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HARBOR SEAL (*Phoca vitulina richardii*): Washington Inland Waters Stocks: (Hood Canal, Southern Puget Sound, Washington Northern Inland Waters)

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 such factors as 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 for haulout sites (Pitcher and Calkins 1979, Pitcher and McAllister 1981).

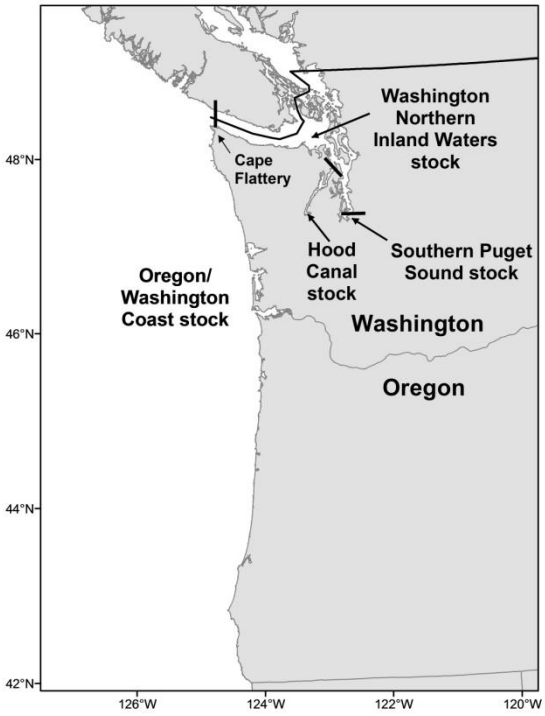

Figure 1. Approximate distribution of harbor seal stocks in the U.S. Pacific Northwest (shaded area). Stock boundaries separating the three stocks are shown.

Until recently, differences in mean pupping date (Temte 1986), movement patterns (Jeffries 1985, Brown 1988), pollutant loads (Calambokidis et al. 1985), and fishery interactions have 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 is currently 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 includes only the stocks in Washington's inland waters. Stock assessment reports for Oregon/Washington Coast and California harbor seals 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 Washington were conducted during the pupping season in 1999, during which time the total numbers of hauled-out seals (including pups) were counted. In 1999, the mean count of harbor seals occurring in Washington's inland waters was 7,213 (CV=0.14) in Washington Northern Inland Waters, 711 (CV=0.14) in Hood Canal, and 1,025 (CV=0.14) in Southern Puget Sound (Jeffries et al. 2003).

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. 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 estimates of 11,036 (7,213 x 1.53; CV=0.15) for the Washington Northern Inland Waters stock; 1,088 (711 x 1.53; CV=0.15) for the Hood Canal stock; and 1,568 (1,025 x 1.53; CV=0.15) for the Southern Puget Sound stock of harbor seals (Jeffries et al. 2003). However, because the most recent abundance estimates are >8 years old, there are no current estimates of abundance for these stocks. Surveys of harbor seals in Washington inland waters are planned for 2013.

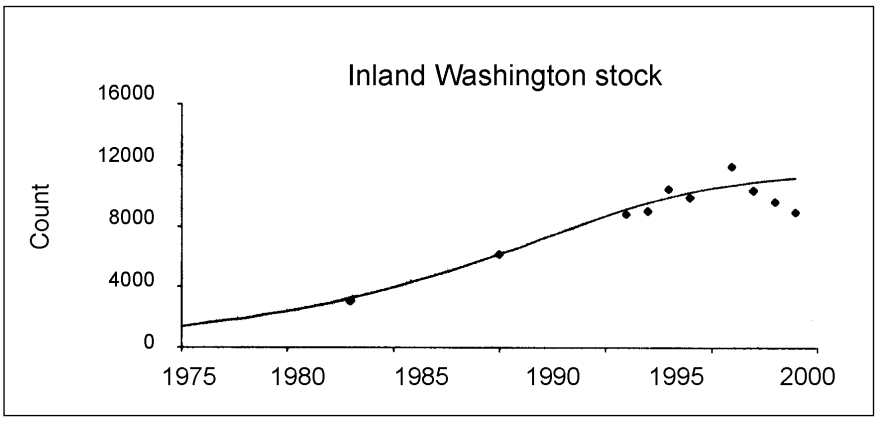

Figure 2. Generalized logistic population growth curve for the Washington Inland Waters stock of harbor seals, 1978-1999 (Jeffries et al. 2003).

Minimum Population Estimate

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

Current Population Trend

Historical levels of harbor seal abundance in Washington are unknown. The population apparently decreased during the 1940s and 1950s due to a state-financed bounty program. Approximately 17,133 harbor seals were killed in Washington by bounty hunters between 1943 and 1960 (Newby 1973). The population remained relatively low during the 1970s but, since the termination of the harbor seal bounty program in 1960 and with the passage of the Marine Mammal Protection Act (MMPA) in 1972, harbor seal numbers in Washington have increased (Jeffries 1985).

Between 1983 and 1996, the annual rate of increase for this stock was 6% (Jeffries et al. 1997). The peak count occurred in 1996 and, based on a fitted generalized logistic model (Fig. 2), the population is thought to be stable (Jeffries et al. 2003). In the absence of recent abundance estimates, the current population trend is unknown.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

From 1991 to 1996, counts of harbor seals in Washington State have increased at an annual rate of 10% (Jeffries et al. 1997). Because the population was not at a very low level by 1991, the observed rate of increase may underestimate the maximum net productivity rate (R_{MAX}). When a logistic model was fit to the 1978-1999 abundance data, the resulting estimate of R_{MAX} was 12.6% (95% CI = 9.4-18.7%) (Jeffries et al. 2003). This value of R_{MAX} is very close to the default pinniped maximum theoretical net productivity rate of 12% (R_{MAX}), therefore, 12% will be employed 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. Some movement of animals between Washington's coastal and inland waters is likely, although data from tagging studies have not shown movement of harbor seals between the two locations (Huber et al. 2001). For the purposes of this stock assessment report, the animals taken in waters east of Cape Flattery, WA, are assumed to have belonged to the Washington Northern Inland Waters stock, and Table 1 includes data only from that portion of the fishery. There was no observer coverage in the northern Washington marine set gillnet tribal fishery in inland waters in 2007-2011; however, there were two fishermen self-reports of harbor seal deaths in this fishery in 2008 and five in 2009 (Makah Fisheries Management, unpublished data). The mean annual mortality for this fishery in 2007-2011 is 1.4 harbor seals from self-reports. Fishing effort in the northern Washington marine drift gillnet tribal fishery in inland waters is also conducted within the range of the Washington Northern Inland Waters stock of harbor seals. This fishery is not observed; however, there was one self-report of a harbor seal death in 2008 (Makah Fisheries Management, unpublished data). The mean annual mortality for this fishery in 2007-2011 is 0.2 harbor seals from self-reports.

Commercial salmon drift gillnet fisheries in Washington inland waters 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 inland waters has declined considerably since 1994 because far 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 gillnet fisheries is included in Table 1.

Table 1. Summary of available information on the incidental mortality and serious injury of harbor seals (Washington Northern Inland Waters, Hood Canal, and Southern Puget Sound stocks) 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 noted otherwise.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean annual takes (CV in parentheses)
Northern WA marine set gillnet (tribal fishery in inland waters)	2008 2009	fisherman self-reports	-	2 5	n/a n/a	1.4 (n/a)
Northern WA marine drift gillnet (tribal fishery in inland waters)	2008	fisherman self-reports	-	1	n/a	>0.2 (n/a)
WA Puget Sound Region salmon set/drift gillnet (observer programs listed below covered segments of this fishery):	-	-	-	-	-	-
Puget Sound non-treaty salmon gillnet (all areas and species)	1993	observer data	1.3%	2	n/a	see text
Puget Sound non-treaty chum salmon gillnet (areas 10/11 and 12/12B)[1]	1994	observer data	11%	1	10	see text[1]
Puget Sound treaty chum salmon gillnet (areas 12, 12B, and 12C)[1]	1994	observer data	2.2%	0	0	see text[1]
Puget Sound treaty chum and sockeye salmon gillnet (areas 4B, 5, and 6C)[1]	1994	observer data	7.5%	0	0	see text[1]
Puget Sound treaty and non-treaty sockeye salmon gillnet (areas 7 and 7A)[1]	1994	observer data	7%	1	15	see text[1]

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean annual takes (CV in parentheses)
Unknown Washington Northern Inland Waters fisheries	2007-2011	stranding data	n/a	1, 1, 1, 1, 2	n/a	≥1.2 (n/a)
Unknown Hood Canal fisheries	2007-2011	stranding data	n/a	0, 0, 0, 0, 1	n/a	> 0.2 (n/a)
Unknown Southern Puget Sound fisheries	2007-2011	stranding data	n/a	0, 5, 0, 0, 0	n/a	>1.0 (n/a)
Minimum total annual takes Washington Northern Inland Waters						> 2.8 (n/a)
Minimum total annual takes Hood Canal						> 0.2 (n/a)
Minimum total annual takes Southern Puget Sound						>1.0 (n/a)

[1]This fishery has not been observed since 1994 (see text); these data are not included in the calculation of recent minimum total annual takes.

Strandings of harbor seals entangled in fishing gear or with serious injuries caused by interactions with gear are a final source of fishery-related mortality information. As these strandings could not be attributed to a particular fishery, they have been included in Table 1 as occurring in unknown Washington inland waters fisheries. According to Northwest Marine Mammal Stranding Network records, maintained by the NMFS Northwest Region (NMFS, Northwest Regional Office, unpublished data), 12 fishery-related harbor seal deaths and serious injuries were reported in Washington inland waters in 2007-2011: six from the Washington Northern Inland Waters stock, one from the Hood Canal stock, and five from the Southern Puget Sound stock, resulting in mean annual takes of 1.2 harbor seals in Washington Northern Inland Waters, 0.2 in Hood Canal, and 1.0 in Southern Puget Sound. Fishery interactions included two gaff injuries, two gillnet entanglements, in one fishing net entanglement, and one entanglement in fishing gear in Washington Northern Inland Waters; one gillnet entanglement in Hood Canal; and five gillnet entanglements in Southern Puget Sound. Harbor seal deaths caused by interactions with recreational hook and line fishing gear were also reported in 2007-2011: two seals had hook injuries and one ingested a hook in Washington Northern Inland Waters and two seals ingested hooks in Southern Puget Sound, resulting in mean annual mortalities of 0.6 and 0.4, respectively, from these two stocks. 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). Two additional harbor seals that stranded with serious hook injuries from recreational hook and line gear in Washington Northern Inland Waters in 2007-2011 were treated and released with non-serious injuries (Carretta et al. 2013); therefore, they were not included in the mean annual mortality in this report.

Other Mortality

According to Northwest Marine Mammal Stranding Network records, maintained by the NMFS Northwest Region (NMFS, Northwest Regional Office, unpublished data), a total of 32 human-caused harbor seal deaths or serious injuries were reported from non-fisheries sources in 2007-2011 for the Washington Northern Inland Waters stock. Eight animals were shot, 13 nine were struck by boats, two died in oil spills, three two were killed by dogs, and 13 were entangled in marine debris, resulting in a mean annual mortality of 6.4 harbor seals from this stock. During the same time period, 10 human-caused deaths or serious injuries were reported for the Southern Puget Sound stock: one animal entangled in marine debris, six were shot, one was killed by a dog, one entangled in a buoy line, and one entangled in a scientific research net, resulting in a mean annual mortality of 2.0 harbor seals. These 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 seriously injured harbor seal was disentangled from marine debris and released with non-serious injuries in Washington Northern Inland Waters in 2007 (Carretta et al. 2013); therefore, it was not included in the mean annual mortality in this report.

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 Endangered Species Act. Based on currently available data, the minimum level of human-caused mortality and serious injury is 9.8 harbor seals per year for the Washington Northern Inland Waters stock (2.8 from fishery sources in Table 1 + 0.6 from recreational hook and line fisheries + 6.4 from non-fishery sources). Annual human-caused serious injury and mortality for the Hood Canal stock is 0.2 from unknown fishery sources. Annual human-caused serious injury and mortality for the Southern Puget Sound stock is 3.4, including 1.0 from fishery sources listed in Table 1, 0.4 from recreational hook and line fisheries, and 2.0 from non-fishery sources. PBRs cannot be calculated for these stocks because there are no current abundance estimates. Human-caused mortality relative to PBR is unknown for these stocks, but is considered to be small relative to stock size. Therefore, the Washington Northern Inland Waters, Hood Canal, and Southern Puget Sound stocks of harbor seals are not classified as "strategic" stocks. At present, the minimum annual fishery mortality and serious injury for these stocks (based on stranding data) are 1.2 for the Washington Northern Inland Waters stock, 0.2 for the Hood Canal stock, and 1.0 for the Southern Puget Sound stock. Since a PBR cannot be calculated for these stocks, 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), but in the absence of recent abundance estimates, this stock's status relative to OSP is unknown.

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