 (n/a)
CA squid purse seine fishery	1997-2001	logbook data	Warden obs 2-3 trips/month	0	Avg. Annual take = 0	n/a
(unknown net and hook fisheries)	1999-2003	stranding data		6		1.5
Total annual takes						388 (0.05)

[1]The CA set gillnets were not observed after 1994, except for Monterey Bay, where the fishery was observed in 1999 and 2000. Mortality in other regions was extrapolated from current (1999-2003) effort estimates and 1990-94 entanglement rates, thus the CV of the mortality estimate for this fishery is likely to be underestimated by an unknown amount. There was no observer coverage in this fishery in 2001-2003.

STATUS OF STOCK

A review of harbor seal dynamics through 1991 concluded that their status relative to OSP could not be determined with certainty (Hanan 1996). They are not listed as "endangered" or "threatened" under the Endangered Species Act nor as "depleted" under the MMPA. Total fishing mortality cannot be accurately estimated for recent years, but extrapolations from past years indicate that fishing mortality (388 per year) is less than the calculated PBR for this stock (1,896), and thus they would not be considered a "strategic" stock under the MMPA. The average rate of incidental fishery mortality for this stock is likely to be greater than 10% of the calculated PBR; therefore, fishery mortality cannot be considered insignificant and approaching zero mortality and serious injury rate. The population appears to be

stabilizing at what may be their carrying capacity and the fishery mortality is declining. There are no known habitat issues that are of particular concern for this stock. Two unexplained harbor seal mortality events occurred in Point Reyes National Park involving at least 90 seals in 1997 and 16 seals in 2000. Necropsy of three seals in 2000 showed severe pneumonia; tests for morbillivirus were negative, but attempts are being made to identify another virus isolated from one of the three (F. Gulland, pers. comm.). All west-coast harbor seals that have been tested for morbilliviruses were found to be seronegative, indicating that this disease is not endemic in the population and that this population is extremely susceptible to an epidemic of this disease (Ham-Lammé et al. 1999).

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