Volume III, Chapter 18
Harbor Seals

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18.0 Habor Seals (*Phoca vitulina*)

18.1 Introduction

The harbor seal (*Phoca vitulina*) is a small, stocky phocid seal found throughout the temperate and arctic waters of the northern hemisphere, and has the widest distribution of any pinniped. In the Pacific Ocean, harbor seals inhabit coastal and estuarine waters from Baja California, north along the western coast of the continental U.S., British Columbia, and southeast Alaska, west through the Gulf of Alaska and Aleution Islands to Russia and Japan, and in the Bering Sea north to Cape Newenham and the Pribolof Islands (Carretta *et al*. 2002). Harbor seals generally considered non-migratory, with local movements associated with daily and seasonal variation in tides, weather, prey availability and reproduction (Scheffer and Slipp 1944; Fisher 1952; Bigg 1969a; Bigg 1973; Jeffries 1984; Jeffries 1985; Jeffries 1986). Harbor seals are considered a non-migratory species, breeding and feeding in the same general area throughtout the year (Scheffer and Slipp 1944; Bigg 1969a).

Harbor seals are the most common, widely distributed pinniped found in nearshore waters of Washington and Oregon, and use hundreds of sites to rest or haulout including intertidal sand bars and mudflats in estuaries, intertidal rocks and reefs, sandy, cobble, and rocky beaches, islands, logbooms, docks and floats. Group sizes typically range from small numbers of animals on some intertidal rocks to several thousand animals found seasonally in coastal estuaries. Males and females are similar in size (to 250 lbs) and coloration. Pelage patterns are typically a light base pelage with dark spots, although some individuals have a pelage that is reversed in coloration with dark base and light spots.

During the first half of the twentieth century, numbers of harbor seals were severely reduced in Washington and Oregon by a state-financed population control programs that considered harbor seals to be salmon predators in direct competition with commercial and sport fishermen. The Washington Department of Fisheries paid a bounty for seals and sea lions until 1960, and the Oregon Fish Commission maintained a Columbia River Seal Control Program which paid a seal hunter to kill and control seal numbers in the Columbia River until 1970 (Pearson and Verts 1970; Newby 1973). After the bounty and control ceased and with federal protective status established with passage of the Marine Mammal Protection Act (MMPA) in 1972, Washington and Oregon harbor seal populations began to recover.

As managed by National Marine Fisheries Service (NMFS) under the MMPA, harbor seals in Washington and Oregon have been separated into coastal and inland stocks because of differences in cranial morphology, pupping phenology, and genetics (Temte 1986; Lamont *et al*. 1996; Carretta *et al*. 2002). The Oregon/Washington Coast Stock includes all harbor seals from the California/Oregon border to Cape Flattery on the Olympic Peninsula of Washington (Carretta *et al*. 2002). Harbor seals in the Columbia River are part of the Oregon/Washington Coast Stock.

18.2 Life History & Habitat Requirements

18.2.1 Life History

18.2.1.1 Diet

Harbor seals are considered opportunistic feeders and eat a wide variety of fish, cephalopods, and crustaceans. In northwest waters, fish species commonly eaten by harbor seals include Pacific herring, northern anchovy, various salmon species, various codfish species, flatfish species, pricklebacks, greenlings, and sculpins (Scheffer and Slipp 1944; Bigg 1969a; Beach *et al*. 1985; Brown *et al*. 1989; Olesiuk 1993; NMFS 1997).

In general, the waters of the Columbia River estuary provide a variety of food for harbor seals with important prey items in their diet consisting of schooling fishes (Pacific whiting, smelts, herring), various flatfish, lamprey and salmonids (Beach *et al*. 1985; Reimer and Brown 1997; NMFS 1997). Important year-round prey of harbor seals in the Columbia River include longfin smelt, staghorn sculpin, Pacific tomcod, English sole, starry flounder, snake prickleback and Pacific herring. Seasonally important prey species include eulachon, Pacific herring, salmon, staghorn sculpin, Northern anchovy, and a variety of flatfish species (see Table 18-1 and Beach *et al*. 1985; Reimer and Brown 1997; Brown *et al*. 1989).

During winter months, eulachon make up the majority of prey consumed by harbor seals in the Columbia. Frequent foraging on oily prey like eulachon, northern anchovy and Pacific herring is considered important due to their seasonal abundance, high caloric content and energetic value to female harbor seals for blubber deposition needed during lactation (Jeffries 1984). Annual shifts in abundance of the regional harbor seal population from Grays Harbor, Willapa Bay, Tillamook Bay and Netarts Bay during the winter were correlated with the winter eulachon run when peak abundance of harbor seals occur in the Columbia (Jeffries 1984). Harbor seal abundance in the Columbia declines in spring and summer, when the population shifts to adjacent estuaries that provide protected haulout sites, relatively shallow feeding areas and preferred prey for females with pups.

Browne *et al*. (2002) reported that based on analysis of scats collected seasonally from haulout sites in the lower Columbia River near Astoria, harbor seals consumed adult and juvenile salmonids throughout the year, but with greatest frequency in the spring. Although identification of salmon species is difficult using otoliths and other skeletal remains found in harbor seals scats is difficult, Browne et al. (2002) also reported in their study that the most common age and species of salmon consumed by harbor seals were juvenile chinook salmon.

Browne *et al*. (2002) also point out the inherent difficulties of determining salmon species and age classes using otoliths and other skeletal structures and suggest genetic

identification techniques may provide a valuable tool to better quantify importance of various salmon species in the diet of harbor seals.

Table 18-1. Summary of food habit studies for harbor seals in the Columbia River. Prey species indicated occurred in more than 10% of samples except for salmonids.

Source:	Beach *et al*. 1985
Season and Year:	Year-round 1980-82
Sample Size:	436
Type:	Scats
Prey species	% of Samples
Whitebait smelt	36
Northern anchovy	21
Pacific lamprey	14
Flatfish spp.	12
Gadids	12
Staghorn sculpin	11
Eulachon	10
Salmonids	**6**
Steelhead	<1
Other species: Pacific herring, Bay goby, Snake prickleback, Pacific whiting, Lingcod, Pile perch, Shiner perch, Kelp greenling	
Source:	Brown *et al*. 1989
Season and Year:	Winter 1986-88
Sample Size:	83
Type:	Gastrointestinal tracts
Prey species	% of Samples
Eulachon	100
Longfin smelt	14
Pacific lamprey	10
Source:	Reimer and Brown 1997
Season and Year:	Winter and Spring 1992-93
Sample Size:	51
Type:	Scats
Prey species	% of Samples
Eulachon	84
Pacific lamprey	20
Starry Flounder	12
Other species: Staghorn sculpin, Pacific herring, Whitebait smelt, Longfin smelt, Pacific sandlance, Pacific tomcod, Pacific whiting	

Source:	Reimer and Brown 1997
Season and Year:	Fall 1994
Sample Size:	36
Type:	Scats
Prey species	% of Samples
Northern anchovy	50
Pacific herring	44
Salmonids	**39**
Smelt spp.	25
Staghorn sculpin	19
Other species: Pacific whiting, Pacific lamprey, Rex sole, Whitebait smelt, Pacific sandlance, Peamouth, Surfperch, Shiner perch, Pacific mackeral	
Source:	Reimer and Brown 1997
Season and Year:	Spring 1995
Sample Size:	67
Type:	Scats
Prey species	% of Samples
Staghorn sculpin	49
Starry flounder	36
Pacific herring	28
Salmonids	**19**
Smelt spp.	18
Pacific lamprey	16
Snake Prickleback	15
Other species: Pacific sand lance, River lamprey, Shiner perch, Pile perch, Surfperch, Peamouth, Northern anchovy, Whitebait smelt, American shad, Pacific whiting, Threespine stickleback	

18.2.1.2 Reproduction

Harbor seals have an annual reproductive cycle with the birth season typically lasting up to two months (Scheffer and Slipp 1944; Bigg 1969b; Bigg and Fisher 1974). Females produce one pup per year, beginning at age four or five. Pups are precocious at birth, capable of swimming and following their mothers into the water immediately after birth. Pups typically remain with their mothers until weaning at 4-6 weeks of age and following weaning feed on their own (Scheffer and Slipp 1944; Bigg 1969a; Bigg 1973). Lactation lasts from two to six weeks followed by estrous, ovulation and mating, then blastocyst implantation up to three months later (Bigg 1969a; Bigg 1969b; Bigg 1973; Bigg and Fisher 1974; Tempte 1986). Experimental studies suggest that over the range of harbor seals each population maintains its unique reproductive timing through a specific response to photoperiod, the existence of an annual endogenous reproductive rhythm, genentic uniqueness and availability of abundant prey following weaning (Bigg 1969b; Bigg 1973; Bigg and Fisher 1974; Tempte 1986; Tempte *et al*. 1991; Lamont *et al.* 1996; Westlake and O'Corry-Crowe 2002).

Harbor seal pupping season varies by geographic area, with pups born along the Washington and Oregon coast including the Columbia River from mid-April through June (Jeffries 1984; Jeffries 1985; Huber *et al*. 2001). Coastal estuaries of Oregon and Washington (including Netarts Bay, Tillamook Bay, Willapa Bay and Grays Harbor) are important pupping

areas that provide protected haulout and nursing areas for mothers and pups, as well as shallow feeding areas with abundant prey for weaned pups. Although harbor seal pups are born in the Columbia River, adjacent estuaries along the Oregon and Washington coast are used more extensively for pupping by the regional harbor seal population (Beach *et al*. 1985; Jeffries 1986).

18.2.1.3 Migration and Seasonal Movements

Harbor seals are considered non-migratory although movements in response to seasonally abundant prey, ie to the Columbia during winter eulachon runs and into adjacent esturaries along the Oregon and Washington coasts (Netarts Bay, Tillamook Bay, Willapa Bay and Grays Harbor) during pupping season, have been reported (Beach *et al*. 1985; Jeffries 1986).

18.2.2 Habitat Requirements

The harbor seal in the most common marine mammal found in nearshore waters of Washington and Oregon, and is especially numerous in bays and esturaries including the Columbia River. Preferred haulout locations are usually in areas where access to deepwater channels is maintained. Typically these locations include intertidal sandbars, mudflats, offshore rocks and reefs. Artificial haulout sites such as docks, floats and logbooms are regularly used in some locations (Scheffer and Slipp 1944; Bigg 1969a; Jeffries *et al*. 2000).

Historically, harbor seals were reported upriver at Celilo Falls by the Lewis and Clark Expedition (Cutright 1989; Moulton 1990), as well as being found at a number of upriver prehistoric archaeological sites (Lyman et al. 2002). This upriver movement in the Columbia River suggests harbor seals were following returning runs of salmon upriver and feeding in areas of concentration and restricted passage such as Celilo Falls.

18.3 Population & Distribution

18.3.1 Population

The harbor seal population in the north Pacific is estimated between 222,000 and 235,000 animals consisting of 28,000 in the California Stock, 25,000 in the Oregon/Washington Stock, 15,000 in the Washington Inland Stock, 75,000-88,000 in British Columbia, 37,000 in the Southeast Alaska Stock, 29,000 in the Gulf of Alaska Stock and 13,000 in the Bering Sea Stock (Carretta et al. 2002; Angliss and Lodge 2002).

18.3.2 Distribution

18.3.2.1 Winter and Spring (Non-Breeding Season)

Peak harbor seal abundances in the Columbia River occur during the winter and spring when a number of upriver haulout sites are used. Peak abundances and upriver movements in the winter and spring months are correllated with spawning runs of eulachon smelt and outmigration of salmonid smolts (Beach *et al*. 1985; Jeffries 1986; NMFS 1993).

18.3.2.2 Summer and Fall (Pupping and Molt Season)

Following the decline and disappearance of eulachon in the Columbia, harbor seals discontinue use of upriver haulout sites and move back downriver. At this time only haulout sites at Desdemona Sands, shoals north of Tongue Point, in Grays Bay and Cathlamet Bay were used by harbor seals (Beach *et al*. 1985; Jeffries 1986; WDFW unpubl. data; ODFW unpubl. data).

By mid-April, harbor seal pupping begins in the Oregon/Washington Coast Stock with important pupping and nursery areas located in estuaries adjacent to the Columbia River ie Netarts Bay, Tillamook Bay, Willapa Bay and Grays Harbor (Beach *et al*. 1985; Jeffries 1986). At this time harbor seal abundance in the Columbia River has decreased and coincides with movements and increases in harbor seal abundance in adjacent estuaries (Jeffries 1986). In the Columbia, abundance declines to annual lows with 800-1200 seals using haulout sites in the lower river at this time.

Harbor seal pupping season is followed by an annual molt cycle that occurs from earlyJuly through September. At this time, harbor seal counts remain high in adjacent estuaries. By late September, counts in all areas decrease to seasonal lows. Counts remain relatively low until winter increases begin in the Columbia River as seals move into the river to feed on eulachon (Jeffries 1986).

18.4 Status & Abundance Trends

18.4.1 Status

Harbor seals are protected under the federal Marine Mammal Protection Act (MMPA) as well as being designated as protected wildlife species by the states of Washington and Oregon (WAC 232-12-011; OAR 635-044-013). Harbor seals in the Columbia River are part of the Oregon/Washington Coast Stock as defined under MMPA regulations (Carretta *et al*. 2002). The Oregon/Washington Coast Stock of harbor seals is not considered as "depleted" under the MMPA or listed as "threatened" or "endangered" under the ESA (Carretta *et al*. 2002).

18.4.2 Trends

18.4.2.1 Oregon/Washington Coast Stock

Harbor seal numbers were severely reduced in the early 1900s by bounty hunters under state-financed control programs that considered harbor seals to be predators in direct competition with commercial and sport fishermen. After the bounty program ceased in 1960 and with federal and state protection, the harbor seal populations in Washington and Oregon began to recover.

Newby (1973) estimated that a total of 2,000–3,000 harbor seals resided in Washington in the early 1970s. In the late 1960s, Pearson and Verts (1970) conducted shorebased surveys of the Oregon coast including the Columbia River and estimated fewer than 500 harbor seals were present in Oregon with fewer than 100 present in the Columbia River. Beginning in late 1970s, systematic surveys of harbor seal populations in Washington and Oregon were initiated by various researchers, including biologist from WDFW, ODFW and NMFS (Brown and Mate 1983; Brown 1997; Jeffries 1984; Jeffries 1985; Jeffries *et al*. 2003).

Aerial surveys for harbor seals along the Washington and Oregon coast that included the Columbia River were conducted by WDFW, ODFW and NMFS, and were typically flown during the pupping season when maximum numbers were onshore. Data collected during surveys included date, time, location, a visual estimate of seal numbers, and photographs of all sites where more than 25 seals were hauled out. Total number of seals (including pups) present at each site was counted from slides (Jeffries 1984; Jeffries 1985; Brown 1997; Jeffries *et al.* 2003). Some proportion of the seals remain in the water and these seals were missed by the aerial surveys (Jeffries 1985; Huber *et al*. 2001). A correction factor was used to adjust counts of seals hauled out to estimate total numbers of seals (Jeffries 1985; Huber *et al*. 2001; Jeffries *et al*.

2003). Because a large proportion of harbor seals haul out onto land in discrete aggregations at specific times, a count of hauled out seals provides a precise measure of population trend.

Aerial surveys during the 1999 pupping season resulted in a mean count of 16,165 harbor seals in the Oregon/Washington Coast Stock. Using a correction factor of 1.53 to account for seals in the water and missed during surveys results in a population estimate of 24,732 harbor seals in the Oregon/Washington Coast Stock (Carretta *et al*. 2002; Jeffries *et al*. 2003; ODFW, unpubl. Data). Results of surveys from the late 1970s to 1999 indicate growth of the Oregon/Washington Coast Stock has slowed and may have reached equilibrium (Brown 1997; Carretta *et al*. 2002; Jeffries *et al*. 2003). The Oregon/Washington Coast Stock including the Columbia River has reached an apparent equilibrium indicating the harbor seal is most likely at or near carrying capacity (Brown 1997; Jeffries *et al*. 2003).

18.4.2.2 Harbor Seal Trends in the Columbia River

Following federal and state protection of harbor seal populations, numbers of seals present in the Columbia River increased during the 1970's and 1980's. During this period, the harbor seal population grew at 6-10 percent annually (NMFS 1997; Brown 1997; Jeffries *et al*. 2003). Based on analysis of regional pupping season counts (Jeffries *et al*. 2003; see Figure 18-1), harbor seal populations began to level off and reached equilibrium in the early 1990's. Since then, harbor seal abundance has changed little with counts of 800-1200 seals recorded during annual surveys.

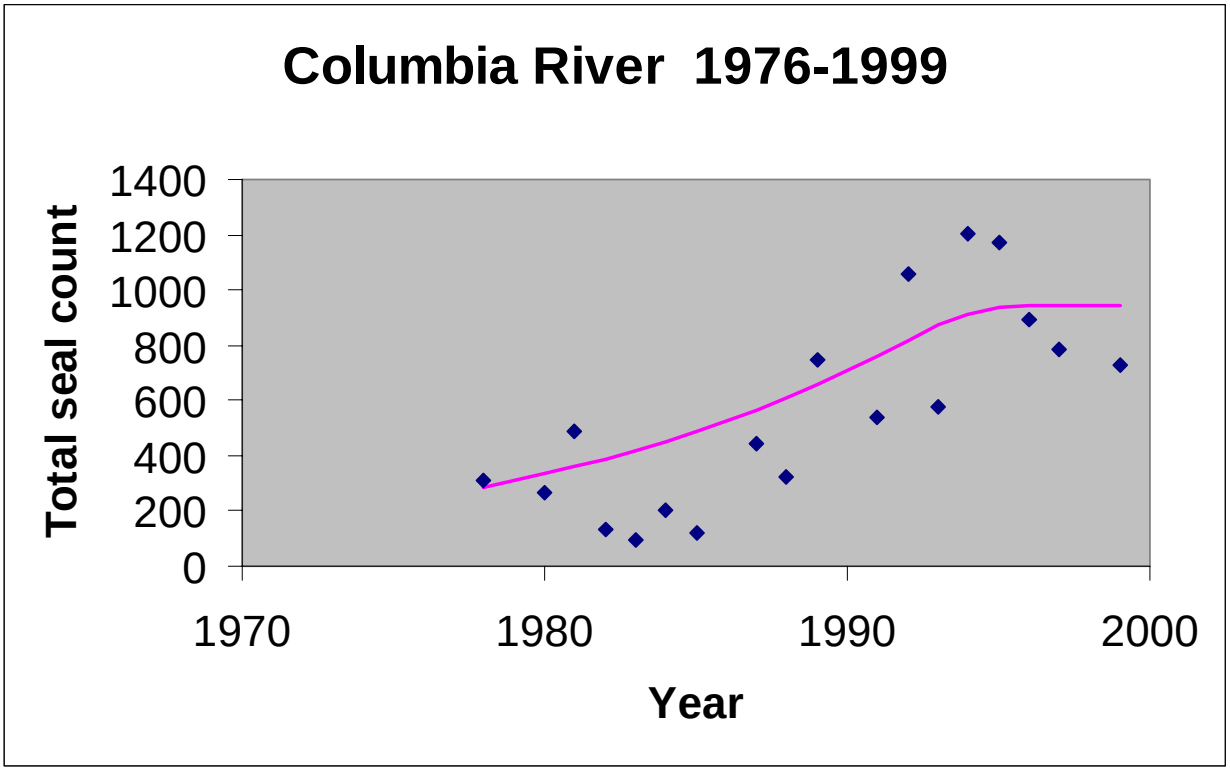

Figure 18-1. Generalized logistic trend line fit to annual harbor seal pupping season counts for the Columbia River from 1976-1999 (Beach et al. 1985; WDFW unpubl. data; Jeffries *et al*. 2003).

18.4.3 Environmental Conditions

18.4.3.1 Haulout Sites

Harbor seals occur throughout the year in the Columbia River with numerous haulout sites found on intertidal mudflats and sand bars in the lower river. Highest numbers of harbor seals use the haulout sites on Desdemona Sands, Taylor Sands and Miller Sands. During periods of peak abundance in the winter these sites may have between 500-2000 seals hauled out on them. Additional haulout sites used by smaller numbers of seals (10-300 seals) were identified at the South Jetty; in Baker Bay; in Grays Bay; in Cathlamet Bay, and below Woody Island. The farthest upriver haulout sites were located near Wallace Island and at the mouth of the Cowlitz River near Longview (Jeffries 1984; Jeffries 1986; Jeffries *et al*. 2000; WDFW unpubl. data; ODFW unpubl. data). Use of these upriver sites is correlated with upriver movement of harbor seals feeding on eulachon smelt runs (Jeffries 1985).

18.4.3.2 Seasonal Use

Use of haulout sites in the Columbia River varies seasonally with peak abundances of 2,000-2,500 seals occurring during winter months corresponding to annual eulachon smelt runs into the river. At this time the largest groups of harbor seals are present in the Columbia River with groups of 800-1200 seals regularly using haulouts near Desdemona Sands and north of Tongue Pt (WDFW unpubl. data; ODFW unpubl. data). During these periods of peak abundance in the winter, harbor seals use haulout sites in the lower Columbia River, as well as moving upstream to use haulout sites above Woody Island, near Wallace Island and at the mouth of the Cowlitz River (Jeffries 1984; Beach *et al*. 1985; Jeffries 1986).

Although pups are born in the Columbia River, relative abundance of harbor seals declines in late spring and summer during the pupping season corresponding to the movement of pregnant females into preferred pupping and nursery areas in adjacent estuaries (Netarts Bay, Tillamook Bay, Willapa Bay and Grays Harbor) (Jeffries 1986). However, during the pupping season the greatest number of haulout sites are used by harbor seals in the Columbia River as pregnant females and females with pups segregate into nursery areas. In the Columbia, pupping and nursery areas are located in Cathlamet Bay, Baker Bay and near lower Woody Island.

18.5 Factors Affecting Population Status

Drift gillnet fisheries in the Columbia River have taken harbor seals incidental to the fishery with highest incidental takes likely to occur during winter chinook salmon fisheries when harbor seal abundance is greatest (Beach *et al*. 1985; Matteson *et al*. 1993). In recent years with reduced gillnet seasons the level of incidental mortality of harbor seals in Columbia River has been considered minimal (Carretta *et al*. 2002).

Alteration of Columbia River shoals and sandbars used as haulout sites by harbor seals is possible due to dredging activities by USACOE. Dredging activities have the potential to destroy or remove existing haulout sites which would likely result in shifting of harbor seals to other haulout areas or use of new sites.

18.6 Inventory & Assessment of Existing Management & ConservationPlans

Harbor seals are protected by the federal Marine Mammal Protection Act and state regulations (WAC 232-12-011 and OAR 635-044-013).

No federal or state management plan exists for harbor seals.

No federal or state restoration or conservation plan exists for harbor seals.

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