Revised 7/31/2015

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 coastal and estuarine areas from Mexico to Alaska. These seals do not make extensive pelagic migrations, but do travel 300-500 km 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).

Within the subspecies *P. v. richardii*, abundant evidence of geographic structure comes from differences in mitochondrial DNA (Huber *et al*. 1994, 2010, 2012; 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 *et al*. (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. Three genetically distinct populations of harbor seals within Washington inland waters are also evident, based on work by Huber *et al.* (2010, 2012). Although 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 arbitrary from a biological perspective. Nonetheless, failure to recognize geographic structure in 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 are 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: 1) Southern Puget Sound (south of the Tacoma Narrows Bridge); 2) Washington Northern Inland Waters (including Puget Sound north of the Tacoma Narrows Bridge, the San Juan Islands, and the Strait of Juan de Fuca); 3) Hood Canal; and 4) Oregon/Washington Coast.

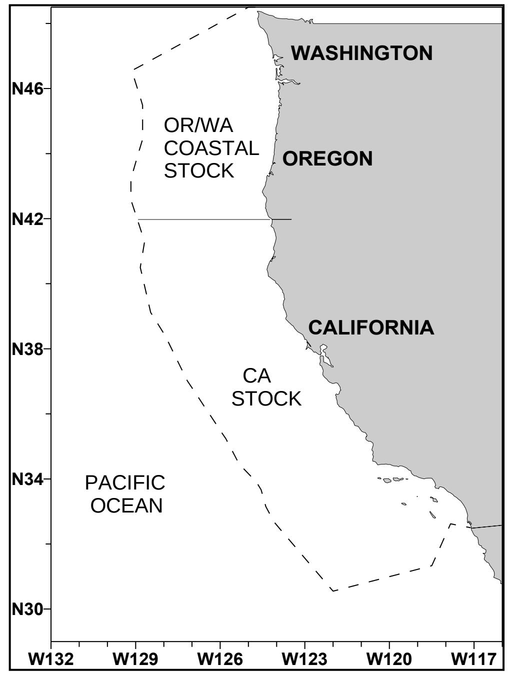

Figure 1. Stock boundaries for the California and Oregon/Washington coastal stocks of harbor seals. Dashed line represents the U.S. EEZ.

POPULATION SIZE

A complete count of all harbor seals in California is impossible because not all animals are hauled out simultaneously. A complete pup count (as is done for other pinnipeds in California) is also not possible because harbor seal pups enter 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 radio-tagged seals 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 during May-July of 2012 (20,109 animals) (NMFS unpublished data) and the Harvey and Goley (2011) correction factor, the harbor seal population in California in 2012 is estimated to number 30,968 seals (CV=0.157).

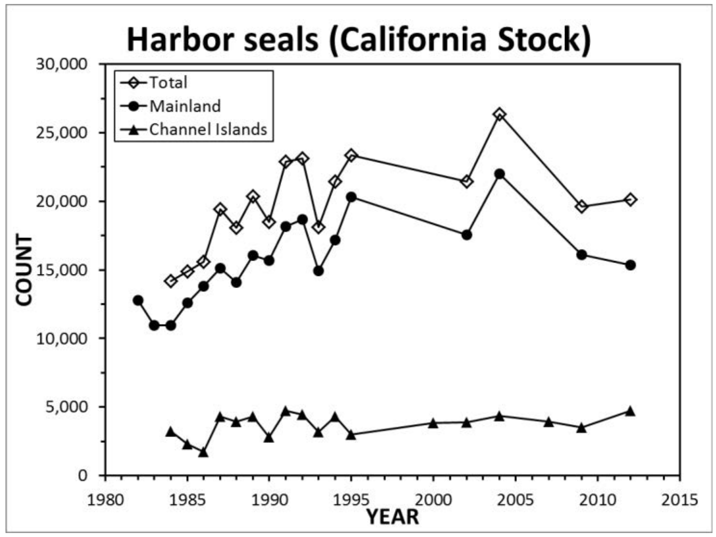

Figure 2. Harbor seal haulout counts in California during May to July (Hanan 1996; R. Read, CDFG unpubl. data; Lowry *et al*. 2008, NMFS unpubl. data from 2009-2012 surveys).

Minimum Population Estimate

The minimum population size is estimated from the number of hauled out seals counted in 2012 (20,109), multiplied by the lower 20th percentile of the correction factor (1.36), or 27,348 seals.

Current Population Trend

Counts of harbor seals in California increased from 1981 to 2004 when the statewide maximum count was recorded. Subsequent surveys conducted in 2009 and 2012 have been lower than the 2004 maximum count (Fig. 2).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Historically, the largest known source of human-caused mortality of California harbor seals was the California halibut set gillnet fishery (Julian and Beeson 1998), where estimates of bycatch mortality were approximately 1-2% of the estimated population size between 1990 and 1995. Since 1996, that fishery been observed infrequently and at low observer coverage levels, though fishing effort levels have declined. Any estimate of current net productivity level should account for human-caused mortality, otherwise estimated net productivity will be negatively-biased. At this time, there are insufficient data on bycatch (only 3 of the last 5 years have observations from the fishery, with low observer coverage) and uncertainty regarding the degree of negative biases for other sources of human-caused mortality to reliably estimate the current net productivity level. An assessment of *maximum net productivity levels* is not possible, because abundance estimates were not available when the population was very small and presumably recovering from past exploitation (Bonnot 1928).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (27,348) 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 1,641 animals per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Serious Injury Guidelines

NMFS uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to distinguish serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*".

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 the last century, the population increased dramatically.

Fishery Information

A summary of known commercial fishery mortality and serious injury for this stock of harbor seals for the period 2008-2012 is given in Table 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. 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 and representing between 1-2% of the estimated population size. This fishery has been observed infreqently since 1995 and fishing effort has declined from approximately 5,000 trips in the early 1990s to 1,300 trips in 2012 (Carretta *et al*. 2014a.).

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, Carretta *et al*. 2014a; Heery *et al*. 2010); n/a indicates that data are not available. Mean annual takes are based on 2008-2012 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	2008 2009 2010 2011 2012	observer	0% 0% 12.5% 8.0% 5.5%	0 0 3 0 0	n/a n/a 23 (0.59) n/a n/a	23 (0.59)
CA small-mesh drift gillnet fishery for white seabass, yellowtail, barracuda, and tuna	2010 2011 2012	observer	0.7% 3.3% 4.6%	0 0 0	0 (n/a) 0 (n/a) 0 (n/a)	0 (n/a)
WA, OR, CA groundfish trawl (includes at-sea hake and other limited-entry groundfish sectors)	2005 2006 2007 2008 2009	observer	99% to 100% of tows in at-sea hake fishery; 18%-26% of landings in other groundfish sectors	1 1 0 4 1	1 (n/a) 1 (n/a) 0 (n/a) 29 (n/a) 1 (n/a)	6.4 (n/a)
Unknown net fisheries	2008-2012	stranding	n/a	5	n/a	≥ 1.0
Total annual takes						30 (0.59)

Other Mortality

NMFS stranding records for California for the period 2008-2012 include the following human-caused mortality and serious injury not included in Table 1: shootings (1), ship/vessel strikes (3), entrainment in power plants (40), hook and line fisheries (6), human-induced abandonment of pups or harassment (9), marine debris entanglement (2), stabbing/gaff wounds (2), and research-related deaths (1) (Carretta *et al*. 2014b.). The total non-fishery related mortality and serious injury for the period totals 64 harbor seals, or an annual average of 12.8 seals.

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 designated as "depleted" under the MMPA. Annual human-caused mortality from commercial fisheries (30/yr) and other human-caused sources (12.8/yr) is 42.8 animals, which is less than the calculated PBR for this stock (1,641), and thus they are <u>not</u> considered a "strategic" stock under the MMPA. The average annual rate of incidental commercial fishery mortality (30 animals) is less than 10% of the calculated PBR (1,641 animals); therefore, fishery mortality is considered insignificant and approaching zero mortality and serious injury rate. The population size has increased since the 1980s when statewide censuses were first conducted. The highest population counts occurred in 2004 and subsequent counts in 2009 and 2012 have been lower. Expanding pinniped populations in general have resulted in increased human-caused serious injury and mortality, due to shootings, entrainment in power plants, interactions with recreational hook and line fisheries, separation of mothers and pups due to human disturbance, dog bites, and vessel and vehicle strikes (Carretta et al. 2014b). 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).

REFERENCES

Bartholomew, G. A., R. A. Boolootian. 1960. Numbers and population structure of the pinnipeds on the California Channel Islands. J. Mammal. 41:366-375.

Bonnot, P. 1928. Report on the seals and sea lions of California. Fish Bulletin Number 14. California Division of Fish and Game.

Bonnot, P. 1951. The sea lions, seals and sea otter of the California coast. California Fish and Game 37(4):371-389.

Brown, R. F. 1988. Assessment of pinniped populations in Oregon. Processed Report 88-05, National Marine Fisheries Service, Northwest and Alaska Fisheries Center, Seattle, Washington.

Burg, T. M. 1996. Genetic analysis of eastern Pacific harbor seals (*Phoca vitulina richardsi*) from British Columbia and parts of Alaska using mitochondrial DNA and microsatellites. Masters Thesis, Univ. of British Columbia, Vancouver, British Columbia. 77pp.

Calambokidis, J., S. M. Speich, J. Peard, G. H. Steiger, and J. C. Cubbage. 1985. Biology of Puget Sound marine mammals and marine birds: population health and evidence of pollution effects. U.S. Dep. Commer., NOAA Tech. Memo. NOS-OMA-18. 159 pp.

Carretta, J.V., L. Enriquez, and C. Villafana. 2014a. Marine mammal, sea turtle, and seabird bycatch in California gillnet fisheries in 2012. NOAA Technical Memorandum, NOAA-TM-NMFS-SWFSC-526. 16p.Carretta, J.V., S.M. Wilkin, M.M. Muto, K. Wilkinson, and J. Rusin. 2014b. Sources of human-related injury and mortality for U.S. Pacific west coast marine mammal stock assessments, 2008-2012. NOAA Technical Memorandum, NOAA-TM-NMFS-SWFSC-533. 110 p.

Carretta, J.V. and L. Enriquez. 2012a. Marine mammal and seabird bycatch in California gillnet fisheries in 2011. NOAA Technical Memorandum, NOAA-TM-NMFS-SWFSC-500. 14p.

Carretta, J.V. and L. Enriquez. 2012b. Marine mammal and seabird bycatch in California gillnet fisheries in 2010. Administrative Report LJ-12-01. NOAA Fisheries, Southwest Fisheries Science Center, National Marine Fisheries Service, La Jolla, CA 92037. 14 p.

Carretta, J.V. and L. Enriquez. 2010. Marine mammal and sea turtle bycatch in the California/Oregon swordfish and thresher shark drift gillnet fishery in 2009. Administrative Report LJ-10-03, available from Southwest Fisheries Science Center, 3333 North Torrey Pines Ct., La Jolla, California, 92037. 11p.

Carretta, J.V. and L. Enriquez. 2009. Marine mammal bycatch in the California/Oregon swordfish and thresher shark drift gillnet fishery in 2008. Administrative Report LJ-09-03, available from Southwest Fisheries Science Center, 3333 North Torrey Pines Ct., La Jolla, California, 92037. 10 p.

Ham-Lammé, K. D., D. P. King, B. C. Taylor, C. House, D. A. Jessup, S. Jeffries, P. K Yochem, F. M. D. Gulland, D. A. Ferrick, and J. L. Stott. 1999. The application of immuno-assays for serological detection of morbillivirus exposure in free ranging harbor seals (*Phoca vitulina*) and sea otters (*Enhydra lutris*) from the western coast of the United States. Mar. Mamm. Sci. 15(2):601-608.

Hanan, D. A. 1996. Dynamics of Abundance and Distribution for Pacific Harbor Seal, *Phoca vitulina richardsi*, on the Coast of California. Ph.D. Dissertation, University of California, Los Angeles. 158pp.

Harvey, J.T. and D. Goley. 2011. Determining a correction factor for aerial surveys of harbor seals in California. Marine Mammal Science 27(4):719-735.

Heery, E., Bellman, M.A., and J. Majewski. 2010. Estimated bycatch of marine mammals, seabirds, and sea turtles in the 2002-2008 U.S. west coast commercial groundfish fishery. West Coast Groundfish Observer Program. NWFSC, 2725 Montlake Blvd E., Seattle, WA 98112. 106 p.

Herder, M. J. 1986. Seasonal movements and hauling site fidelity of harbor seals, *Phoca vitulina richardsi*, tagged at the Russian River, California. MS Thesis. Humbolt State Univ. 52 pages.

Huber, H., S. Jeffries, R. Brown, and R. DeLong. 1994. Harbor seal stock assessment in Washington and Oregon 1993. Annual report to the MMPA Assessment Program, Office of Protected Resources, NMFS, NOAA, 1335 East-West Highway, Silver Spring, MD 20910.

Huber, H. R., S. J. Jeffries, D. M. Lambourn, and B. R. Dickerson. 2010. Population substructure of harbor seals (Phoca vitulina richardsi) in Washington State using mtDNA. Can. J. Zool. 88:280-288.

Huber, H. R., B. R. Dickerson, S. J. Jeffries, and D. M. Lambourn. 2012. Genetic analysis of Washington State harbor seals (Phoca vitulina richardii) using microsatellites. Can. J. Zool. 90(12):1361-1369. DOI: 10.1139/cjz-2012-0047.

Jeffries, S. J. 1985. Occurrence and distribution patterns of marine mammals in the Columbia River and adjacent coastal waters of northern Oregon and Washington. *In*: Marine Mammals and Adjacent Waters, 1980-

1982. Processed Report 85-04, National Marine Fisheries Service, Northwest and Alaska Fisheries Center, Seattle, Washington.

Julian, F. And M. Beeson. 1998. Estimates for marine mammal, turtle, and seabird mortality for two California gillnet fisheries: 1990-1995. Fish. Bull. 96:271-284.

Kelly, B. P. 1981. Pelage polymorphism in Pacific harbor seals. Can. J. Zool. 59:1212-1219.

Lowry, M. S., J. V. Carretta and K. A. Forney. 2008. Pacific harbor seal census in California during May-July 2002 and 2004. California Fish and Game: 94:180-193.

Lamont, M. M., J. T. Vida, J. T. Harvey, S. Jeffries, R. Brown, H. H. Huber, R. DeLong, and W. K. Thomas. 1996. Genetic substructure of the Pacific harbor seal (*Phoca vitulina richardsi*) off Washington, Oregon, and California. Mar. Mamm. Sci. 12(3):402-413.

O'Corry-Crowe, G. M., K. K. Martien, and B. L. Taylor. 2003. The analysis of population genetic structure in Alaskan harbor seals, Phoca vitulina, as a framework for the identification of management stocks. Administrative Report LJ-03-08. Southwest Fisheries Sceeince Center, 8604 La Jolla Shores Drive, La Jolla, CA, 92037.

Temte, J. L. 1986. Photoperiod and the timing of pupping in the Pacific harbor seal (*Phoca vitulina richardsi*) with notes on reproduction in northern fur seals and Dall's porpoises. Masters Thesis, Oregon State Univ., Corvallis, Oregon.

Westlake, R. L. and G. M. O'Corry-Crowe. 2002. Macrogeographic structure and patterns of genetic diversity in harbor seals (Phoca vitulina) from Alaska to Japan. Journal of Mammalogy 83(4): 1111-1126.