Revised 12/15/2011

HARBOR SEAL (*Phoca vitulina richardii*): 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. richardii* 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; Harvey and Goley 2011). 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. 2008).

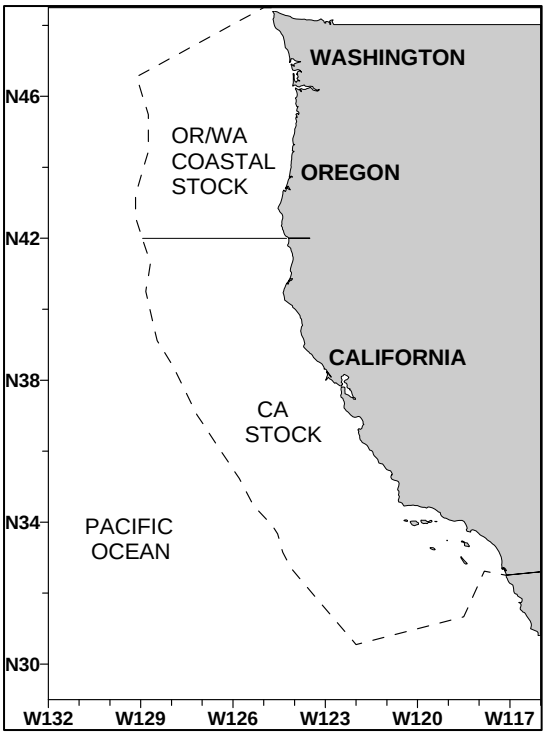

Figure 1. Stock boundaries for the California and Oregon/Washington coastal stocks of harbor seals. Dashed line represents the U.S. EEZ.

Within the subspecies *P. v. richardii*, 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 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 precocial, 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 a correction factor equal to the inverse of the estimated fraction of seals on land. Harvey and Goley (2011) calculated a correction factor of 1.54 (CV=0.157) based on 180 seals radio-tagged in California. This correction factor is based on the mean of four date-specific correction factors (1.31, 1.38, 1.62, 1.84) calculated for central and northern California. Based on the most recent harbor seal counts (19,608 in May-July 2009; NMFS unpublished data) and the Harvey and Goley (2011) correction factor, the harbor seal population in California is estimated to number 30,196 seals (CV=0.157).

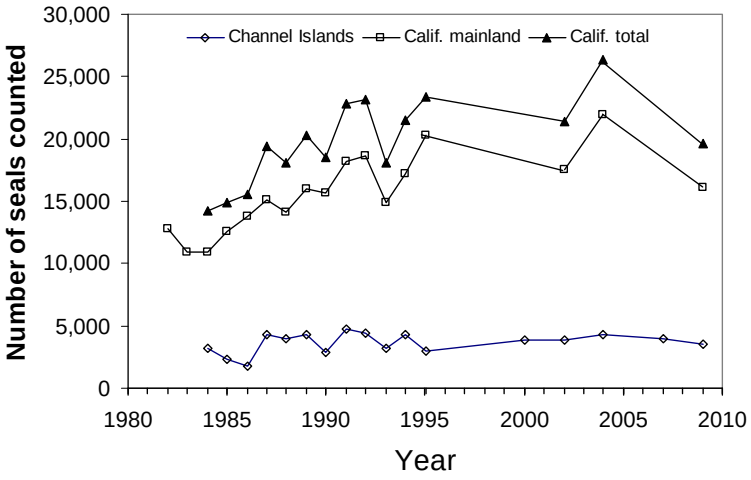

Figure 2. Harbor seal haulout counts in California during May/June (Hanan 1996; R. Read, CDFG unpubl. data; Lowry *et al*. 2008, NMFS unpubl. data from 2009 surveys).

Minimum Population Estimate

The minimum population size is estimated from the number of seals counted hauled out in 2009 (19,608), multiplied by the lower 20th percentile of the correction factor (1.36), or 26,667 seals.

Current Population Trend

Counts of harbor seals in California increased from 1981 to 2004 (Fig. 2). The maximum statewide count in the 1981-2009 time series occurred in 2004 (Fig. 2).

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 true rate of net production is greater than this observed growth rate because fishery and other human-caused mortality removes 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. A current estimate of net production for the California harbor seal stock is difficult to determine because the fishery that was responsible for the most mortality (California halibut and white seabass set gillnet) has only been intermittently observed since the mid-1990s, and statewide annual counts of seals at rookeries are not available after 1995 (Fig. 2).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (26,667) 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 1,600.

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.

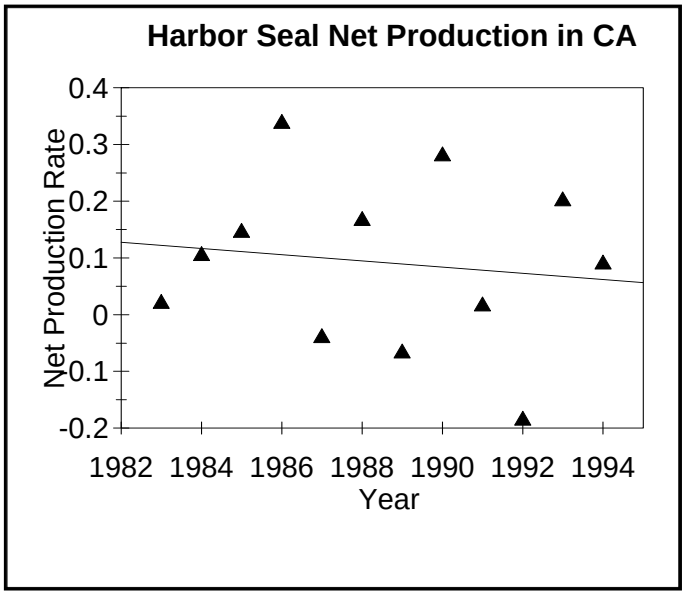

Figure 3. Net production rates and regression line estimated from haulout counts and fishery mortality.

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. Historically, the set gillnet fishery for halibut and white seabass was the largest source of fishery mortality and remains the most likely fishery in California to interact with harbor seals today. Julian and Beeson (1998) reported a range of annual mortality estimates from 227 to 1,204 seals (mean = 584) from 1990 to 1994, based on 5% to 15% fishery observer coverage. Regulations implemented in 1994 moved the fishery farther offshore in southern California, which may have reduced harbor seal entanglements in this region. The fishery was not observed again until 1999 and 2000 in Monterey Bay, although annual mortality estimates of 300-400 seals were still calculated based on 1990-1994 bycatch rates and 1999-2000 fishing effort (Cameron and Forney 2000, Cameron and Forney 2001, Carretta 2002, 2003). The observer program for this fishery was discontinued after 2000. In 2002 the fishery was subject to further area restrictions that effectively eliminated fishing north of Point Arguello, California. In 2006, the fishery was again observed at low levels (12 sets out of an estimated 1,300), with one observed mortality. In 2007, 248 sets were observed (~17% observer coverage) with 2 harbor seal deaths observed and a resulting mortality estimate of 11 animals (Table 1). Total effort in the set gillnet fishery has declined from approximately 4,000 sets annually to approximately 1,300 (Carretta and Enriquez 2009a). Stranding data from California between 2005 and 2009 include eight harbor seal deaths caused by hook-and-line fisheries (The total annual human-caused mortality from 2005 to 2009 from commercial fisheries is 18 animals per year (Table 1). There were also 7 harbor seal deaths attributed to recreational hook and line fisheries between 2005 and 2009 (NMFS, unpublished stranding data).

Other Mortality

NMFS stranding records for California for the period 2005-2009 include the following human-caused mortality not included in Table 1: shootings (2), ship/vessel strikes (1), entrainment in power plants (52), and research-related deaths (3). This results in an annual average of 12 harbor seal deaths per year for the years 2005-2009.

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). California harbor seals are not listed as "endangered" or "threatened" under the Endangered Species Act nor as "depleted" under the MMPA. Annual human-caused mortality from commercial fisheries (18/yr) and other human-caused sources (13/year) is 31 animals, which is less than the calculated PBR for this stock (1,600), and thus they would not be considered a "strategic" under the MMPA. The fishery that historically removed the largest numbers of harbor seals (halibut and white seabass set gillnet) has been observed only intermittently in recent years, but annual bycatch from 2007 when the fishery had ~18% observer coverage indicates that current rates of absolute bycatch are much lower than during the 1990s. The average annual rate of incidental commercial fishery mortality (18 animals) is less than 10% of the calculated PBR (1,600 animals);

therefore, fishery mortality is considered insignificant and approaching zero mortality and serious injury rate. The population appears to be stabilizing at what may be its carrying capacity and the fishery mortality is declining. There are no known habitat issues that are of particular concern. Two unexplained harbor seal mortality events occurred in Point Reyes National Seashore 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).

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 (Carretta and Enriquez 2006, 2009; Heery et al. 2010). n/a indicates that data are not available. Mean annual takes are based on 2005-2009 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 halibut and white seabass set gillnet fishery	2005 2006 2007 2008 2009	observer	0% <1% 17.8% 0% 0%	0 0 2 0 0	n/a n/a 11 (0.73) n/a n/a	11 (0.73)[1]
CA anchovy, mackerel, sardine, and tuna purse seine fishery	2004-2006	observer	~2%	0	0	0
WA, OR, CA groundfish trawl (includes at-sea hake and other limited-entry groundfish sectors)	2004 2005 2006 2007 2008	observer	99% to 100% of tows in at-sea hake fishery; 18%-26% of landings in other groundfish sectors	1 1 1 0 4	1 (n/a) 1 (n/a) 1 (n/a) 0 (n/a) 29 (n/a)	6.4 (n/a)
CA squid purse seine fishery	2004-2006	observer	~5%	0	0	0
(unknown net fisheries)	2005-2009	stranding	n/a		n/a	≥0.8
Total annual takes						18 (0.73)

[1] Only 2007 data is included in the mean annual take calculation for the CA halibut and white seabass fishery, due to the low observer coverage (<1%) in 2006.

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