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HARBOR SEAL (*Phoca vitulina richardsi*): 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 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 (174 km) and along the U.S. west coast (up to 550 km) have been recorded (Pitcher and McAllister 1981, Brown and Mate 1983, Herder 1986). Harbor seals have also displayed strong fidelity for haul out sites (Pitcher and Calkins 1979, Pitcher and McAllister 1981).

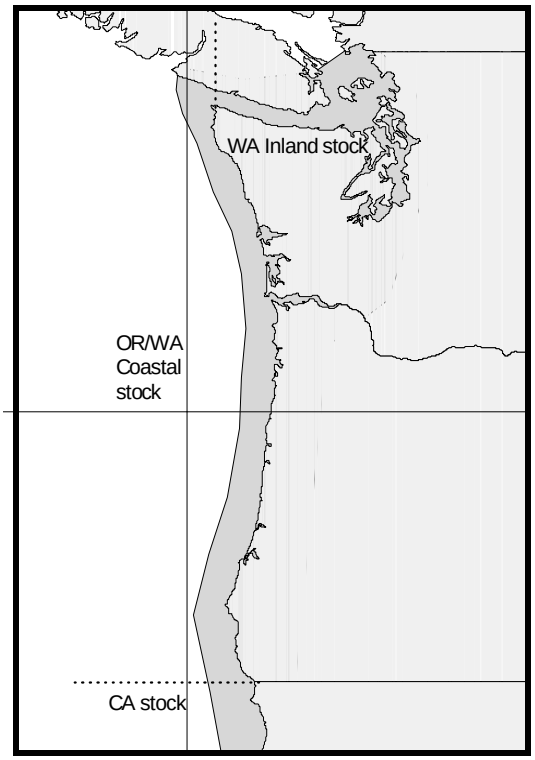

Figure 1. Approximate distribution of harbor seals in the U.S. Pacific Northwest (shaded area). Stock boundaries separating the three stocks are shown.

For management purposes, 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 3 separate harbor seal stocks along the west coast of the continental U.S. (Boveng 1988): 1) inland waters of Washington State (including the Hood Canal, Puget Sound, and Strait of Juan de Fuca out to Cape Flattery), 2) outer coast of Oregon and Washington, and 3) California (see Fig. 1). Recent genetic analyses provide additional support for this stock structure (Huber et al. 1994, Burg 1996, Lamont et al. 1996). Samples from Washington, Oregon, and California demonstrate a high level of genetic diversity and indicate that the harbor seals of inland Washington possess unique haplotypes not found in seals from the coasts of Washington, Oregon, and California (Lamont et al. 1996). This report considers only the Oregon/Washington Coast stock. Harbor seal stocks that occur in the inland and coastal waters of Alaska are reported separately in the Stock Assessment Reports for the Alaska Region.

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. in press). 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, unpubl. data). Combining these counts results in 16,165 (CV=0.10) harbor seals in the Oregon/Washington Coast stock.

Radio-tagging studies conducted at 6 locations (3 Washington inland waters sites and 3 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 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. in press; ODFW, unpubl. data).

Minimum Population Estimate

The log-normal 20th percentile of the 1999 population estimate for this stock is 22,380 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 Marine Mammal Protection Act (MMPA) in 1972, harbor seal counts for this stock have increased from 6,389 in 1977 to 16,165 in 1999 (Jeffries et al. in press; ODFW, unpubl. data).

Between 1983 and 1996, the annual rate of increase for this stock was 4%, with the peak count of 18,667 seals occurring in 1992. From 1991 to 1996, however, this stock declined 1.6% (t=3.25; p=0.083) annually (Jeffries et al. 1997), which may indicate that this population has exceeded equilibrium levels. Analyzing only the Oregon data (average annual rate of increase was 0.3% from 1988-96) indicates that the Oregon segment of the stock may be approaching equilibrium (Brown 1997).

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} was18.5% (95% CI = 12.9-26.8%) (Jeffries et al. in press). This value of R_{MAX} is higher than the pinniped default value of 12%; however, since it applies to only a portion of the stock, the actual rate for the entire stock is uncertain. Therefore, until additional data for the entire stock become available, the pinniped default maximum theoretical net productivity rate (R_{MAX}) of 12% will be employed for this harbor seal stock (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population estimate (22,380) times one-half the default maximum net growth rate for pinnipeds (½ of 12%) times a recovery factor of 1.0 (for stocks thought to be within OSP, Wade and Angliss 1997), resulting in a PBR of 1,343 harbor seals per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

NMFS observers monitored the northern Washington marine set gillnet fishery during 1994-1998 and in 2000; there was no observer coverage in 1999, however, the total fishing effort was only 4 net days in inland waters (Gearin et al. 1994, 2000; P. Gearin, unpubl. data). For the entire fishery (coastal + inland waters), observer coverage ranged from approximately 33 to 98% during observed years. Fishing effort is conducted within the range of both stocks of harbor seals (Oregon/Washington Coast and Washington Inland Waters stocks) occurring in Washington State waters. For the purposes of this stock assessment report, the animals taken in the inland portion of the fishery are assumed to have belonged to the Washington Inland Waters stock and the animals taken in the coastal portion of the fishery are assumed to have belonged to the Oregon/Washington Coast stock. 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). Accordingly, Table 1 includes data only from that portion of the northern Washington marine set gillnet fishery occurring within the range of the Oregon/Washington Coast stock (those waters south and west of Cape Flattery), where observer coverage was 30% in 1994 and 100% in 1995-1997 and 2000. In 1994, the observer program was delayed because the biological opinion on the fishery, relating to takes of marbled murrelets under the ESA, was not completed by the time the fishery began. One vessel fished in the coastal fishery in 1994 and 30% of the sets were observed. No fishing effort occurred in the coastal portion of the fishery in 1998 or 1999. Data from 1994 to 2000 are included in Table 1, although the mean estimated annual mortality is calculated using

only the most recent 5 years for which data are available. The mean estimated mortality for this fishery is 5 (CV=0.52) harbor seals per year from this stock.

The WA/OR/CA groundfish trawl fishery (Pacific whiting component) was monitored for incidental take during 1996-2000. The only harbor seal mortalities occurred in 1996, 1997, and 2000. The mortalities in 1996 and 1997 occurred during unmonitored hauls and therefore were not used to estimate mortality for the entire fishery in those years. However, observer coverage (based on observed tons) was 65% and 66% (respectively) in 1996 and 1997, observers monitored 100% of the vessels during the fishery, and the reported mortalities are thought to be the only harbor seal mortalities in the fishery in those years. The mean estimated mortality in 1996-2000 for monitored hauls in this fishery is 0.8 (CV=1.0) harbor seals per year from this stock, plus 0.4 animals per year from unmonitored haul data.

Table 1. Summary of available information on the incidental mortality and 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. All entanglements resulted in the death of the animal. Mean annual takes are based on 1996-2000 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 fishery: coastal waters)	94 95 96 97 98 99 00	obs data	30% 100% 100% 100% no fishery no fishery 100%	4 3 9 13 0 0 3	13 3 9 13 0 0 3	5 (0.52)
WA/OR/CA groundfish trawl (Pacific whiting component)	96 97 98 99 00 96 97	obs data unmonitored hauls	65.2% 65.7% 77.3% 68.6% 80.6%	0 0 0 0 2 1 1	0 0 0 0 4	0.8 (1.0) 0.4 (n/a)
WA Grays Harbor salmon drift gillnet	91-93	obs data	4-5%	0, 1, 1	0, 10, 10	6.7 (0.50)
WA Willapa Bay drift gillnet	91-93	obs data	1-3%	0, 0, 0	0, 0, 0	0
				Reported mortalities		
WA Willapa Bay drift gillnet	90-00	self reports	n/a	0, 0, 6, 8, n/a, n/a, n/a, n/a, n/a, n/a, n/a	n/a	$\geq$ 3.5 (n/a) see text
Unknown west coast fisheries	96-00	strand data	n/a	0, 0, 0, 1, 0		$\geq$ 0.2 (n/a)
Minimum total annual takes						$\geq$ 16.6 (0.35)

The Washington and Oregon Lower Columbia River drift gillnet fishery was monitored during the entire year in 1991-1993 (Brown and Jeffries 1993, Matteson et al. 1993c, Matteson and Langton 1994a). Harbor seal mortalities, incidental to the fishery, were observed only in the winter season and were extrapolated to estimate total harbor seal mortality. However, the structure of the fishery has changed substantially since the 1991-1992 fishing seasons, and this level of take no longer applies to the current fishery (see Appendix 1).

The Washington Grays Harbor salmon drift gillnet fishery was also monitored in 1991-1993 (Herczeg et al. 1992a; Matteson and Molinaar 1992; Matteson et al. 1993a; Matteson and Langton 1994b, 1994c). During the 3-year period, 98, 307 and 241 sets were monitored, representing approximately 4-5% observer coverage in each year. No mortalities were recorded in 1991. In 1992, observers recorded one harbor seal mortality incidental to the fishery, resulting in an extrapolated estimated total kill of 10 seals (CV=1.0). In 1993, observers recorded one harbor seal mortality incidental to the fishery, though a total kill was not extrapolated. Similar observer coverage in 1992 and 1993 (4.2% and 4.4%, respectively) suggests that 10 is also a reasonable estimate of the total kill in 1993. Thus, the mean estimated mortality for this fishery in 1991-1993 is 6.7 (CV=0.50) harbor seals per year (Table 1). No observer data are available for this fishery after 1993, however, harbor seal takes are unlikely to have increased since the fishery was last observed, due to reductions in the number of participating vessels and available fishing time (see details in Appendix 1). Fishing effort and catch have declined throughout all salmon fisheries in the region due to management efforts to recover ESA-listed salmonids.

Combining the estimates from the northern Washington marine set gillnet (5), WA/OR/CA groundfish trawl (0.8 from monitored hauls + 0.4 from unmonitored haul data), and Washington Grays Harbor salmon drift gillnet (6.7) fisheries results in an estimated mean mortality rate in observed fisheries of 12.9 harbor seals per year from this stock.

The Washington Willapa Bay drift gillnet fishery was also monitored at low levels of observer coverage in 1991-1993 (Herczeg et al. 1992a, 1992b; Matteson and Molinaar 1992; Matteson et al. 1993b; Matteson and Langton 1994c, 1994d). In those years, 752, 576 and 452 sets were observed, representing approximately 2.5%, 1.4% and 3.1% observer coverage, respectively. No harbor seal mortalities were reported by observers. However, because mortalities were self-reported by fishers in 1992 and 1993, the low level of observer coverage failed to document harbor seal mortalities which had apparently occurred. Due to the low level of observer coverage for this fishery, the self-reported fishery mortalities have been included in Table 1 and represent a minimum mortality estimate resulting from that fishery (3.5 harbor seals per year). Harbor seal takes are unlikely to have increased since the fishery was last observed in 1993, due to reductions in the number of participating vessels and available fishing time (see details in Appendix 1). Fishing effort and catch have declined throughout all salmon fisheries in the region due to management efforts to recover ESA-listed salmonids.

An additional source of information on the number of harbor seals killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1994 and 2000, there were no fisher self-reports of any harbor seal mortalities. However, because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. Logbook data are available for part of 1989-1994, after which incidental mortality reporting requirements were modified. Under the new system, logbooks are no longer required; instead, fishers provide self-reports. Data for the 1994-1995 phase-in period is fragmentary. After 1995, the level of reporting dropped dramatically, such that the records are considered incomplete and estimates of mortality based on them represent minimums (see Appendix 7 in Angliss et al. 2001 for details).

Strandings of harbor seals entangled in fishing gear or with injuries caused by interactions with gear are a final source of fishery-related mortality information. One fishery-related stranding was reported in 1999 and, since it could not be attributed to a particular fishery, it is listed in Table 1 as occurring in an unknown west coast fishery. Fishery-related strandings during 1996-2000 resulted in an estimated annual mortality of 0.2 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).

Other Mortality

According to Northwest Marine Mammal Stranding Network records, maintained by the NMFS Northwest Region, a total of 6 human-caused harbor seal mortalities or serious injuries were reported from non-fisheries sources in 1996-2000. Five animals were shot (1 each in 1997, 1999, and 2000 and 2 in 1998) and one animal was struck by an off-road-vehicle (in 1997), resulting in an estimated mortality of 1.2 harbor seals per year 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

Several Pacific Northwest treaty Indian tribes have promulgated tribal regulations allowing tribal members to

exercise treaty rights for subsistence harvest of harbor seals. There have been only a few reported takes of harbor seals from directed tribal subsistence hunts. It is possible that very few seals have been taken in directed hunts because tribal fishers use seals caught incidentally to fishing operations for their subsistence needs before undertaking a ceremonial or subsistence hunt. From communications with the tribes, the NMFS Northwest Regional Office (J. Scordino, pers. comm.) believes that 5-10 harbor seals from this stock may be taken annually in directed subsistence harvests.

STATUS OF STOCK

Harbor seals are not considered as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Based on currently available data, the level of human-caused mortality and serious injury (16.6 + 1.2 + 5-10 = 22.8-27.8) is not known to exceed the PBR (1,343). Therefore, the Oregon/Washington Coast stock of harbor seals is not classified as a "strategic" stock. The minimum total fishery mortality and serious injury for this stock (16.6: based on observer data (12.9) and self-reported fisheries information (3.5) or stranding data (0.2) where observer data were not available or failed to detect harbor seal mortality) appears to be less than 10% of the calculated PBR (134) and, therefore, appears to be insignificant and approaching zero mortality and serious injury rate. The stock size increased until 1992, but has declined in recent years. At this time it is not possible to assess the status of this stock relative to its Optimum Sustainable Population (OSP) level.

REFERENCES

Angliss, R.P., D.P. DeMaster, and A.L. Lopez. 2001. Alaska marine mammal stock assessments, 2001. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-124. 203 pp.

Bigg, M. A. 1969. The harbour seal in British Columbia. Fish. Res. Bd. Can. Bull. 172. 33 pp.

Bigg, M. A. 1981. Harbour seal, *Phoca vitulina*, Linnaeus, 1758 and *Phoca largha*, Pallas, 1811. Pp. 1-27, *In:* Ridgway, S. H., and R. J. Harrison (eds.), Handbook of Marine Mammals. Vol. 2: Seals. Academic Press, New York.

Boveng, P. 1988. Status of the Pacific harbor seal population on the U.S. west coast. Admin. Rept. LJ-88-06. Southwest Fisheries Center, National Marine Fisheries Service, P.O. Box 271, La Jolla, CA. 43 pp.

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

Brown, R. F. 1997. Abundance of Pacific harbor seals (*Phoca vitulina richardsi*) in Oregon: 1977-1996. Oregon Dept. Fish and Wildlife, Wildlife Diversity Program, Tech. Report No. 97-6-04. 12 pp.

Brown, R. F., and S. J. Jeffries. 1993. Preliminary report on estimated marine mammal mortality in Columbia River fall and winter salmon gillnet fisheries, 1991-1992. Unpubl. report. Columbia River Area Gillnet Fishery Observer Program. 13 pp. Available at Oregon Dept. Fish and Wildlife, Newport, OR 97365.

Brown, R. F., and B. R. Mate. 1983. Abundance, movements, and feeding habits of the harbor seal, *Phoca vitulina*, at Netarts and Tillamook Bays, Oregon. Fish. Bull. 81:291-301.

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. MS Thesis, Univ. of British Columbia, Vancouver, BC. 77 pp.

Calambokidis, J., S. Speich, J. Peard, G. Steiger, D. M. Fry, J. Lowenstine, and J. 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.

Credle, V. R., D. P. DeMaster, M. M. Merklein, M. B. Hanson, W. A. Karp, and S. M. Fitzgerald (eds.). 1994. NMFS observer programs: minutes and recommendations from a workshop held in Galveston, Texas, November 10-11, 1993. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-94-1. 96 pp.

Fisher, H. D. 1952. The status of the harbour seal in British Columbia, with particular reference to the Skeena River. Fish. Res. Bd. Can. Bull. 93. 58 pp.

Gearin, P. J. National Marine Mammal Laboratory, AFSC, NMFS, 7600 Sand Point Way NE, Seattle, WA 98115.

Gearin, P. J., S. R. Melin, R. L. DeLong, H. Kajimura, and M. A. Johnson. 1994. Harbor porpoise interactions with a chinook salmon set-net fishery in Washington State. Rep. Int. Whal. Commn. Special Issue 15:427-438.

Gearin, P. J., M. E. Gosho, J. L. Laake, L. Cooke, R. L. DeLong, and K. M. Hughes. 2000. Experimental testing of acoustic alarms (pingers) to reduce bycatch of harbour porpoise, *Phocoena phocoena*, in the state of Washington. J. Cetacean Res. Manage. 2(1):1-9.

Herczeg, K. M., A. A. Abajian , and V. M. C. Molinaar. 1992a. Summary report on the 1991 summer dip-in salmon gillnet fisheries in Willapa Bay and Grays Harbor. Unpubl. report. Pacific States Marine Fisheries Commission, Astoria, OR. 10 pp. Available at PSMFC, 45 SE 82nd Ave., Ste. 100, Gladstone, OR 97027.

Herczeg, K. M., V. M. C. Molinaar, and A. A. Abajian. 1992b. Summary report on the 1991 fall Willapa Bay salmon gillnet fishery. Unpubl. report. Pacific States Marine Fisheries Commission, Astoria, OR. 10 pp. Available at PSMFC, 45 SE 82nd Ave., Ste. 100, Gladstone, OR 97027.

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., Humbolt, California. 52 pp.

Huber, H., S. Jeffries, R. Brown, and R. DeLong. 1994. Harbor seal, *Phoca vitulina richardsi*, stock assessment in Washington and Oregon, 1993. 1993 Annual Report to the MMPA Assessment Program, Office of Protected Resources, NMFS, NOAA, 1335 East-West Highway, Silver Spring, MD 20910. Available at National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115.

Huber, H. R., S. J. Jeffries, R. F. Brown, R. L. DeLong, and G. VanBlaricom. 2001. Correcting aerial survey counts of harbor seals (*Phoca vitulina richardsi*) in Washington and Oregon. Mar. Mammal. Sci. 17(2):276-293.

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, WA.

Jeffries, S. J., R. F. Brown, H. R. Huber, and R. L. DeLong. 1997. Assessment of harbor seals in Washington and Oregon, 1996. Pp. 83-94, *In:* Hill, P. S., and D. P. DeMaster (eds.), MMPA and ESA Implementation Program, 1996. AFSC Processed Report 97-10. 255 pp. Available at National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115.

Jeffries, S., H. Huber, J. Calambokidis, and J. Laake. In press. Trends and status of harbor seals in Washington State: 1978-1999. J. Wildl. Manage.

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. Mammal Sci. 12(3):402-413.

Matteson, K. M., and J. A. Langton. 1994a. Summary report on the 1993 fall Columbia River salmon gillnet fishery. Unpubl. report. Pacific States Marine Fisheries Commission, Astoria, OR. 19 pp. Available at PSMFC, 45 SE 82nd Ave., Ste. 100, Gladstone, OR 97027.

Matteson, K. M., and J. A. Langton. 1994b. Summary report on the 1993 fall Grays Harbor salmon gillnet fishery. Unpubl. report. Pacific States Marine Fisheries Commission, Astoria, OR. 18 pp. Available at PSMFC, 45 SE 82nd Ave., Ste. 100, Gladstone, OR 97027.

Matteson, K. M., and J. A. Langton. 1994c. Summary report on the 1993 summer dip-in salmon gillnet fisheries in Willapa Bay and Grays Harbor. Unpubl. report. Pacific States Marine Fisheries Commission, Astoria, OR. 22 pp. Available at PSMFC, 45 SE 82nd Ave., Ste. 100, Gladstone, OR 97027.

Matteson, K. M., and J. A. Langton. 1994d. Summary report on the 1993 fall Willapa Bay salmon gillnet fishery. Unpubl. report. Pacific States Marine Fisheries Commission, Astoria, OR. 18 pp. Available at PSMFC, 45 SE 82nd Ave., Ste. 100, Gladstone, OR 97027.

Matteson, K. M., and V. M. C. Molinaar. 1992. Summary report on the 1992 summer dip-in salmon gillnet fisheries in Willapa Bay and Grays Harbor. Unpubl. report. Pacific States Marine Fisheries Commission, Astoria, OR. 13 pp. Available at PSMFC, 45 SE 82nd Ave., Ste. 100, Gladstone, OR 97027.

Matteson, K. M., W. B. Barnett, and J. A. Langton. 1993a. Summary report on the 1992 fall Grays Harbor salmon gillnet fishery. Unpubl. report. Pacific States Marine Fisheries Commission, Astoria, OR. 17 pp. Available at PSMFC, 45 SE 82nd Ave., Ste. 100, Gladstone, OR 97027.

Matteson, K. M., W. B. Barnett, and J. A. Langton. 1993b. Summary report on the 1992 fall Willapa Bay salmon gillnet fishery. Unpubl. report. Pacific States Marine Fisheries Commission, Astoria, OR. 17 pp. Available at PSMFC, 45 SE 82nd Ave., Ste. 100, Gladstone, OR 97027.

Matteson, K. M., J. A. Langton, and R. L. Hadley. 1993c. Summary report on the 1993 winter Columbia River salmon gillnet fishery. Unpubl. report. Pacific States Marine Fisheries Commission, Astoria, OR. 29 pp. Available at PSMFC, 45 SE 82nd Ave., Ste. 100, Gladstone, OR 97027.

Newby, T. C. 1973. Changes in Washington State harbor seal population, 1942-1972. Murrelet 54:5-6.

Oregon Department of Fish and Wildlife, Marine Science Dr., Bldg. 3, Newport, OR 97365.
Pearson, J. P. 1968. The abundance and distribution of harbor seals and Steller sea lions in Oregon. MS Thesis, Oregon State Univ., Corvallis, OR. 23 pp.
Pitcher, K. W., and D. G. Calkins. 1979. Biology of the harbor seal (*Phoca vitulina richardsi*) in the Gulf of Alaska. U.S. Dep. Commer., NOAA, OCSEAP Final Rep. 19(1983):231-310.
Pitcher, K. W., and D. C. McAllister. 1981. Movements and haul out behavior of radio-tagged harbor seals, *Phoca vitulina*. Can. Field Nat. 95:292-297.
Scheffer, V. B., and J. W. Slipp. 1944. The harbor seal in Washington State. Amer. Midl. Nat. 32:373-416.
Scordino, J. National Marine Fisheries Service, Northwest Region, 7600 Sand Point Way NE, Seattle, WA 98115.
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. MS Thesis, Oregon State Univ. Corvallis, OR.
Wade, P. R., and R. Angliss. 1997. Guidelines for assessing marine mammal stocks: report of the GAMMS workshop April 3-5, 1996, Seattle, Washington. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12. 93 pp.