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HARBOR SEAL (*Phoca vitulina richardii*): Oregon/Washington Coast Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Harbor seals inhabit coastal and estuarine waters off Baja California, north along the western coasts of the continental U.S., British Columbia, and Southeast Alaska, west through the Gulf of Alaska and Aleutian Islands, and in the Bering Sea north to Cape Newenham and the Pribilof Islands. They haul out on rocks, reefs, beaches, and drifting glacial ice and feed in marine, estuarine, and occasionally fresh waters. Harbor seals generally are non-migratory, with local movements associated with tides, weather, season, food availability, and reproduction (Scheffer and Slipp 1944; Fisher 1952; Bigg 1969, 1981). Harbor seals do not make extensive pelagic migrations, though some long distance movement of tagged animals in Alaska (900 km) and along the U.S. west coast (up to 550 km) have been recorded (Brown and Mate 1983, Herder 1986, Womble 2012). Harbor seals have also displayed strong fidelity to haulout sites (Pitcher and Calkins 1979, Pitcher and McAllister 1981).

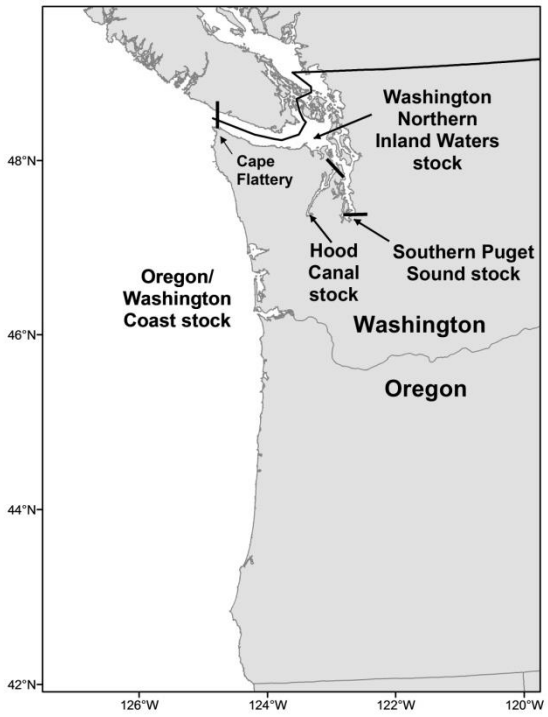


Figure 1. Harbor seal stocks in the U.S. Pacific Northwest

Until recently, differences in mean pupping date (Temte 1986), movement patterns (Jeffries 1985, Brown 1988), pollutant loads (Calambokidis et al. 1985), and fishery interactions led to the recognition of three separate harbor seal stocks along the west coast of the continental U.S. (Boveng 1988): 1) inland waters of Washington State (including Hood Canal, Puget Sound, and the Strait of Juan de Fuca out to Cape Flattery), 2) outer coast of Oregon and Washington, and 3) California Recent genetic evidence suggests that the population of harbor seals in Washington inland waters has more structure than was previously recognized. Studies of pupping phenology, mitochondrial DNA, and microsatellite variation of harbor seals in Washington and Canada-U.S. transboundary waters confirm the currently recognized stock boundary between the Washington Coast and Washington Inland Waters harbor seal stocks, but three genetically distinct populations of harbor seals within Washington inland waters are also evident (Huber et al. 2010, 2012). Within U.S. west coast waters, five stocks of harbor seals are recognized: 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; 4) Oregon/Washington Coast; and 5) California. This report considers only the Oregon/Washington Coast stock. Stock assessment reports for California harbor seals and harbor seals in Washington inland waters (including the Southern Puget Sound, Washington Northern Inland Waters, and Hood Canal stocks) also appear in this volume. Harbor seal stocks that occur in the inland and coastal waters of Alaska are discussed separately in the Alaska Stock Assessment Reports. Harbor seals occurring in British Columbia are not included in any of the U.S. Marine Mammal Protection Act (MMPA) stock assessment reports.

POPULATION SIZE

Aerial surveys of harbor seals in Oregon and Washington were conducted by personnel from the National Marine Mammal Laboratory (NMML) and the Oregon and Washington Departments of Fish and Wildlife (ODFW and WDFW) during the 1999 pupping season. Total numbers of hauled-out seals (including pups) were counted during these surveys. In 1999, the mean count of harbor seals occurring along the Washington coast was 10,430 (CV=0.14) animals (Jeffries et al. 2003). In 1999, the mean count of harbor seals occurring along the Oregon coast and in the Columbia River was 5,735 (CV=0.14) animals (Brown 1997; ODFW, unpublished data). Combining these counts results in 16,165 (CV=0.10) harbor seals in the Oregon/Washington Coast stock.

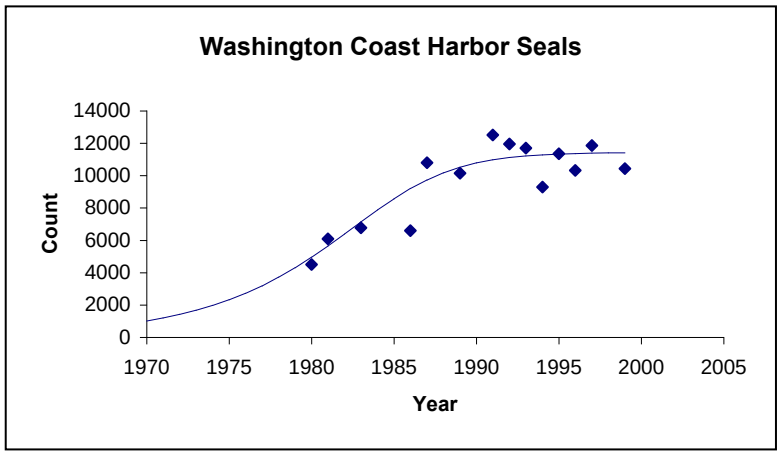
Radio-tagging studies conducted at six locations (three Washington inland waters sites and three Oregon and Washington coastal sites) collected information on haulout patterns from 63 harbor seals in 1991 and 61 harbor seals in 1992. Haulout data from coastal and inland sites were not significantly different and were thus pooled, resulting in a correction factor of 1.53 (CV=0.065) to account for animals in the water which are missed during the aerial surveys (Huber et al. 2001). Using this correction factor results in a population estimate of 24,732 (16,165 x 1.53; CV=0.12) for the Oregon/Washington Coast stock of harbor seals in 1999 (Jeffries et al. 2003; ODFW, unpublished data). However, because the most recent abundance estimate is >8 years old, there is no current estimate of abundance available for this stock.

Minimum Population Estimate

No current information on abundance is available to obtain a minimum population estimate for the Oregon/Washington Coast stock of harbor seals.

Current Population Trend

Historical levels of harbor seal abundance in Oregon and Washington are unknown. The population apparently decreased during the 1940s and 1950s due to state-financed bounty programs. Approximately 17,133 harbor seals were killed in Washington by bounty hunters between 1943 and 1960 (Newby 1973). More than 3,800 harbor seals were killed in Oregon between 1925 and 1972 by bounty hunters and a state-hired seal hunter (Pearson 1968). The population remained relatively low during the 1960s but, since the termination of the harbor seal bounty program and with the protection provided by the passage of the MMPA in 1972, harbor seal counts for this stock have increased from 6,389 in 1977 to 16,165 in 1999 (Jeffries et al. 2003; ODFW, unpublished data). Based on the analyses of Jeffries et al. (2003) and Brown et al. (2005), both the Washington and Oregon portions of this stock were reported as reaching carrying capacity (Fig. 2). In the absence of recent abundance estimates, the current population trend is unknown.



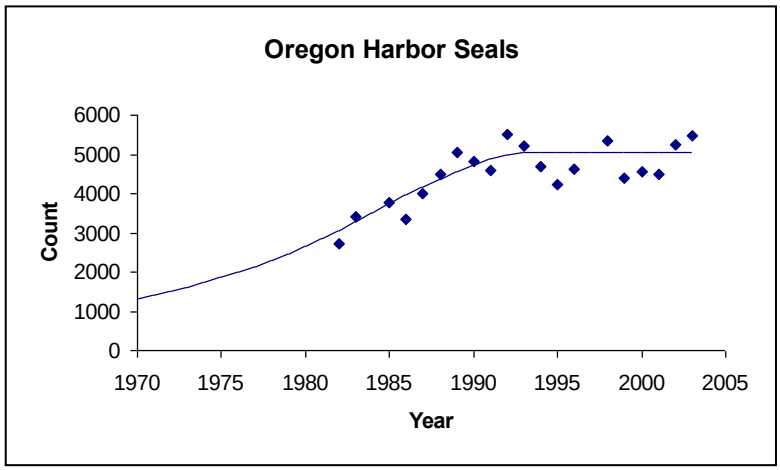


Figure 2. Generalized logistic growth curves of Washington Coast (Jeffries et al. 2003) and Oregon (Brown et al. 2005) harbor seals.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The Oregon/Washington Coast harbor seal stock increased at an annual rate of 7% from 1983 to 1992 and at 4% from 1983 to 1996 (Jeffries et al. 1997). Because the population was not at a very low level by 1983, the observed rates of increase may underestimate the maximum net productivity rate (R_{MAX}). When a logistic model was fit to the Washington portion of the 1975-1999 abundance data, the resulting estimate of R_{MAX} was 18.5% (95% CI = 12.9-26.8%) (Jeffries et al. 2003). When a logistic model was fit to the Oregon portion of the 1977-2003 abundance data, estimates of R_{MAX} ranged from 6.4% (95% CI = 4.6-27%) for the south coast of Oregon to 10.1% (95% CI = 8.6-20%) for the north coast (Brown et al. 2005). Until a combined analysis for the entire stock is completed, the pinniped default maximum theoretical net productivity rate (R_{MAX}) of 12% will be used for this harbor seal stock (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

Because there is no current estimate of minimum abundance, a potential biological removal (PBR) cannot be calculated for this stock.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing 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*". Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fisheries Information

Fishing effort in the northern Washington marine gillnet tribal fishery is conducted within the range of the Oregon/Washington Coast and Washington Northern Inland Waters stocks of harbor seals. Movement of animals between Washington's coastal and inland waters is likely, although tagging data do not show movement of harbor seals between the two locations (Huber et al. 2001). For the purposes of this report, animals taken in waters south and west of Cape Flattery, WA, are assumed to belong to the Oregon/Washington Coast stock and Table 1 includes data only from that portion of the fishery. Fishing effort in the coastal marine set gillnet tribal fishery has declined since 2004. A test set gillnet fishery, with 100% observer coverage, was conducted in coastal waters in 2008 and 2010. This test fishery required the use of nets equipped with acoustic alarms, and observers reported one harbor seal death in 2008 and three in 2010 (Makah Fisheries Management, unpublished data). The mean annual mortality for the marine set gillnet tribal fishery in 2007-2011 is 0.8 (CV=0) harbor seals from observer data.

The U.S. West Coast groundfish fishery was monitored for incidental takes in 2005-2009 (Jannot et al. 2011). Harbor seal deaths were observed in the groundfish trawl fishery (Pacific hake at-sea processing component) in 2005, 2006, and 2008; the nearshore fixed gear fishery in 2006 and 2008; and the non-nearshore fixed gear (limited entry non-primary sablefish) fishery in 2009. The mean annual mortality for each of these fisheries in 2005-2009 is 1.0 (CV=0.24) harbor seals for the groundfish trawl fishery, 5.6 (CV=0.68) for the nearshore fixed gear fishery, and 0.2 for the non-nearshore fixed gear fishery.

Table 1. Summary of available information on the incidental mortality and serious injury of harbor seals (Oregon/Washington Coast stock) in commercial and tribal fisheries that might take this species and calculation of the mean annual mortality rate; n/a indicates that data are not available. Mean annual takes are based on 2007-2011 data unless otherwise noted.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean annual takes (CV in parentheses)
Northern WA marine set gillnet (tribal test fishery in coastal waters)	2007 2008 2009 2010 2011	observer data	no fishery 100% no fishery 100% no fishery	0 1 0 3 0	0 (0) 1 (0) 0 (0) 3 (0) 0 (0)	0.8 (0)
West Coast groundfish trawl (Pacific hake at-sea processing component)	2005 2006 2007 2008 2009	observer data	67%[1] 83%[1] 73%[1] 76%[1] 79%[1]	1 1 0 2 0	1 (0.52) 1 (0.42) 0 3 (0.34) 0	1.0 (0.24)
West Coast groundfish nearshore fixed gear	2005 2006 2007 2008 2009	observer data	5%[2] 11%[2] 9%[2] 7%[2] 4%[2]	0 1 0 2 0	0 n/a[3] 0 27 (0.68) 0	5.6 (0.68)

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean annual takes (CV in parentheses)
West Coast groundfish non-nearshore fixed gear (limited entry non-primary sablefish)	2009	observer data	n/a	1	n/a[3]	>0.2 (n/a)
WA Grays Harbor salmon drift gillnet[2]	1991-1993	observer data	4-5%	0, 1, 1	0, 10, 10	see text[24]
WA Willapa Bay drift gillnet[2]	1991-1993	observer data	1-3%	0, 0, 0	0, 0, 0	see text[24]
WA Willapa Bay drift gillnet[2]	1990-1993	fisherman self-reports	n/a	0, 0, 6, 8	n/a	see text[24]
Unknown West Coast fisheries	2007-2011	stranding data	n/a	0, 0, 0, 0, 3	n/a	>0.6 (n/a)
Minimum total annual takes						>8.2 (0.52)

[1]Percent hauls observed for marine mammals.
[2]Percent observed landings of target species.
[3]Bycatch estimate not provided due to high CV (>80%) for estimate; minimum bycatch of one observed harbor seal is included in the calculation of mean annual take.
[4]This fishery has not been observed since 1993 (see text); these data are not included in the calculation of recent minimum total annual takes.

Commercial salmon drift gillnet fisheries in Washington outer coast waters (Grays Harbor, Willapa Bay) were last observed in 1993 and 1994, with observer coverage levels typically less than 10% (Erstad et al. 1996, Pierce et al. 1994, Pierce et al. 1996, NWIFC 1995). Drift gillnet fishing effort in the outer coast waters has declined considerably since 1994 because fewer vessels participate today (NMFS NW Region, unpublished data), but entanglements of harbor seals likely continue to occur. The most recent data on harbor seal mortality from commercial and tribal gillnet fisheries is included in Table 1.

Combining recent estimates from commercial fisheries observer data for the West Coast groundfish trawl (1.0), West Coast groundfish nearshore fixed gear (5.6), and West Coast groundfish non-nearshore fixed gear (0.2) fisheries results in a mean annual mortality rate of 6.8 harbor seals from these fisheries. An additional 0.8 harbor seals per year were taken in the northern Washington marine set gillnet tribal fishery.

Strandings of harbor seals entangled in fishing gear or with serious injuries caused by interactions with gear are another source of fishery-related mortality. Based on stranding network data, there were three commercial fishery-related deaths of harbor seals from this stock reported in 2011 (listed as unknown West Coast fisheries in Table 1), resulting in a mean annual mortality of 0.6 harbor seals in 2007-2011. Fishery entanglements included two gillnet and one trawl net interaction. Hook and line gear is used by both commercial (salmon troll) and recreational fisheries in coastal waters. Two harbor seal deaths due to ingested hooks were reported in 2007-2011, resulting in an additional mean annual mortality of 0.4 seals from unknown hook and line fisheries. Estimates from stranding data are considered minimum estimates because not all stranded animals are found, reported, or examined for cause of death (via necropsy by trained personnel). An additional harbor seal that stranded with a serious hook injury in 2011 was treated and released with non-serious injuries (Carretta et al. 2013); therefore, it was not included in the mean annual mortality in this report.

Data on fisheries mortality reported in Table 1 likely represent minimum estimates, particularly for fisheries where observer coverage is low and bycatch events are too infrequent to be documented by fishery observers. The magnitude of negative bias in mortality estimates is unknown and methods to correct for such negative biases in these fisheries have not been developed.

Other Mortality

During 2007-2011, one harbor seal from this stock was incidentally killed during scientific halibut longline operations in 2011, resulting in a mean annual research-related mortality of 0.2 animals.

According to Northwest Marine Mammal Stranding Network records, maintained by the NMFS Northwest Region (NMFS, Northwest Regional Office, unpublished data), a total of nine human-caused harbor seal deaths were reported from non-fisheries sources in 2007-2011. Six animals were shot, two animals were struck by boats, and one animal was killed by a dog, resulting in a mean annual mortality of 1.8 harbor seals from this stock. This estimate is considered a minimum because not all stranded animals are found, reported, or examined for cause of death (via necropsy by trained personnel).

Subsistence Harvests by Northwest Treaty Indian Tribes

Tribal subsistence takes of this stock may occur, but no data on recent takes are available.

STATUS OF STOCK

Harbor seals are not considered to be "depleted" under the MMPA or listed as "threatened" or "endangered" under the ESA. Based on currently available data, the minimum level of human-caused mortality and serious injury is 10.6 harbor seals per year: (8.2 from fishery sources in Table 1, plus 0.4 from unknown hook and line fisheries, plus 0.2 scientific takes annually, plus 1.8 non-fishery causes annually). A PBR cannot be calculated for this stock because there is no current abundance estimate. Human-caused mortality relative to PBR is unknown, but it is considered to be small relative to the stock size. Therefore, the Oregon/Washington Coast stock of harbor seals is not classified as a "strategic" stock. The minimum annual commercial fishery mortality and serious injury for this stock, based on recent observer data (6.8) and stranding data (0.6) is 7.4. Since a PBR cannot be calculated for this stock, fishery mortality relative to PBR is unknown. The stock was previously reported to be within its Optimum Sustainable Population (OSP) range (Jeffries et al. 2003, Brown et al. 2005), but in the absence of recent abundance estimates, this stock's status relative to OSP is unknown.

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