FINAL REPORT

MARINE MAMMALS IN THE SOUTHWESTERN STRAIT OF JUAN DE FUCA:

NATURAL HISTORY AND POTENTIAL IMPACTS OF HARBOR DEVELOPMENT IN NEAH BAY

by

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Seattle, Washington

Contract No. DACW67-85-M-0046

January 1987

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EXECUTIVE SUMMARY

A one year study of marine mammals between Tatoosh Island and Pillar Point on the southwestern portion of the Strait of Juan de Fuca was conducted by Cascadia Research under contract to the Army Corps of Engineers. The goal of the project was to determine the occurrence of marine mammals in the area and evaluate the potential impacts on marine mammals of construction and operation of a log export facility, deepwater channel, and small boat harbor in Neah Bay.

Monthly aerial, land, and boat surveys were conducted between August 1985 and July 1986. Boat surveys covered a total of 1,825 nautical miles (nm) and aerial surveys 1,135 nm. Both aerial and boat surveys had three components: 1) shoreline surveys for pinnipeds hauled out and other marine mammals near the shore, 2) transects 1 nm offshore that paralleled the shoreline, and 3) offshore transects running perpendicular to the shore extending out 3 nm. Land observations were conducted from several locations primarily to count pinnipeds at haul-out areas, monitor the northbound gray whale migration, and make observations of marine mammals at the entrance and in Neah Bay. Residents of the study area were questioned about marine mammal occurrence in previous years and recruited to record marine mammal sightings.

Additional study effort was focused on the gray whale because of its status as an endangered species. Research efforts included monitoring the gray whale migration, photographically identifying and tracking individual non-migrating animals, measuring the lengths (and hence age class) of gray whales residing in the study area, and examining aspects of gray whale behavior.

Just under 800 sightings of 10 marine mammal species (including river otter) were made in the study area, primarily from boat surveys. Harbor seals were the most commonly seen marine mammals and occurred year-round in the study area. Harbor seals hauled out at 19 locations in the study area, with highest concentrations at Tatoosh Island and between Slip and Pillar Points. California sea lions were the next most abundant species and were present from September to June with highest numbers from December to May. They were most common in Neah Bay where up to 30 congregated in the water to feed on discarded fish remains. The sea lions first occurred in numbers the previous year. Large numbers of California sea lions migrate through the study area and pass the entrance to Neah Bay from March to June. Northern sea lions were seen in highest numbers at Tatoosh Island, where they were seen hauled out in the summer and fall. Northern sea lion

abundance was lowest in summer. Migrating northern sea lions were seen following the same route and timing in the study area as California sea lions, but in smaller numbers. A single northern elephant seal was seen in the study area. Elephant seals have been reported as occasional visitors to the study area with most sightings at Tatoosh Island or offshore.

River otters and a single sea otter were seen in the study area and most often near the entrance to Neah Bay. River otters were seen during all seasons, with up to seven river otters seen at one time at the entrance to Neah Bay. A single sea otter was seen on six occasions between 18 and 24 November 1985 just outside Neah Bay off First Beach. It is one of the few confirmed sightings in recent years of a sea otters in inland waters of Washington State.

Two species of small cetaceans were frequently seen in the study area. Harbor porpoise were the most abundant cetacean and were seen primarily from 0.5 to 1.5 nm offshore. Sighting frequency of harbor porpoise varied by region with greatest numbers seen off the Sekiu River and Kydaka Point. Harbor porpoise were present in all seasons but were most numerous in fall. Dall's porpoise were seen less often than harbor porpoise and tended to occur farther offshore. Dall's porpoise were seen in all seasons.

Three other species of cetaceans were seen or reported in the study area. Both killer whales and minke whales are occasional visitors to the study area. The gray whale migrates past Cape Flattery and Tatoosh Island at the western edge of the study area. During the southbound migration in December and January, few gray whales entered the study area. The highest number of animals migrating north was seen in early March, earlier than expected. Gray whales migrating north generally passed on the west side of Tatoosh Island.

Some gray whales reside in the study area for prolonged periods. Seven gray whales seen in the study area were individually identified through photographs. These seven animals accounted for 55 of the 68 sightings of gray whales in the study area. Gray whales in the study area were observed foraging on numerous occasions and spent an estimated 44% of the time foraging. Most foraging locations were between Waadah Island (Neah Bay) and the Sekiu River. One whale stayed in the study area at least from January to late April and apparently never migrated to the breeding lagoons in Mexico. One identified gray whale was seen on the last survey on 15 July 1986. Residents reported one whale stayed until late September 1986. Six gray whales (including three of the individually identified whales) were measured through aerial photogrammetry in or adjacent to the study area. Five of these six were between 7.1 and 7.8 m in length and were judged to be yearlings; the sixth animal was 9.3 m long. Gray whales frequently entered Neah Bay or passed across the entrance to Neah Bay. One identified gray whale died, apparently from entanglement in a gillnet, and reports from people in the area indicated this was not uncommon.

Shock waves from blasting, required for constructing a deep water channel, could potentially impact marine mammals in the study area. California sea lions are considered the most likely species to be impacted by blasting because of the large number that congregate in Neah Bay. Gray whales, harbor seals, river otters, northern sea lions, and sea otters all occasionally occurred in the area where blasting would occur. All other species were considered to be rare visitors to the Neah Bay area and therefore likely outside the impact range of the blast shock waves. Methods are available to both reduce the force of the shock waves and reduce the chances of marine mammals occurring in the study area at the time of blasting. Potential long-term impacts on marine mammals of operation of a log export facility and small boat harbor include: 1) disturbance from increased boat and vessel traffic, 2) degradation of water quality, and 3) decreased prey availability. These potential long-term effects of Neah Bay development appear unlikely to occur at a level detrimental to marine mammals in the vicinity. The most important problems are potential blast-related impacts on California sea lions, that are abundant in Neah Bay, and gray whales, which are classified as endangered by the state and the federal government. Some additional research is recommended on these two species.

ACKNOWLEDGMENTS

Many people aided in completion of this project. We are grateful to all those who provided information on marine mammals in the study area. We especially want to thank A. Seda of Big Salmon Resort and D. Gerber who went out of their way to provide data on marine mammals in the study area. Dr. R.T. Paine provided valuable marine mammal sightings from his research over the last 10 years on Tatoosh Island. A. Frid conducted kayak surveys in the Neah Bay area for the project. S. Kort, B. McLaughlin, P. Dawson, and J. Nesbitt all assisted with the field work. K. McGraw, G. Arnold, and K. Brunner of the Army Corps of Engineers provided valuable assistance at several points in the project. The Makah Tribal Council and the U.S. Coast Guard provided permission to use Tatoosh and Waadah Islands. T. Didomenico of the Makah Tribal Council staff provided information and was our liaison with the Tribal Council. G. Arnold made historical information available to us. The Whale Museum provided background data and sightings from their Whale Hotline reports; R. Osborne was especially helpful in sorting and preparing this data and R. Fowler shared his research experiences. The National Marine Mammal Laboratory provided access to the Platforms of Opportunity (POP) database for the study area; R. DeLong and H. Braham were helpful in this regard. J. Scordino, National Marine Fisheries Service provided information on previous marine mammal strandings in the study area. R. Wigen, D. Huelsbeck, and D. Croes all provided valuable information on archaeological findings at Hoko River and Ozette. S. Jeffries, B. Troutman, A. Geiger, and S. Speich of the Marine Mammal Investigations, Washington Dept. of Game were helpful and provided unpublished data and other information. K. Kenyon and E. Bowlby shared their expertise on sea otters. Rite Bros. Aviation, PAVCO Aviation, and Pearson Air provided aircraft and pilots for the aerial surveys. T. Wahl provided information on marine mammal sightings off the Washington coast. J. Peard and B. McLaughlin aided in preparation of the final report. K. McGraw and S. Jeffries reviewed this report.

INTRODUCTION

The Army Corps of Engineers is currently studying the feasibility of constructing a log export facility and small boat harbor in Neah Bay. The project would require underwater blasting to achieve necessary channel depths and construction of a breakwater. Cascadia Research was contracted by the Army Corps of Engineers to conduct a one year study on the marine mammals between Tatoosh Island and Pillar Point, southwest Strait of Juan de Fuca. The objectives of the study were to determine the seasonal abundance, preferred habitats, and migrations of marine mammals and to evaluate the potential impact of construction and operation of the proposed harbor improvements.

A variety of marine mammals have been studied along the outer coast of Washington (Johnson and Jeffries 1977, 1983, Beach et al. 1985) and in the eastern Strait of Juan de Fuca, San Juan Islands, and Puget Sound (Calambokidis et al. 1978, 1979, 1985, Everitt et al. 1979, 1980, Balcomb et al. 1980, Flaherty and Stark 1982, Dorsey 1983). Only limited research has been conducted, however, on marine mammals along the southwest portion of the Strait of Juan de Fuca.

This report summarizes the occurrence of marine mammals in the Neah Bay area between August 1985 and July 1986 and evaluates the possible impacts of the proposed development on marine mammals.

METHODS

Study area

The study area consisted of all shoreline and near-shore (<3 nm offshore) areas in the southwestern Strait of Juan de Fuca, extending from Tatoosh Island east to Pillar Point (Figure 1). The migration route of gray whales past Cape Flattery at the entrance of the study area was also examined. The study area was divided into five geographic areas (Sectors 1-5) for evaluation of patterns in marine mammal distribution. With the exception of Neah Bay (Sector 2), these areas were roughly equivalent in size. Figure 1 shows the sectors and the location names used in this report.

Most of the study area consists of exposed rocky coastline. The only sheltered harbors are in Neah and Clallam Bays. The western end of the study area is exposed to ocean swell and weather. Inclement weather including high winds, heavy seas, and prolonged periods of thick fog prevails in this region.

General strategy

Data on abundance, distribution, and behavior of marine mammals in the study area were gathered through surveys based from boats, aircraft, and land. Each type of survey had specific strengths: 1) boat surveys provided the most comprehensive way to observe near-shore marine mammals as well as photograph and identify gray whales, 2) aerial surveys provided near-simultaneous complete coverage of the study area as well as a platform for photogrammetry (length measurements of gray whales), and 3) land-based observations allowed monitoring of undisturbed movements and behavior of marine mammals and of gray whale migration patterns. Surveys were conducted during all months of the year to determine seasonal patterns of occurrence.

Surveys were supplemented by interviews with local residents to learn more about the occurrence of marine mammals in the study area. People who lived or worked along the water in the area were also urged to record information on marine mammal sightings during the study.

Boat surveys

Surveys were conducted from a 14 ft inflatable boat (Zodiac) with a 30 hp outboard motor. Boat surveys had three components: 1) Shoreline Transects were conducted as close to shore as possible and were designed to

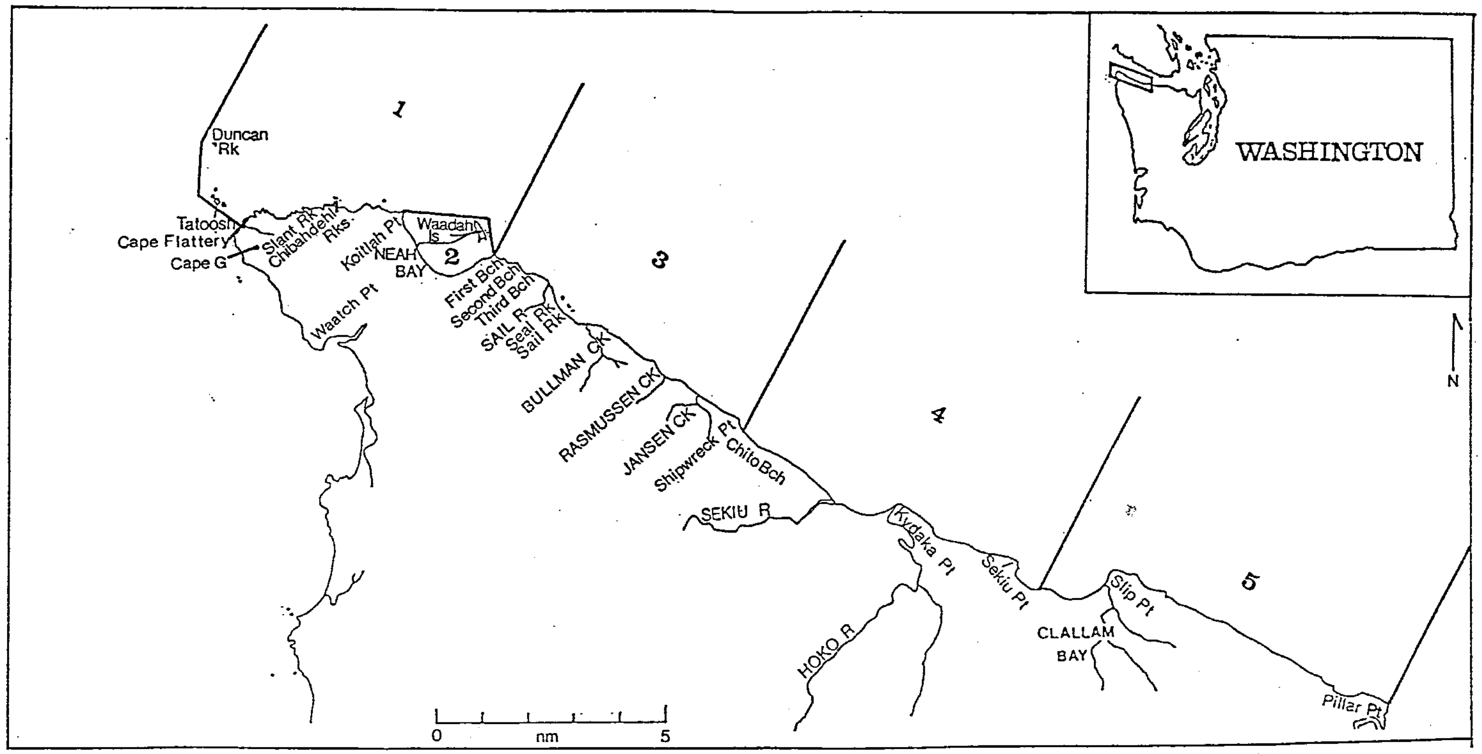


Figure 1. Study area showing place names referred to in text and sectors used to stratify study area.

census all pinnipeds hauled out or in the water, as well as other marine mammals such as gray whales; 2) 1nm Transects paralleled the shore at approximately 1 nm and were designed to census near-shore cetaceans; and 3) Offshore Transects were conducted perpendicular to the shoreline and generally out to 3 nm and were designed to measure the offshore distribution of marine mammals. Figure 2 shows the typical routes of these three survey components. All boat surveys were conducted at approximately 12 kts. Locations of sightings were recorded in relation to landmarks along the shoreline or triangulated from compass bearings to two or more landmarks.

Boat surveys were conducted every month from August 1985 to July 1986 (Table 1). A total of 1,825 nautical miles (nm) were covered during boat surveys of the study area, including coverage of 90 nm or more in all but two months. Weather conditions limited boat operations in the study area in August and October 1985. Over 200 nm per month were covered during boat surveys in April to June 1986, when supplemental research was being conducted on gray whales, and in September, when weather was ideal.

Boat surveys usually originated in Neah Bay, consequently, more effort was conducted in this vicinity than most other areas. Sector 5, Slip Point to Pillar Point (furthest from Neah Bay) received less coverage than other areas. This skewed effort is consistent with probable locations of blasting activity in the study area.

Kayak surveys

Alex Frid, a student from the Evergreen State College, conducted kayak-based surveys in the Neah Bay area as part of an internship supervised by Cascadia. Results of these observations are included in this report. Kayak-based surveys were conducted for a total of 14 days in October and November 1985. Observations were restricted to the area from Koitlah Point to just east of Seal and Sail Rocks.

Aerial surveys

Fifteen aerial surveys were flown from August 1985 to July 1986, including two attempted surveys that were canceled in progress due to inclement weather (Table 2). At least one survey was flown every month except November 1985, when weather forced cancellation of all planned flights. A total of 1,135 nautical miles were surveyed in aerial surveys with fairly even coverage throughout the study area.

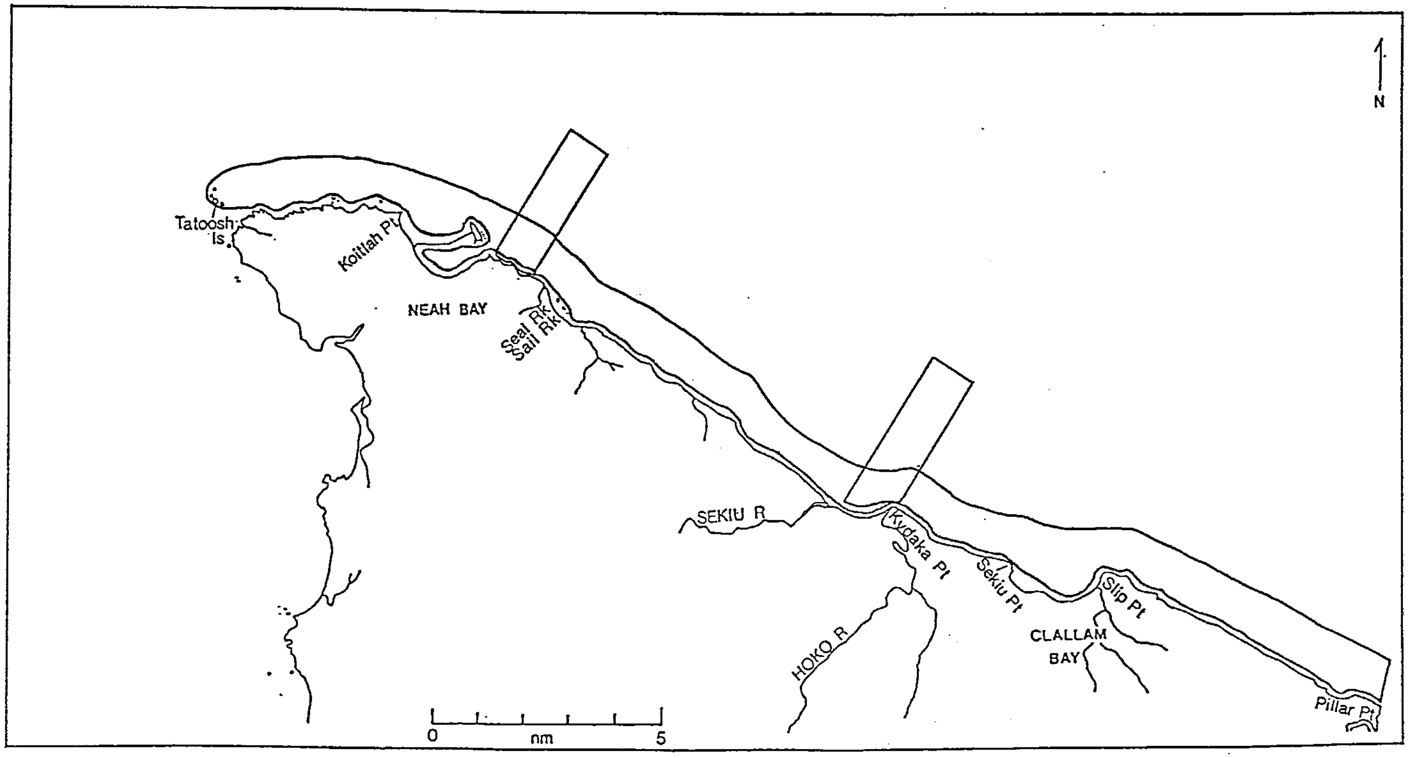


Figure 2. Study area showing typical transect routes taken on boat and aerial surveys. Includes all transect types: Shoreline Transect, 1nm Transect, and Offshore Transect (perpendicular to shore).

Table 1. Dates, locations, and activities of boat surveys between August 1985 and July 1986. X indicates survey was conducted. The number of Offshore Surveys (perpendicular to the shore) are included.

Date	Time	Area Covered	Survey Type		
			Shoreline	1nm	#Offshore
08/11/85	1300-1530	Tatoosh-Neah	X	-	0
09/14/85	1200-1955	Tatoosh-Pillar	X	X	0
09/23/85	1010-1755	Tatoosh-Pillar	X	X	0
09/28/85	1230-1920	Neah-Clallam	X	X	2
09/29/85	809-1825	Tatoosh-Pillar	X	X	2
10/19/85	1050-1635	Seal Rk-Chibahdehl	X	-	2
11/08/85	741-1655	Tatoosh-Pillar	X	X	4
11/09/85	727-1105	Tatoosh-Sail Rk	X	X	2
12/12/85	805-1120	Tatoosh-1st Beach	X	X	0
12/13/85	845-1635	Neah-Pillar	X	X	4
12/14/85	905-1618	Tatoosh-3rd Beach	X	X	2
01/26/86	820-1600	Tatoosh-Kydaka	X	X	2
01/27/86	830-1510	Neah-Pillar	X	X	0
02/09/86	915-1730	Tatoosh-Shipwreck	X	X	0
02/10/86	755-1725	Neah-Clallam	X	X	0
02/11/86	830-1135	Clallam-Pillar	X	-	0
03/11/86	830-1145	Tatoosh-Neah	X	X	0
03/27/86	800-1830	Tatoosh-Sekiu R	X	X	3
03/28/86	830-1515	Neah-Pillar	X	X	2
03/29/86	830-1215	Neah-Kydaka	X	-	3
04/08/86	745-1545	Neah-Pillar	X	X	2
04/09/86	715-1150	Neah-Sekiu R	X	X	0
04/10/86	710-1820	Koitlah-Sekiu R	X	-	0
04/11/86	745-1100	Tatoosh-Neah	X	-	0
04/25/86	1408-1800	Neah-Sekiu R	X	X	0
04/26/86	710-1905	Tatoosh-Sekiu R	X	-	0
04/27/86	843-1815	Chibahdehl-Sekiu R	X	-	0
04/28/86	830-0850	Neah	X	-	0
05/06/86	1450-1905	Neah-Kydaka	X	X	0
05/07/86	830-1930	Tatoosh-Pillar	X	X	0
05/08/86	825-1610	Koitlah-Sekiu R	X	X	4
05/23/86	830-2125	Tatoosh-Clallam	X	X	2
05/24/86	750-2055	Neah-Clallam	X	X	0
05/25/86	658-1450	Tatoosh-Sekiu R	X	X	0
06/04/86	1055-1930	Tatoosh-Kydaka	X	X	0
06/05/86	725-1930	Tatoosh-Clallam	X	X	2
06/06/86	710-1925	Tatoosh-Pillar	X	X	2
06/25/86	1530-2105	Neah-Sekiu R	X	-	0
06/27/86	918-1810	Tatoosh-Sekiu R	X	-	0
07/07/86	1250-1932	Tatoosh-Sekiu R	X	X	0
07/08/86	907-1655	Koitlah-Clallam	X	X	0

Table 2. Dates, locations, and activities of aerial surveys between August 1985 and July 1986. X indicates survey was conducted. The number of Offshore Surveys (perpendicular to the shore) are included.

Date	Survey Type		
	Shoreline	1nm	#Offshore
08/06/85	x	x	0
09/24/85	x	x	4
10/18/85	x	x	4
12/04/85	x	x	4
01/20/86	x	x	4
02/12/86	x	x	2
03/30/86	x	–	2
04/28/86	x	x	4
05/22/86	x	x	2
05/31/86	x	–	2
06/07/86*	–	–	–
06/11/86	x	x	0
06/25/86*	–	–	–
06/26/86	x	x	4
07/15/86	x	x	2

* survey aborted due to weather

Surveys were flown in a Cessna 172, a single-engine high-wing aircraft chartered out of Port Angeles, Tacoma, or Olympia. Aerial surveys followed a similar general design as the boat surveys with three components: Shoreline Transects, 1nm Transects, and Offshore Transects (Figure 2).

Aerial photogrammetry

Size classes of animals were determined through aerial photogrammetry. Aerial survey aircraft were maneuvered directly over whales at altitudes of 400-600 feet. Vertical photographs were taken out the open window with a Nikon 35 mm camera equipped with a 200 mm lens. Scale was derived from calibrated focal length and barometric altimeter readings corrected with photographs of measured objects near the subject whale taken on the same day (docks at Neah Bay). Photographs were measured to 0.02 mm with a stereo dissecting microscope equipped with calibrated ocular reticles. Whale images were graded both according to resolution and how bent or straight the whale appeared. Aerial measurements of a whale that was later found dead were 2.9% less than true ground measurements of the animal. Additional data on precision and accuracy and details of these methods are presented in Calambokidis et al. (1985).

Land observations

Land censuses were conducted from: Tatoosh Island, Cape Flattery, Koitlah Point, Waadah Island, Makah Fish Dock, Coast Guard tower at Baadah Point, shoreline areas just west of the Sekiu River, and the shoreline opposite Seal and Sail Rocks. These observations were designed to: 1) monitor the number and route of gray whales migrating past Cape Flattery (see below), 2) count harbor seals at the haul-out sites at Seal and Sail Rocks, Tatoosh Island, Waadah Island, and 1 nm W of the Sekiu River, 3) count sea lions in Neah Bay, 4) observe the movements of sea lions, gray whales, and river otters into Neah Bay, and 5) gather dive rate data on gray whales.

Resident gray whales

Photographs were taken of gray whales seen in the study area (east of the northward coastal migration route) for photoidentification of individuals. Both sides of the animals' back were photographed with a 35mm Nikon camera and 200mm telephoto lens and color print film (generally KR-400). Individual whales were identified from prints by coloration, mottling, scars and barnacles. A photographic catalog of the different individuals was compiled and used as a reference to determine the identity of whales encountered later. In all cases where a close photograph was taken, the pictures allowed an unequivocal determination of the identity of the animal. Although gray whales were most often identified from photographs taken during boat surveys, we were also able to identify whales from some photographs taken during the aerial surveys.

Gray whale behavior was also monitored during the boat surveys and land observations. Three specific types of information were gathered. First, the movements of animals were recorded, especially when they were in the Neah Bay area. Second, data were gathered on respiration rates of individual whales. Third, behavior that suggested foraging or feeding was recorded and the locations where it occurred. Feeding could most clearly be seen from the air but was also inferred from the surfacing behavior of individuals observed from land or boat.

Gray whale migration

To determine migration timing and route of gray whales along the west border of the study area (off Cape Flattery), observations were made from two different vantages during the spring. The lower observation point was at Cape Flattery, a point that afforded a clear view of waters on the south and east of Tatoosh Island as well as a view to the west. A second observation point was established at Cape "G", a ridgetop clearcut about 2 miles south of Cape Flattery, that allowed an expansive view west and a view north of Tatoosh Island. Additional watches were posted from Waatch Point, Koitlah Point, and later in the season, when permission was secured from the Coast Guard, from Tatoosh Island lighthouse. To determine migration rate, whales were recorded as they passed a specified landmark. Route data were recorded both relative to landmarks and with range and bearing information measured with a clinometer and sighting compass.

Strandings

Stranded marine mammals in and near the study area were examined. During the study five marine mammals were examined, four of them harbor porpoise and one gray whale.

Interviews

Interviews were conducted with 25 people who lived or worked on or near the water and had information on historical or current occurrences of marine mammals in the study area. They were conducted using a standardized data sheet. These interviews were sometimes hampered by the difficulty people had with properly identifying different species of marine mammals and accurately recalling their sightings. For this reason the most valuable information from these interviews was on the most common species that are easily identified: gray whale, California sea lion, and harbor seal.

Sighting network

People who worked or lived in a situation that brought them into contact with marine mammals were requested to record their marine mammal sightings. We provided these individuals with a sighting data sheet and an identification guide we developed of the more common marine mammals in the study area. We collected these sighting forms at the end of the season. These data were used primarily to confirm observations from our surveys but were also valuable in several cases to get information for periods when field surveys were not being conducted.

Sightings from Platforms of Opportunity and Whale Museum

Recent sightings of marine mammals were obtained from the Platforms of Opportunity (POP) database managed by the National Marine Mammal Laboratory of NOAA and from all sightings reported to the Whale Museum (Moclips Cetological Society) in Friday Harbor, Washington. The Whale Museum database contains over 10,000 marine mammal sightings in Washington State collected by researchers or the general public through the Whale Hotline between 1976 and 1986. The POP sightings for the study area cover the period from 1961 to 1985. Results of these sightings are reported where they supplement data gathered from direct observations.

Historical occurrence

We obtained relevant reports of marine mammal bones identified from the Makah archaeological digs. This information was used for comparing species currently found in the study area with those present historically.

Data analysis

Sightings of marine mammals and survey information were entered into two computer data bases for compilation and analysis. The first database was a record of all sightings of marine mammals made by Cascadia personnel during boat, aerial, or land observations. Information recorded with each sighting included: date, time, location, number of animals, species, direction of travel, weather conditions, and type of survey. This database was used to plot locations of sightings. A modified subset of this database was developed for gray whale sightings that included additional information on behavior, identity, and specific movements. The second database summarized all boat and aerial survey transects broken down by type and location. It included data on miles covered, time in sector, environmental conditions, and the total sightings and number of each marine mammal species encountered. Every passage through a sector of the study area was treated as a separate record. This database was used to calculate sightings in relation to effort by month, season, sector, platform (boat or air), and environmental conditions.

RESULTS

Just under 800 sightings of 10 species of marine mammals (including river otter) were made in the study area between August 1985 and July 1986. This total does not include the land observations of migrating gray whales just outside the study area or sightings reported to us by others. The majority of sightings (404) were made during the 1,825 nm of boat surveys. The aerial surveys accounted for 141 sightings and land observations 105 sightings. Comparisons of sighting rate during aerial versus boat surveys as sightings per nm indicated they were not significantly different (chi-square test, $p>0.05$) for all but one species (California sea lion). For this reason, aerial and boat survey results were pooled for most analyses.

The 10 species sighted during this study consist of: sea otter (Enhydra lutris), river otter (Lutra canadensis), harbor seal (Phoca vitulina), northern elephant seal (Mirounga angustirostris), California sea lion (Zalophus californianus), northern sea lion (Eumetopias jubatas), harbor porpoise (Phocoena phocoena), Dall's porpoise (Phocoenoides dalli), minke whale (Balaenoptera acutorostrata), and gray whale (Eschrichtius robustus). These represent the species of primary consideration for potential impact from proposed activities in Neah Bay. One additional species, the killer whale (Orcinus orca), though not seen in the study area during our surveys, was reported in the study area on several occasions. Survey results and a review of other relevant data is presented for each of these 11 species. A discussion of potential impacts is addressed in a separate section.

SPECIES ACCOUNTS

Sea otter (*Enhydra lutris*)

Background

The sea otter originally ranged from Baja California north to Prince William Sound, Alaska, and southwest through the Aleutians to Japan. Heavily hunted for its fur in the 18th and 19th centuries, it was nearly driven to extinction by the early 1900s (Kenyon 1969, 1986). Since then, sea otter populations have increased, with the largest concentrations in the Aleutian Islands. A remnant population also survived in central California. In the late 1960s and early 1970s sea otters were transplanted from Alaska to areas where they had previously existed in Alaska, British Columbia, Washington, and Alaska (Jameson et al. 1982). These efforts have successfully led to growing populations in Washington, British Columbia, and parts of Alaska, but have failed in Oregon and a few areas of Alaska.

The sea otter is on the list of Washington State Endangered Species. However, the federal government considers the California sea otter a threatened species, but not the Alaskan sea otter (the source stock of sea otters in Washington).

Distribution and abundance in study area

A single sea otter was seen on six occasions in the study area (Table 3). All except one of the sightings were made between 18 and 24 October 1985 near First Beach, just outside the eastern entrance to Neah Bay (Figure 3). On several other occasions ambiguous sea otter sightings were made between Koitlah Point and Cape Flattery. These sightings were considered tentative because only a brief glimpse was gained of an animal that appeared to be a sea otter but the animal's wariness prevented us from resighting and confirming its identity. The animal was seen at close range and photographed on 19 October 1985. It was identified as a male and was observed feeding on a sea urchin in a kelp bed off First Beach on 21 October. The shallow areas and kelp beds around Neah Bay (off Koitlah Point, surrounding Waadah Island, and between Baadah Point and First Beach) are suitable habitat for sea otters.

Interviews with residents indicated that sea otters have not been seen in the study area previously. A single otter sighting was reported near Duncan Rock by Dr. Robert Paine on 18 August 1982.

Table 3. Sightings of sea otters in the study area, August 1985 to July 1986.

Date	Time	Number	Location
09/29/85	1405	1	off Koitlah Pt
10/18/85	1253	1	off First Beach
10/19/85	1435	1	off First Beach
10/21/85	930	1	off First Beach
10/22/85	925	1	NE of Baadah Pt
10/24/85	835	1	off First Beach

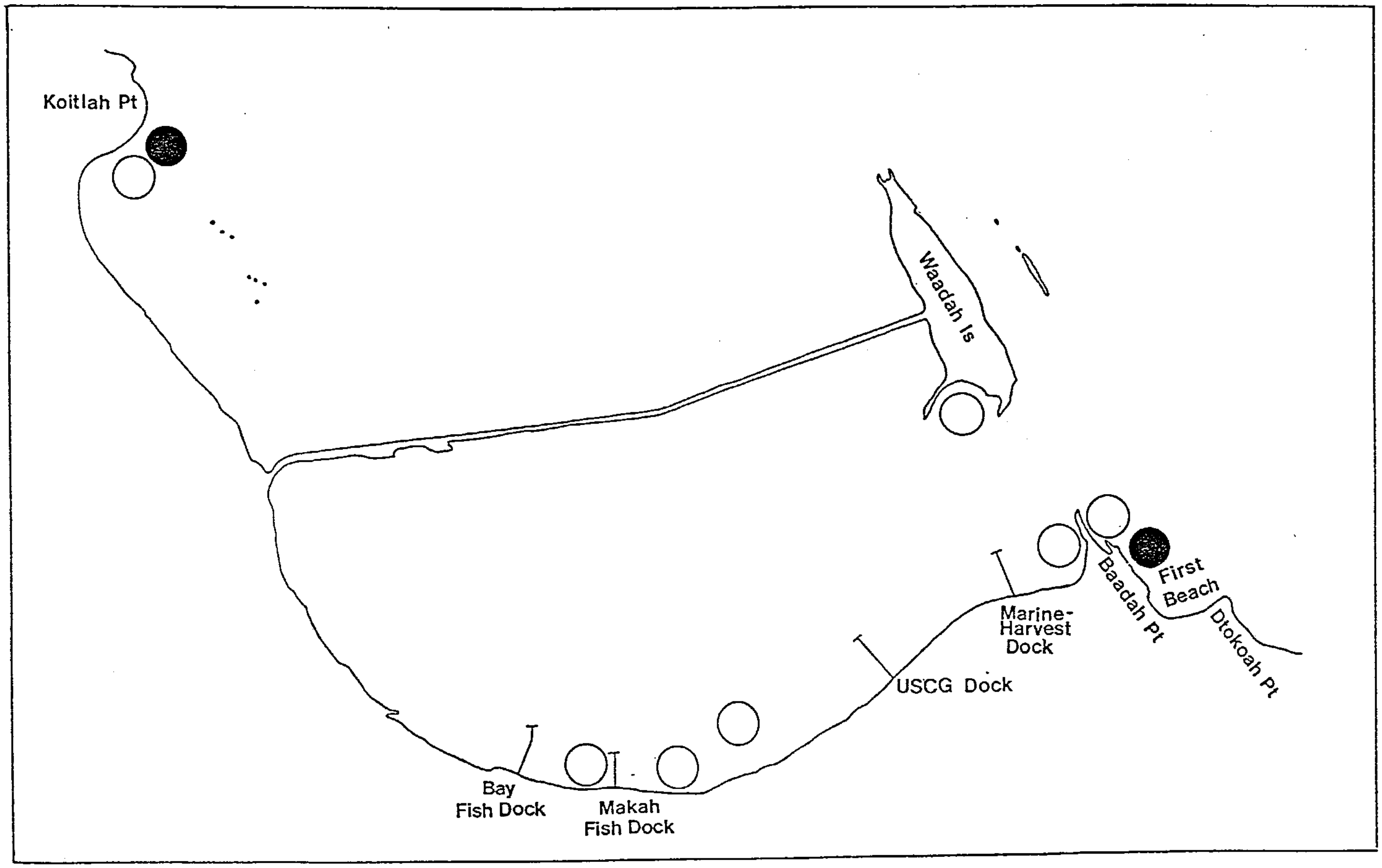


Figure 3. Locations where river otter (○) and sea otter (●) were seen in the Neah Bay area.

Historical occurrence

Kenyon (1969) doubted that sea otters ever occurred historically in the inland waters of Washington State with any regularity. Recent archeological recoveries, however, at the Hoko River (inside the study area), a 2500 year old Makah fishing camp, included six sea otter bones among the 17,000 bones so far recovered (Wigen 1982). This suggests that sea otters may have historically occurred in the study area. Over 500 sea otter bones were recovered from the Makah village at Ozette from the more than 1 million faunal remains examined (Huelsbeck 1983).

Comparison to previous research

The current sea otter population in Washington State is concentrated on the Washington outer coast and is the result of the translocation of sea otter from Alaska to Washington conducted in 1969-1970 (Jameson et al. 1982). This population, after an initial decline, appears to be growing and prospering with 65 sea otters counted off the Washington coast in 1985 (Kenyon 1986).

The occurrence of a sea otter in the Neah Bay area is one of the few confirmed sightings of sea otters in the Strait of Juan de Fuca since they were eliminated in the 19th century. Kenyon (1986) reported that frequent reports of sea otters from the inland waters of Washington State, when investigated, were revealed to be river otters. No sea otter sightings were reported in the Strait of Juan de Fuca by Everitt et al. (1979, 1980). It is possible our sighting is a reflection of the increasing sea otter population, and sea otters will again visit the Neah Bay area.

Summary

- A single male sea otter frequented First Beach and adjacent areas at the mouth of Neah Bay in mid-October 1985.

- Sea otters occurred infrequently in the study area.

River otter (*Lutra canadensis*)

Background

The river otter is usually not considered a marine mammal. In many parts of their range, however, river otter feed and spend most of their time in marine waters. They are considered in this report because, like other marine mammals, they are potentially at risk from underwater blasting and harbor development. River otters are common throughout the inland waters of Puget Sound and the Strait of Juan de Fuca (Hirschi 1978). They are not protected under the Marine Mammal Protection Act of 1972 and are still commercially trapped for their fur in Washington State.

Distribution and abundance in study area

River otters were observed on 14 occasions in the study area (Table 4). Largest numbers seen were two sightings of four and seven otters in October and November off Baadah Point at the eastern entrance to Neah Bay; on both occasions feeding was observed. About half the river otter sightings were of more than one animal. River otters were seen on land on four occasions, twice on docks in Neah Bay. Eight of the 14 sightings were either inside Neah Bay or near Baadah Point or Waadah Island (Figure 3). Sightings were made in fall, spring, and summer with no sightings in winter (December–February).

Residents reported river otter "families" that consistently lived and raised young at: 1) Sail River and adjacent marine waters, 2) 0.7 nm west of Sekiu River, and 3) just east of Baadah Point in Neah Bay.

Historical occurrence

River otter bones were found at the historical Makah villages at Ozette, on the Washington coast, and Hoko River, just east of the Sekiu River on the Strait of Juan de Fuca. Fifteen river otter bones were identified among the more than 1 million faunal remains recovered from Ozette (Huelsbeck 1983). Three river otter bones were identified among some 17,000 bones recovered from the Hoko River (Wigen 1982). River otters were present in the study area during the time periods these village sites were occupied but either were not relatively abundant or were not extensively hunted by the Makah.

Table 4. Sightings of river otters in the study area, August 1985 to July 1986.

Date	Time	Number hauled	Number water	Location
10/25/85	755	0	4	E Baadah Pt
11/09/85	805	2	5	W Baadah Pt
11/11/85	825	0	2	SW Waadah
11/13/85	1030	0	1	SE of Koitlah Pt
03/26/86	1432	0	1	N Baadah Pt
04/07/86	1430	0	1	1.0nm W of Rasmussen Ck
04/09/86	1908	2	0	Makah Fish Dock, Neah Bay
04/10/86	1350	0	2	off Thunderbird Dock, Neah Bay
04/26/86	1659	1	0	0.1nm E of E Bullman Beach
04/26/86	1702	0	1	off Sail R
05/24/86	1535	0	1	under Big Salmon ramp, Neah Bay
05/24/86	2110	1	0	Big Salmon Dock, Neah Bay
06/04/86	900	0	3	500m W of Shipwreck Pt
06/04/86	1145	0	1	200m W of Slant Rk

Comparison to previous research

River otters are considered common in both marine and freshwater systems in the Strait of Juan de Fuca (Everitt et al. 1980, Hirschi 1978). Everitt et al. (1980) listed one marine location within our study area near Cape Flattery where river otters were sighted or trapped.

Summary

- River otters were common in marine waters in the study area and in the Neah Bay area in particular.

- River otters were present during all or most months of the year.

Harbor seal (*Phoca vitulina*)

Background

Harbor seals range along the west coast of North America from Baja California to the Bering Sea, Alaska. They are the most abundant marine mammal in Washington State and occur along the outer coast as well as the protected waters of the state. Harbor seals rest, give birth, and nurse their young at land haul-out sites. Different habitats are used by seals to haul out; exposed mudflats, rocky reefs and ledges, sandy beaches, salt marshes, log booms, and recreational floats are the most common habitats used by harbor seals in Washington State (Calambokidis et al. 1978). These sites are generally used at low tide, though depending on the habitat, the haul-out cycle can be based around high tide or darkness.

Distribution and abundance in the study area

Harbor seals were the most abundant marine mammals in the study area; just under 300 sightings of harbor seals were made. Harbor seals were encountered singly in the water as well as in groups hauled out. Figure 4 shows the locations of harbor seal haul-out areas identified in this study. Counts of seals at these areas are listed in Appendix Tables A-1 to A-6. A brief description of each of these haul-out areas and the number of seals using them is provided below:

Rocks and ledges between Slip Point and Pillar Point. Near-shore rocks and ledges at about ten locations appear to be used for haul out in this area (Figure 4, Appendix Table A-1). The highest number of seals was 102 on 29 September 1985 at six locations. Between 10 and 60 harbor seals were seen in this area during most surveys.

Tatoosh Island. Harbor seals haul out on the reefs on the west side Tatoosh Island (Appendix Table A-2). The highest count of 55 seals was seen on 24 September 1985. Harbor seal numbers at Tatoosh Island were very low from October through January, most likely because of the typically heavy swell during winter months. The haul-out site is awash at high tide and would be difficult for seals to use during heavy swells.

Seal and Sail Rocks and vicinity. Harbor seals consistently hauled out on tidally-exposed rocks and ledges in this area (Appendix Table A-3). The most frequently used sites were on the west side of Sail Rock and on a set of scattered rocks approximately 500 m east of Sail

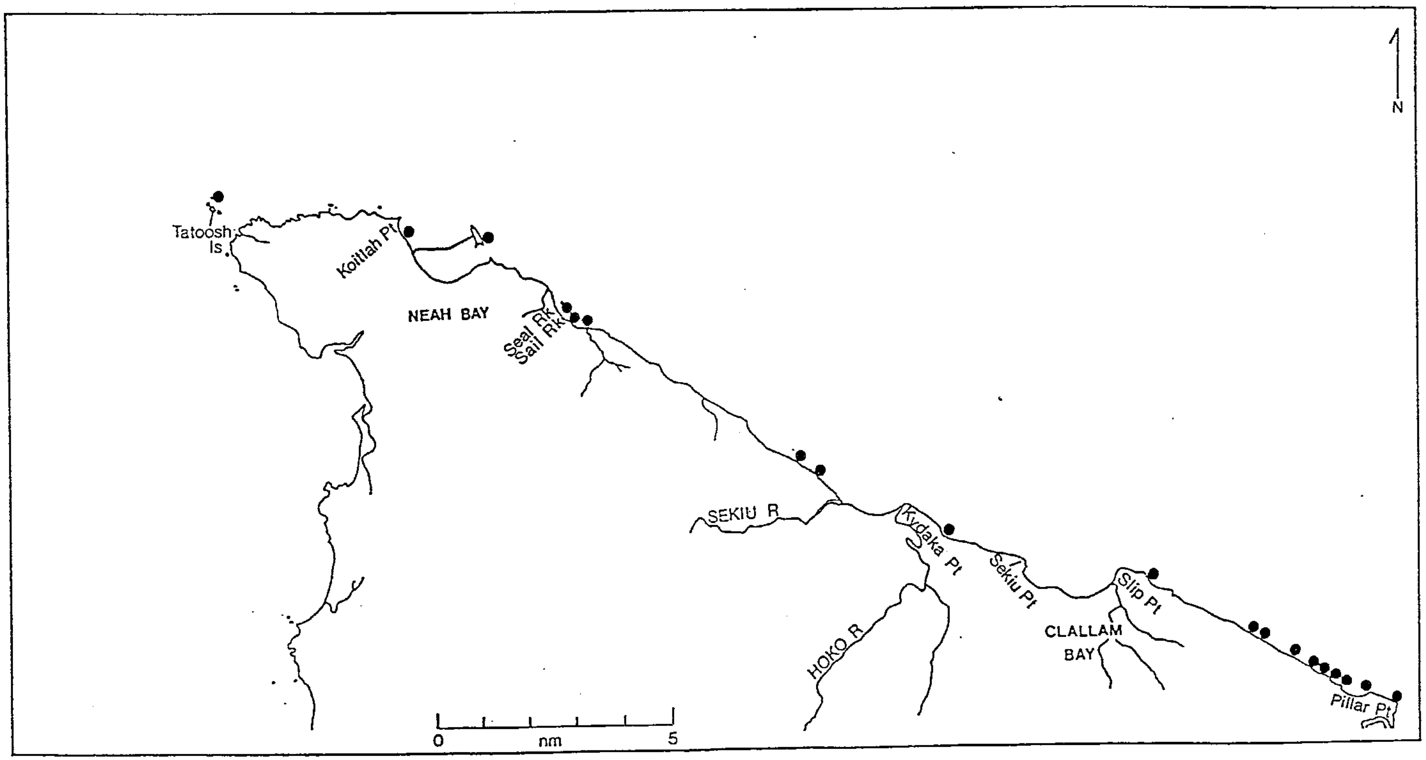


Figure 4. Locations of harbor seal haul-out sites between Tatoosh Island and Pillar Point.

Rock. A maximum of 35 seals were seen in this area on 28 March 1986. This site was used year-round by harbor seals.

Waadah Island. Up to eight harbor seals hauled out on tidally exposed reefs on the northeast side of Waadah Island (Appendix Table A-4). Seals hauled out at this site primarily between October and May, with only a few seals observed at this site at other times.

Koitlah Point. A few seals hauled out seasonally on intertidal rocks just east of Koitlah Point (Appendix Table A-4). A maximum of 4 seals were seen on 14 December 1985. Two or more seals were seen here only in December and January.

Rocks west of Sekiu River. A maximum of 10 seals were seen on intertidal rocks approximately 1 nm west of the Sekiu River (Appendix Table A-5). The site is located just offshore from residential houses. Interviews with these residents indicated seal numbers were much higher than our counts indicate because highest numbers were seen in the early morning prior to the time most of our surveys reached this area. Up to 26 harbor seals have been counted by one resident who estimated 10-15 seals was typical on most mornings (D. Gerber, pers. comm.).

Eagle Rocks. Seals were seen hauled out on these near shore rocks east of Kydaka Point on only two occasions in December and June (Appendix Table A-6). The maximum was 14 seals.

Harbor seals were frequently seen in the water at a variety of other locations along the shoreline (Appendix Table A-7). Eighteen sightings were made of harbor seals in the water in Neah Bay, with most of these in October (Appendix Table A-8). These sightings in all but one case were of single seals; the sole exception was of 3 seals on 31 May 1986. Though harbor seals were primarily encountered nearshore, there were seven sightings of single seals from 0.5 to 2.2 nm offshore (Appendix Table A-9).

An analysis of harbor seal sighting frequency by nm of survey coverage revealed significant regional differences in harbor seal distribution (chi-square, $p<0.001$). Sector 5 (Slip Point to Pillar Point) had the highest frequency of sightings per nm of shoreline survey (.19) and Sector 1 (Tatoosh Island to Koitlah Point) had the highest number of seals per nm (2.7). The Neah Bay area (Sector 2) had the lowest sightings per nm (.06) and the second lowest number per nm (.3) of the five sectors in the study area.

A maximum of 132 harbor seals (on 29 Sept 85) were seen in the study area during any one survey. Counts made when the entire study area was surveyed at or near low tide are given in Table 5. Since counts of harbor seals at haul-out areas only represent a portion of the animals likely present, the total number of seals in the study area is probably closer to 200 animals.

Much larger concentrations of harbor seals were observed just outside the study area, south of Tatoosh Island and east of Pillar Point. Large groups of seals were found on rocks off Waatch Point and Cape of Arches, south of Tatoosh Island. High numbers of seals were also seen on our route to the study area during aerial surveys, with over 200 seals frequently observed on intertidal rocks between the Lyre River and Pillar Point.

Seasonal abundance

Harbor seals were present year-round in the study area. Some seasonal changes in overall numbers were apparent though not dramatic. Sightings of harbor seals per nm of survey were significantly different by month (chi-square, $p<0.025$) and by season ($p<0.005$) with the lowest sighting rates in the spring (Figure 5). There were also seasonal changes in the number of animals at specific haul-out areas, described above by site and summarized for the major haul-out areas in Figure 5. Overall these seasonal variations may not represent true changes in the abundance of animals but rather seasonal shifts in haul-out behavior or movements between local haul-out areas.

Reproduction

Relatively few harbor seal pups were seen in the study area during summer months. Harbor seal pups were seen in June, July, and August. A maximum of two pups were seen during any one survey. It appears that female harbor seals are likely going elsewhere to give birth and suckle their pups.

Historical occurrence

Harbor seals were present historically in the study area and were recovered from both Ozette and Hoko River archeological sites. Nine harbor seal bones were identified from Hoko River (Wigen 1982) and 377 from Ozette (Huelsbeck 1983).

Table 5. Counts of harbor seals from Tatoosh Island to Pillar Point on aerial (A) and boat (B) surveys that covered most or all the study area at or near low tide. Numbers in parentheses indicate number of pups included in total.

Date	Type surv.	Tatoosh Island	Waadah-Koitlah	Seal-Sail Rk.	Slip-Pillar	Other	Total
08/06/85	A	50(1)	0	10	12(1)	1	73(2)
09/14/85	B	15	0	26	18	1	60
09/23/85	B	40	0	8	38	0	86
09/24/85	A	55	1	20	1	1	78
09/29/85	B	30	0	0	102	0	132
10/18/85	A	1	0	0	16	2	19
11/08/85	B	0	7	0	23	1	31
12/04/85	A	0	4	19	51	14	88
01/20/86	A	3	0	28	44	0	75
02/12/86	A	15	0	22	1	0	38
03/28/86	B	24	4	35	55	0	118
03/30/86	A	0	0	25	1	0	26
04/28/86	A	0	1	2	7	0	10
05/07/86	B	41	0	26	3	0	70
05/22/86	A	10	1	8	11	5	35
05/31/86	A	47	0	7	1	0	55
06/06/86	B	41	0	18	26	5	90
06/11/86	A	46	0	1	0	0	47
06/26/86	A	23(2)	0	6	4	2	35(2)
07/15/86	A	52(2)	2	5	16	0	75(2)

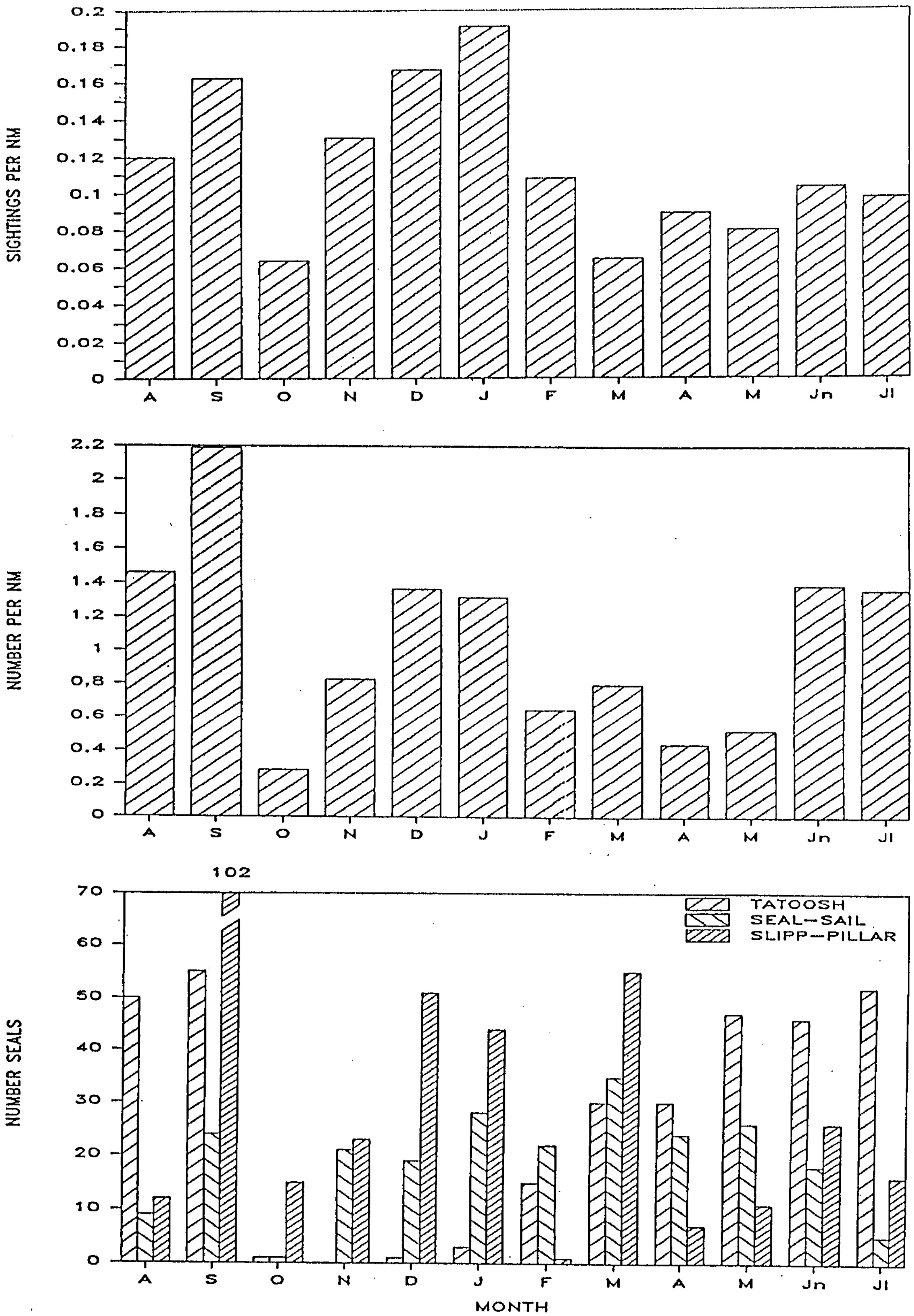


Figure 5. Harbor seal occurrence by month in the study area.
A - Sightings per nm of shoreline survey
B - Number per nm of shoreline survey
C - Monthly high counts of harbor seals at the three primary haul-out sites

Comparison to previous research

The current harbor seal population in Washington State is probably in excess of 10,000 animals with highest densities occurring in the Columbia River, Willapa Bay, Grays Harbor, and the San Juan Islands (Beach et al. 1985, Calambokidis et al. 1979, 1985). Harbor seal numbers have been growing in recent years with increases of over 10% a year documented for seals at most locations (Calambokidis et al. 1985, Beach et al. 1985, Jeffries 1986).

The number of haul-out areas and the number of seals we observed are much higher than reported previously for this area (Everitt et al. 1979, 1980). In aerial surveys conducted between November 1977 and August 1979, Everitt et al. (1979, 1980) reported a maximum of seven harbor seals and only two haul-out areas between Pillar Point and Tatoosh Island. Everitt et al. (1980) did not see any pups in the study area and cited previous research in 1976-77 that did not see any pups at Tatoosh Island. Our counts of a total of 100 harbor seals at over 15 haul-out areas suggests a major increase has occurred in harbor seal numbers. This is consistent with observed increases in harbor seal populations in other parts of Washington inland waters (Calambokidis et al. 1985, Beach et al. 1985). The general population size of harbor seals in the study area remains relatively small compared to other parts of Washington State where larger haul-out areas consist of from several hundred to several thousand animals.

Summary

- Harbor seals were common year-round in the study area utilizing over 15 haul-out areas.

- Few harbor seal pups were born in the study area.

- Tatoosh Island and the area from Slip Point to Pillar Point were the areas of highest numbers of harbor seals.

- Harbor seals occasionally occurred inside Neah Bay and haul out seasonally just outside the mouth of Neah Bay on Waadah Reef.

- A maximum of 132 harbor seals were seen at one time in the study area.

Northern elephant seal (*Mirounga angustirostris*)

Background

Northern elephant seals are the largest pinniped of the Northern Hemisphere, with adult males weighing up to 2 tons (DeLong 1986). The northern elephant seal population has recovered dramatically since its near extinction from commercial sealing in the 1800s. The breeding range extends from islands off Baja California to central California. Young of the year, subadults, and adult males move north after the January to March breeding season and occur as far north as Alaska.

Distribution and abundance in study area

The only sighting we made of a northern elephant seal in the study area was a single juvenile animal hauled out on Tatoosh Island on 23 May 1986. The animal was reported to have remained hauled out for several more days after our observation. It appeared to have reddish mangy skin and did not appear in good health.

Sightings in previous years

Sighting reports from the POP and Whale Museum databases indicate elephant seals are infrequent visitors to the area. Two sightings in the study area, both in May, were reported to the Whale Museum and 4 sightings in September and October were in the POP database. Dr. Robert Paine reported seeing an elephant seal on five occasions at Tatoosh Island during his research on the island between 1975 and 1985. Sightings occurred in March, June, and July with one tagged individual seen in two different years. Two people interviewed reported one elephant seal occurring in Neah Bay, one in May 1983 and the other about 3 years prior to the April 1985 interview. These may have both referred to the same occasion. Al Seda, of Big Salmon Resort, reported seeing elephant seals almost every year offshore of Neah Bay, with most sightings in April.

Historical occurrence

Elephant seal bones have not been recovered from the Hoko River archaeological site (Wigen 1982) but two were recovered from the Makah Village at Ozette (Huelsbeck 1983).

Comparison to previous research

Everitt et al. (1979, 1980) report that elephant seals may occur in the inland waters of Washington State during all months of the year. They record five elephant seal sightings within our study area, four sightings in spring (March-May) and the fifth in fall. They concluded that primarily males of all age classes occur in Washington waters.

Summary

- Northern elephant seals occasionally are seen in the study area, with only one sighting reported inside Neah Bay.

- Elephant seals can occur in any season though sightings were most common in spring.

- Most sightings of elephant seals were of animals at Tatoosh Island or well offshore.

California sea lion (*Zalophus californianus*)

Background

The northeastern Pacific subspecies of the California sea lion breeds from Baja California to central California. Males of the species, however, migrate as far north as British Columbia during the non-breeding season. California sea lion populations have been increasing since the 1930s. The occurrence of California sea lions in Washington State changed dramatically in the last 30 years. California sea lions did not occur in Washington State in this century until the 1950s. Starting in 1979, California sea lions began hauling out in increasing numbers at Port Gardner (Everitt et al. 1980) and since 1983, increasing numbers have been overwintering in southern Puget Sound (Steiger and Calambokidis 1986).

Distribution and abundance in study area

California sea lions were the second most common marine mammal in the study area with 184 sightings of 761 animals. There were highly significant differences in the sighting frequencies of California sea lions by region (chi-square, $p<0.001$). California sea lions were most frequently seen in Neah Bay (Sector 2) with 0.24 sightings per nm of shoreline surveys and 1.2 sea lions per nm. The sightings per nm were five times higher than any of the other four sectors and the number per nm was almost 50 times higher than any other sector. Counts of California sea lions in Neah Bay are listed in Table 6.

California sea lions in Neah Bay fed on fish offal discarded from the fish processing plants in Neah Bay. In the spring and early summer, during sports fishing season, California sea lions fed on the discarded remnants of fish that had been filleted. These food sources appear to be attracting sea lions to this area. Fish offal appears to be the major source of food for California sea lions in Neah Bay which probably induces them to stay near the fish docks.

Locations where California sea lions congregated in Neah Bay are shown in Figure 6. Sea lions were most often observed near one of the three commercial fish docks in the bay. When not feeding, they rafted in a tight group of up to 25 animals in the vicinity of the fish docks. From observations of sea lions in the late evening and early morning, as well as distinctive vocalizations heard in the night, it appears all or most of the sea lions remained inside Neah Bay throughout the night.

Table 6. California sea lions observed in Neah Bay between August 1985 and July 1986. High count for each day is given.

Date	Time	#	Location
09/13/85	1935	1	off Makah Fish Dock
09/29/85	1541	1	S of Waadah Is
10/19/85	1625	1	off Makah Fish Dock
11/02/85	1340	2	off Makah Fish Dock
11/08/85	948	2	off Makah Fish Dock
11/09/85	1635	2	off Makah Fish Dock
11/13/85	1205	1	off Makah Fish Dock
12/04/85	1253	4	off Makah Fish Dock
12/12/85	1530	5	200m SW of Marine-Harvest Dock
12/13/85	1620	16	off Marine-Harvest and USCG Docks
12/14/85	922	16	50m N and S of Marine-Harvest Dock
01/20/86	1535	8	50m E of Makah Fish Dock
01/28/86	957	6	off Makah Fish Dock
02/09/86	1700	17	Makah Fish Dock
02/10/86	645	15	Makah Fish Dock
02/12/86	1013	12	50m W of Makah Fish Dock
03/11/86	830	2	Makah Fish Dock
03/26/86	825	2	Makah Fish Dock
03/27/86	1320	12	W of Makah Fish Dock
03/28/86	1510	11	20m W of Makah Fish Dock
03/29/86	830	14	30m W of Makah Fish Dock
03/30/86	1024	7	Makah Fish Dock
04/07/86	1515	1	off Thunderbird Dock
04/08/86	745	13	off Makah and Big Salmon Docks
04/09/86	1145	20	30m NE of Makah Fish Dock
04/10/86	715	18	50m NW and N of Makah Fish Dock
04/11/86	1045	15	20m N and between Bay and Makah Fish
04/25/86	1408	15	Makah Fish Dock
04/26/86	710	6	NE of Makah Fish Dock
04/27/86	1515	10	20m NW Bay Fish Dock
04/28/86	830	11	Makah Fish and W of USCG Dock
05/06/86	1840	25	Makah Fish Dock
05/07/86	940	30	10-200m N of Makah and Bay Fish and SW USCG Dock
05/08/86	1200	26	10-100m N of Makah Fish Doc
05/22/86	840	15	Between log dump/Bay Fish and off Makah Fish
05/23/86	2115	11	50-1000 W and under Makah Fish
05/24/86	800	6	W of Bay Fish, 100m W and 75m NE of Makah Fish
05/25/86	1210	7	between Bay and Makah Fish, 50m N of Makah Fish, and 100m W of Bay Fish Dock
05/31/86	1555	3	50m N of Makah Fish Dock
06/04/86	1920	1	under Makah Fish Dock
06/05/86	730	2	100m N and under Makah Fish Dock

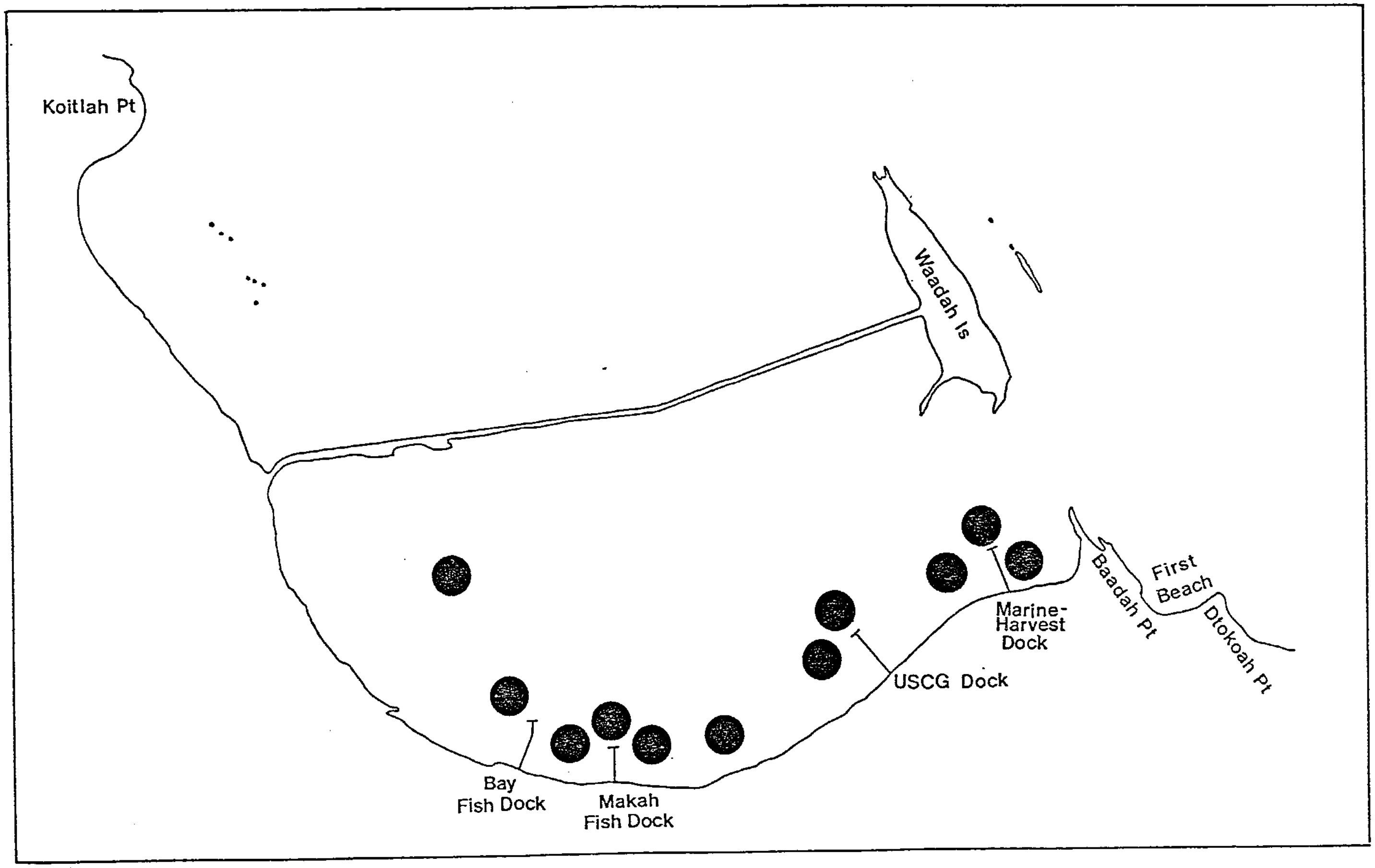


Figure 6. Locations where California sea lions congregated in the water in Neah Bay.

Seasonal abundance

California sea lion occurrence in the study area was seasonal (Figure 7). The differences in California sea lion sightings per nm by month and season were highly significant (chi-square, $p<0.001$, for both cases). The first California sea lion was seen on 13 September 1985 and the last sighting was on 26 June 1986. Sightings within Neah Bay only extended from 13 September 1985 to 5 June 1986. No California sea lions were seen in July or August. Numbers were highest in December through May. The highest count of 30 California sea lions inside Neah Bay occurred on 7 May 1986.

Migration

Besides sightings of California sea lions in and around Neah Bay, most animals were seen swimming along the shore headed east or west. During the study there were 9 sightings of a total of 13 California sea lions swimming east along the shore and 46 sightings of 87 California sea lions swimming west. There were no more than two sightings in any month of animals moving east starting on 14 September 1985. These sightings were possibly animals heading towards Port Gardner, Seattle, or southern Puget Sound, all areas where California sea lions congregate in winter and spring. The number of California sea lions seen migrating west, however, was more dramatic because of the higher number of animals seen. California sea lions were seen moving west from March to June with highest numbers in April and May. During incidental observations from 28 March to 28 April, Don Gerber, a member of our sighting network, recorded 139 California sea lions in 62 groups pass by his house, 0.7 nm west of the Sekiu River. He estimated that he made observations for 20% of the daylight hours.

Migrating sea lions generally followed the shore just outside near-shore kelp beds. The only exception appeared to be around Neah Bay. On four of five occasions in April 1986 when California sea lions were observed migrating west past Baadah Point, they headed into Neah Bay. On the fifth occasion the sea lions swam across the entrance to Neah Bay and continued west around the north side of Waadah Island. The influx of migrating sea lions into Neah Bay is likely responsible for the highest counts of California sea lions in Neah Bay occurring in April and May during the migration.

California sea lions in Neah Bay in previous years

The congregation of California sea lions in Neah Bay has been a recent occurrence. Four people reported that California sea lions first occurred

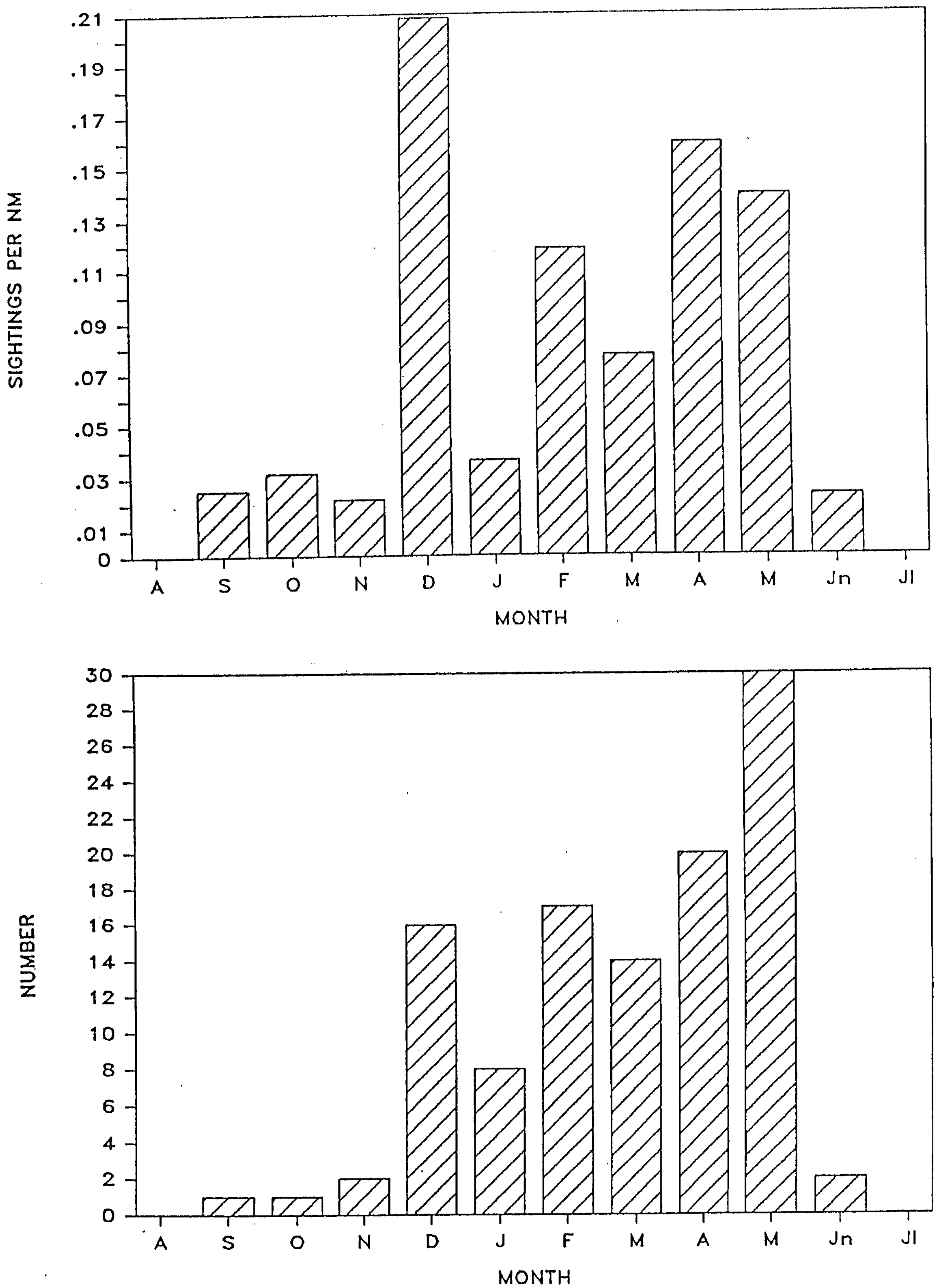


Figure 7. California sea lions seen by month. Top graph shows sightings per nm of shoreline transect and the bottom graph the high count of California sea lions seen by month in Neah Bay.

in groups in Neah Bay in winter to early summer of 1984-85. Two people who could recall numbers said the maximum seen was eight sea lions.

Historical occurrence

There is little information on the occurrence of California sea lions in Washington State prior to commercial exploitation. Records from explorers and sealers usually did not distinguish between northern and California sea lions. Archaeological remains from Ozette include a large number of sea lion bones (Huelsbeck 1983) which included both California and northern sea lions (Huelsbeck, pers. comm.). Bones recovered from the Hoko River, however, did not include California sea lions (Wigen 1982).

Comparison to previous research

California sea lion numbers in inland waters of Washington State have grown in recent years. Large increases in numbers of sea lions at Port Gardner (Everitt et al. 1980, Richter 1985, Richter and Dragavon 1985, Gearin et al. 1986) and in Puget Sound (Steiger and Calambokidis 1986, Gearin et al. 1986) have occurred.

Other researchers have reported arrival and departure times of California sea lions in other regions. Mate (1975) reported that in 1970 California sea lions began arriving in Oregon in mid-August and left by the first week in June. Beach et al. (1985) reported that in 1980 to 1982, California sea lions began arriving at South Jetty, Columbia River in early September and left by late June. California sea lions at Race Rocks, southern Vancouver Island, in 1971 first arrived in September and left by May (Bigg 1985). At Port Gardner, Puget Sound, in 1985, a few California sea lions arrived in October but numbers did not begin to increase until December; all animals were gone by mid-June (Richter 1985). In southern Puget Sound between 1983 and 1985, California sea lions began appearing in October and are last seen in May (Steiger and Calambokidis 1986). The duration of stay of California sea lions in the Neah Bay area is slightly longer than noted at other locations. The higher number of California sea lions seen migrating west compared with east suggests that many sea lions migrating north from California do not proceed east along the south shore of the Strait of Juan de Fuca.

Summary

- California sea lions were the second most common marine mammal occurring in the study area.

- California sea lions were seen most often in Neah Bay where up to 30 congregated to feed on discarded fish and fish remains.

- Occurrence inside Neah Bay began in the winter and spring of 1985 and more than doubled in the next year.

- California sea lion abundance was highest in December to May, with no sea lions seen in July or August.

- High numbers of sea lions migrated west past the entrance of Neah Bay from March to June; smaller numbers migrated east in the fall and winter.

Northern sea lion (*Eumetopias jubatus*)

Background

Northern sea lions, also known as Steller sea lions, breed from central California to northern Japan. They are the largest of the eared seals and differ from California sea lions by their larger size, lighter color, and absence of sagital crest (characteristic of adult male California sea lions). Even though the breeding range of northern sea lions includes Washington, there are no records of northern sea lions ever breeding in the state. Northern sea lion populations, particularly in Alaska, have been declining in recent years due to undetermined causes (Gentry and Withrow 1986, Braham et al. 1980).

Distribution and abundance in study area

Northern sea lions were the third most frequently sighted marine mammal with 88 sightings of 432 animals in the study area. Most of these animals were seen on or around Tatoosh Island (Table 7). Northern sea lion distribution varied significantly by sector (chi-square, $p<0.001$). Sightings per nm of shoreline surveys (0.19) in Sector 1 (Tatoosh Island to Koitlah Point) were almost 10 times higher than any other sector. Numbers of animals seen per nm of shoreline survey were even more skewed with 50 times more sea lions seen per nm in Sector 1 (1.5) than any other sector. The highest numbers were seen on 14 September when 68 were hauled out or in the water at Tatoosh Island. Tatoosh Island was the only site where northern sea lions were seen hauled out, though groups of more than one animal were seen hauled out there only in September.

Northern sea lions were also seen at other locations in the study area though not as often and in smaller numbers than at Tatoosh Island. There were 16 sightings of one or two northern sea lions in Neah Bay (Table 8). The sighting frequency of northern sea lions in Neah Bay was about as frequent as the other sectors, with the exception of Sector 1 (Tatoosh Island to Koitlah Point). Northern sea lions were sometimes found with California sea lions.

Seasonal abundance

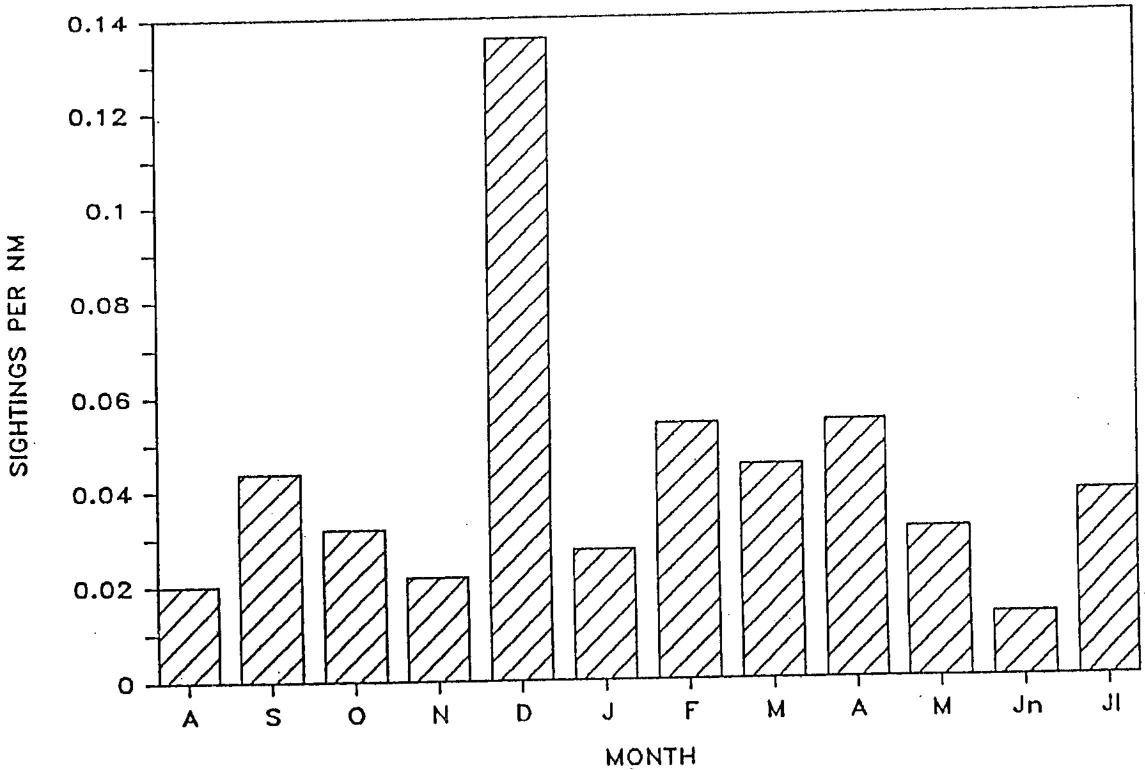
Northern sea lions were seen during all months of the year, however, sighting frequency varied significantly by season (chi-square, $p<0.01$). Both the sighting frequency per nm of shoreline surveyed and the number of animals per nm were lowest in summer (Figure 8). Counts of northern sea

Table 7. Sightings of northern sea lions at the Cape Flattery area (including Tatoosh Island and Duncan Rock), August 1985 to July 1986.

Date	Time	Number hauled	Number water	Location
08/06/85	1040	0	2	N Tatoosh
09/14/85	1919	43	25	N Tatoosh
09/23/85	1248	7	0	N Tatoosh
09/24/85	1612	9	14	N Tatoosh
09/29/85	1320	10	6	N Tatoosh
10/18/85	1235	0	21	N Tatoosh
10/18/85	1238	0	1	1nm E of Tatoosh
12/04/85	1230	0	25	N Tatoosh
12/12/85	910	0	20	N Tatoosh
12/14/85	1019	0	20	N Tatoosh
12/14/85	1224	0	2	N Tatoosh
02/09/86	1532	0	11	N Tatoosh
02/12/86	945	0	11	N and E Tatoosh
03/11/86	1000	0	25	N Tatoosh Is
03/28/86	1015	0	3	N Tatoosh
03/30/86	1040	0	34	N Tatoosh
04/08/86	1730	0	23	N,W,S Tatoosh
04/09/86	1415	0	15	N Tatoosh
04/11/86	910	0	10	N Tatoosh
04/26/86	830	0	2	N and S Tatoosh
04/28/86	1254	0	5	N Tatoosh
04/28/86	1402	0	1	NE Tatoosh
05/07/86	1305	0	3	W Tatoosh
05/22/86	735	0	3	N Tatoosh
05/22/86	805	0	1	Fuca Pillar
05/23/86	1735	1	0	W Tatoosh
05/31/86	1610	0	1	N Tatoosh
05/31/86	1635	0	2	Duncan Rk
06/04/86	1430	1	0	N Tatoosh
06/05/86	1158	1	0	W Tatoosh
06/06/86	1700	1	0	W Tatoosh
07/07/86	1538	1	0	N Tatoosh
07/15/86	1503	1	3	N Tatoosh

Table 8. Sightings of northern sea lions in the water in the Neah Bay and Waadah Island area, August 1985 to July 1986.

Date	Time	Number	Location
10/22/85	1321	1	15m N of NW Waadah Is
10/23/85	1225	1	NW Waadah Is
10/24/85	957	1	off Baadah Pt
10/24/85	1723	1	off Baadah Pt
12/14/85	922	2	50m S of Marine-Harvest Dock
12/14/85	930	1	N Waadah Reef
12/14/85	939	1	200m NW of Neah breakwater
12/14/85	1307	1	10m NW of Marine-Harvest Dock
03/11/86	845	1	50m off SE Waadah Reef
03/27/86	1637	1	E Waadah Reef
04/26/86	1827	1	NW Waadah Is
04/28/86	1240	2	SE of Neah breakwater
04/28/86	1312	1	Koitlah Pt
05/06/86	1800	1	30m W of W Waadah Reef
05/07/86	955	1	NNE Waadah Reef
07/08/86	954	1	NW Waadah Is



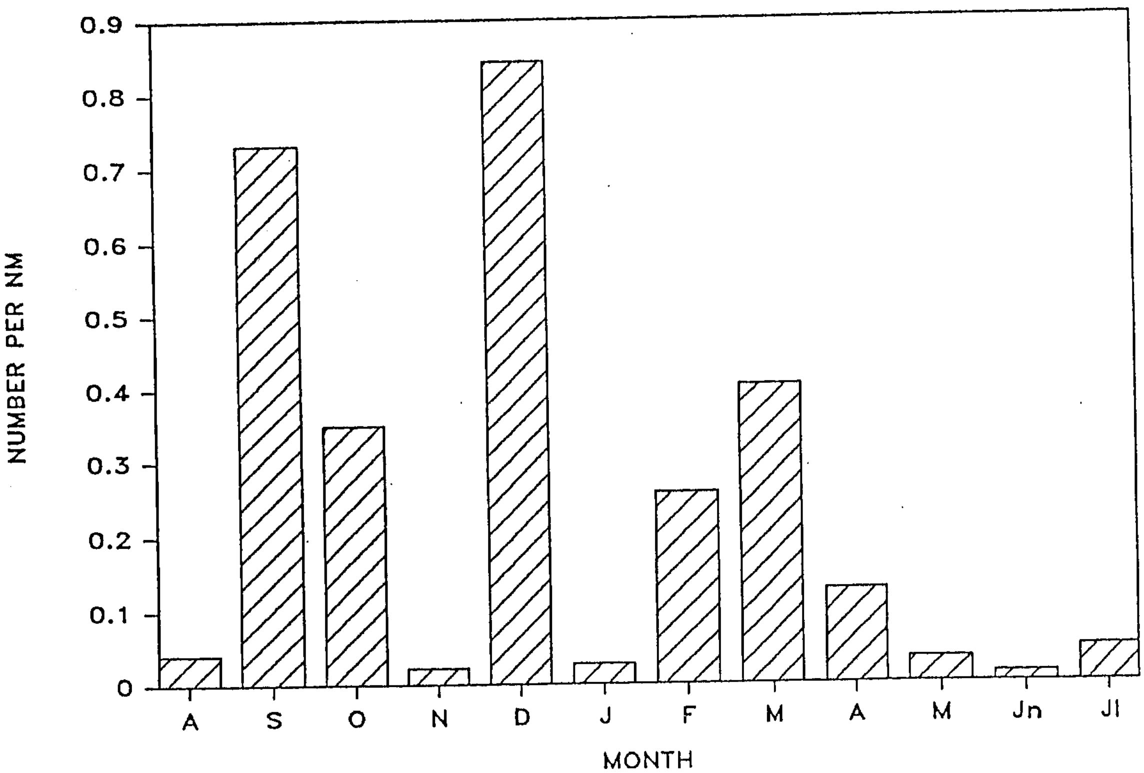


Figure 8. Northern sea lion occurrence by month. Top graph shows the sightings per nm of shoreline transect and the bottom graph the number of animals per nm of shoreline transect.

lions at Tatoosh Island were greater than 10 from September to April, with fewer than 5 animals sighted from May to August.

The northern sea lion breeding season extends from June to August. The decrease in numbers of sea lions in the study area during this period reflects the movement of animals to breeding areas outside Washington State.

Migration

An east-west migration, similar to that of California sea lions, was seen with northern sea lions in the study area, though fewer animals were involved. Five sightings of six northern sea lions were made of animals swimming east through the study area between September and December. Eighteen sightings of 30 northern sea lions were made of animals swimming west in April and May. One sea lion seen swimming east into Clallam Bay on 29 September 1985 was preying on a salmon.

Historical occurrence

Northern sea lion bones were recovered from both Ozette and Hoko River. Huelsbeck (1983) reported 930 sea lion bones from Ozette which included both northern and California sea lions. Wigen (1982) reported just 2 northern sea lion bones from Hoko River.

Comparison to previous research

Everitt et al. (1980) reports 7 counts of 1 to 20 northern sea lions on Tatoosh Island between 28 January 1978 to 5 December 1979. They also reference a count of 55 northern sea lion at Tatoosh Island on 22 October 1976. Scheffer and Macy (1944) report seeing no northern sea lions on Tatoosh Island on their sea lion survey on 21 March 1944. Kenyon and Scheffer (1962) reported seeing 2 Northern sea lions at Cape Flattery on 15 July 1959.

Kenyon and Scheffer (1962) quote an unpublished report of 2,000-3,000 northern sea lions on Jagged Island each summer from 1914 to 1917. Current numbers on the Washington outer coast are far below these numbers (Beach et al. 1985).

The periods of peak abundance of northern sea lions in the study area corresponds with observations in other parts of Washington State. Northern sea lions occur in southern Puget Sound between October and June (Steiger and Calambokidis 1986). Everitt et al. (1980) reported October to April as the period of greatest northern sea lion abundance in Northern Puget Sound with none present in June to August.

Summary

- Northern sea lions were commonly seen close to shore in the study area, and were most numerous around Tatoosh Island, where up to 68 were seen.

- Northern sea lions were least abundant in summer.

- Northern sea lions migrate past Neah Bay in the fall and spring.

Harbor porpoise (*Phocoena phocoena*)

Background

Harbor porpoise are the smallest of the oceanic cetaceans and range in the eastern North Pacific from Southern California to Alaska. An inhabitant of near-shore waters, it is generally found at depths of less than 50 fathoms. The harbor porpoise is one of the more difficult cetaceans to study because of its small size, shy nature, and indistinct surfacing behavior. Unlike many other small cetaceans, the harbor porpoise generally avoids boats and does not approach and ride the bow wave of vessels. Little is known about the harbor porpoise population size but numbers have declined in many portions of its range including Puget Sound (Calambokidis et al. 1985).

Distribution and abundance in study area

The harbor porpoise was one of the most frequently encountered cetaceans in the study area with 60 sightings of 219 animals (Appendix Table A-10). Figure 9 shows the locations where harbor porpoise were sighted. Harbor porpoise were seen during the 1nm Transects and the Offshore Transects. None were sighted on Shoreline Transects or from land with the exception of sightings off Tatoosh Island. The maximum number seen at one time was 40 animals in approximately 12 groups seen on 14 September 1985 at 1.1 nm offshore from Kydaka Point. Some harbor porpoise were associated with calves in July and September (there were limited offshore surveys in August).

Harbor porpoise sighting frequency varied by distance offshore. The number of harbor porpoise seen per nm during Offshore Transects (perpendicular from shore and out to 3 nm) is shown in Figure 10. The greatest number of harbor porpoise were encountered between 0.5 and 1.5 nm offshore. Through most of the study area, this corresponds to an average water depth of about 30 fathoms, though at the east and west ends of the study area, water depths of 70-80 fathoms are found just 1 nm offshore. The high sighting frequency around 1 nm offshore indicates that by conducting many of the boat and aerial surveys paralleling the shore at 1 nm, we were maximizing our chances of seeing harbor porpoise.

Harbor porpoise were not evenly distributed through the study area. Sightings per transect nm (excluding Shoreline Transects) varied significantly by sector (chi-square, $p<0.05$). Sector 2, inside Neah Bay, was excluded because it does not include any offshore areas and no porpoises were reported from inside Neah Bay. The highest sightings per nm

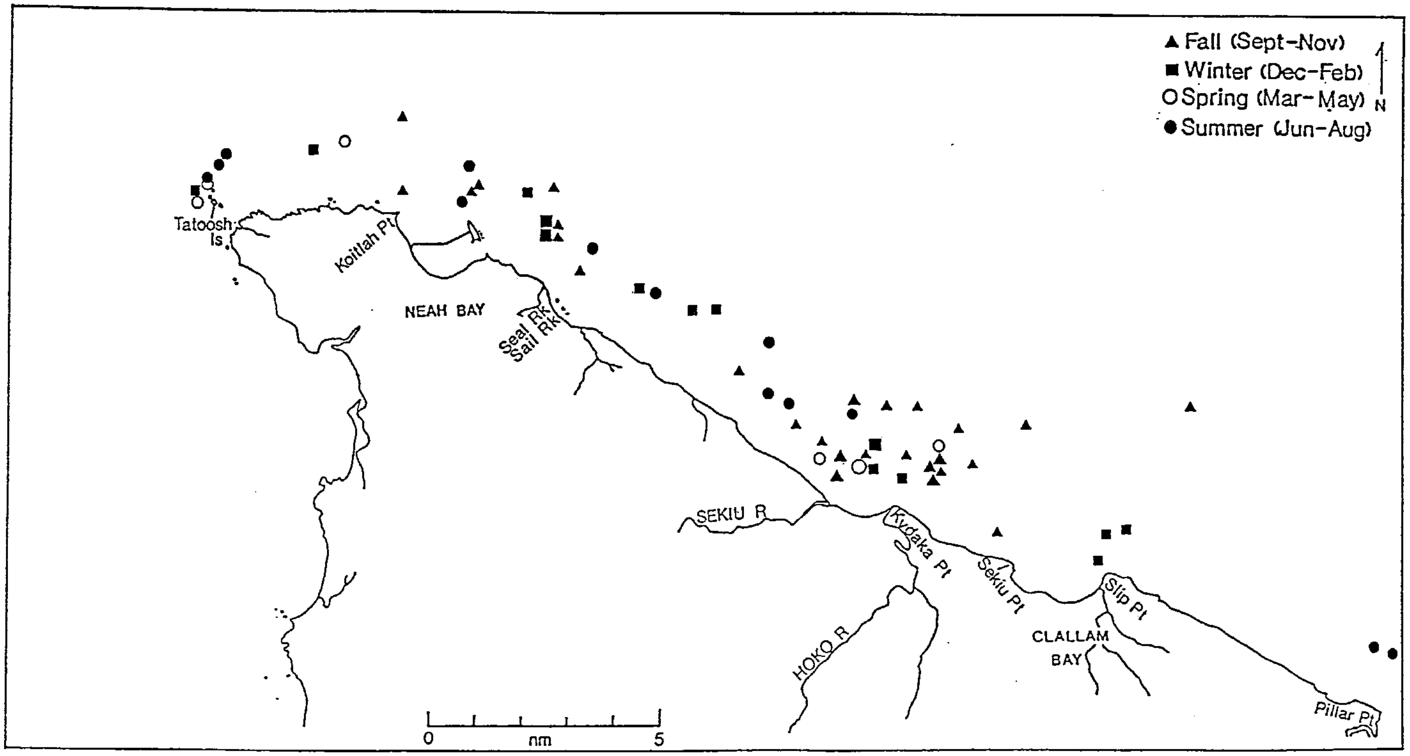


Figure 9. Locations where harbor porpoise were seen by season. Larger symbols for each season indicate groups of five or more animals.

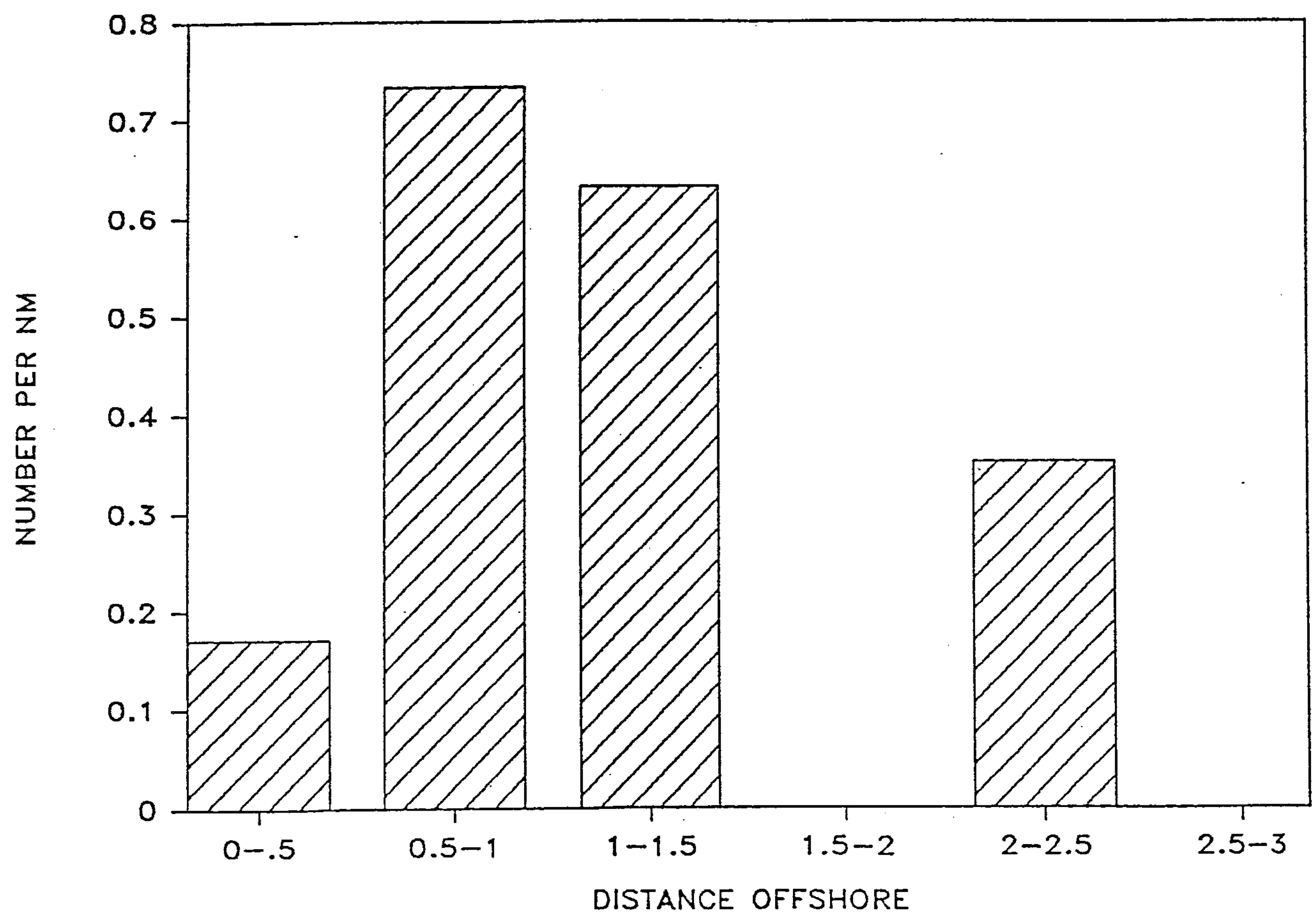


Figure 10. Number of harbor porpoise per nm of offshore transect (perpendicular to shore). Minimum of 35 nm coverage in each block.

and number of animals per nm was in Sector 4 (Shipwreck Point to mid-Clallam Bay). Harbor porpoise were seen most frequently off the Sekiu River and Kydaka Point in this sector. In this area 40 harbor porpoise were seen; the largest group of harbor porpoise we noted in the study area. The lowest harbor porpoise sightings per nm and numbers per nm occurred in Sector 5 (mid-Clallam Bay to Pillar Point). This region has the sharpest shoreline drop-off of anywhere in the study area, with depths greater than 80 fathoms just 1 nm offshore.

Harbor porpoise tended to be associated with tide rips or gull and alcid feeding locations. This tendency was more pronounced in summer and fall, when areas of concentrated prey and feeding birds were frequently seen offshore.

Seasonal abundance

Harbor porpoise were seen in all seasons, but there were some differences in sighting frequency. Harbor porpoise sighting frequency varied significantly by season (chi-square, $p<0.005$), with the highest sightings per nm (0.08) and number per nm (0.43) in fall. The lowest sighting frequency occurred in spring with 0.02 sightings per nm and 0.06 animals per nm. Figure 11 shows the sightings per nm by month. The high sighting frequency in the fall is the result of high numbers of sightings in September. Sighting frequencies varied by month. Some of this variation may be due to changes in weather conditions and thus sighting conditions. Of all the marine mammals seen in this research, harbor porpoise sighting frequency varied the most among the four weather and visibility conditions (chi-square, $p<0.001$).

Locations where harbor porpoise were seen also varied by season. Sightings in the fall were concentrated off Kydaka Point and the Sekiu River. Locations in winter included a number of sightings northeast of Neah Bay and off Slip Point. Sightings in spring were sparse while in summer there were repeated sightings in tide rips off Tatoosh Island.

The Whale Museum database contained only one sighting (in June) of harbor porpoise in the study area. The POP database contained 10 sightings in 6 different months (January, March, July, August, September, and November).

Strandings

Four harbor porpoise were found stranded just south of the study area at Shi Shi Beach. The animals consisted of adults and subadults ranging in

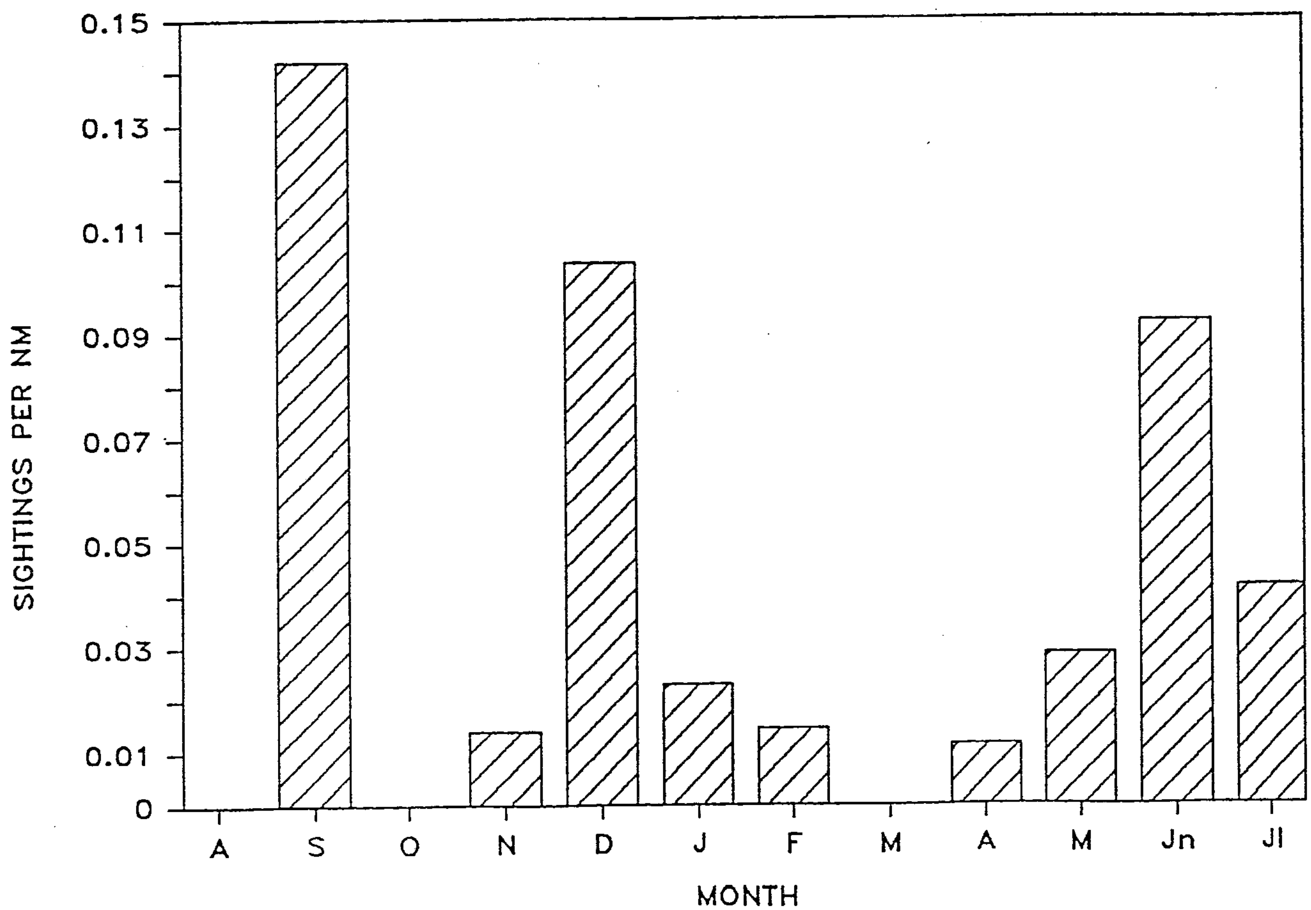


Figure 11. Monthly harbor porpoise sightings per nm (not including shoreline transects).

length from 137-171 cm. The stranding was first reported on 31 July 1985 but not examined until 11 August when the animals were in poor condition. Cause of death could not be determined but entanglement in a fishing net was suspected as the most likely cause for finding four animals stranded on the same beach at the same time. Another harbor porpoise stranded just east of the study area at Salt Creek in July 1984 was examined by the National Marine Mammal Laboratory. It was a 176 cm adult female. Tissues of these animals were recently tested for chemical contaminants (Calambokidis 1986).

Historical occurrence

Porpoise bones were found at both Ozette and Hoko River (Huelsbeck 1983, Wigen 1982). The majority of these remains appear to have been from harbor porpoise (Huelsbeck, pers. comm., Wigen, pers. comm.). Harbor porpoise have been reported as being hunted from small boats by the Makahs in the study area (Scheffer and Slipp 1948, Swan 1868).

Comparison to previous research

Everitt et al. (1980) report that harbor porpoise occur in the inland waters of Washington but no sightings in our study area. Harbor porpoise used to be one of the most abundant cetaceans in Puget Sound through the 1940s (Scheffer and Slipp 1944) but currently are absent from waters south of Admiralty Inlet (Calambokidis et al. 1985). Scheffer and Slipp (1948) quote reports that the harbor porpoise were common in the Strait of Juan de Fuca especially in summer. Flaherty and Stark (1982) estimated there were several hundred harbor porpoise in the San Juan Islands. The number of harbor porpoise seen in the study area, especially in fall, appears higher than many other parts of Washington State. Groups of harbor porpoise as large as those seen in the study area in September are not commonly encountered in the inland waters of Washington (Flaherty and Stark 1982, Calambokidis et al. 1985). Other researchers report that harbor porpoise occur year-round in the inland waters of Washington (Flaherty and Stark 1982, Everitt et al. 1980).

The harbor porpoise is generally associated with coastal waters throughout its range (Leatherwood and Reeves 1983). LaBarr and Ainley (1985) reported harbor porpoise off central California were most commonly encountered in water depths of 20-40 fathoms. Harbor porpoise have been reported to be wary of boats. Amundin and Amundin (1974) reported harbor porpoise avoided motor boats that came within 100-200 m.

Harbor porpoise are generally born between May and July (Leatherwood and Reeves 1983). Flaherty and Stark (1982), however, report calves may be born from April to August in the San Juan Islands. Scheffer and Slipp (1948) report harbor porpoise with young occurring in Washington State in August and September.

Harbor porpoise in the Gulf of Maine occur seasonally in certain areas and apparently move northward from April to July and southward in October (Kraus and Prescott 1984). In the Bay of Fundy, harbor porpoise appear to move in shore in summer and offshore out of the Bay in winter (Gaskin 1977, Neave and Wright 1968) and density is associated with water depth, herring density, and surface temperature (Watts and Gaskin 1985).

Summary

- Harbor porpoise were the most frequently encountered cetacean in the study area.

- Animals were almost always seen away from the near shore area with highest numbers seen 0.5 to 1.5 nm offshore.

- Sighting frequency in the study area varied by region with Sector 4 (Shipwreck Point to Clallam Bay) having the greatest abundance.

- Harbor porpoise were present in all seasons but seasonal variations were found in distribution of sightings and the overall sighting frequency, with the highest sighting frequency in fall.

Dall's porpoise (Phocoenoides dalli)

Background

Dall's porpoise occur only in the North Pacific. In the Eastern North Pacific they occur year round from 34° N to the Aleutians and seasonally into the Bering Sea (Leatherwood and Reeves 1983). They are considered abundant throughout their range. Just slightly larger than the harbor porpoise, they are not as wary of boats and frequently approach vessels to ride the bow waves.

Distribution and abundance in study area

A total of 80 Dall's porpoise were counted in 16 sightings made in the study area (Appendix Table A-11). Locations and seasons of sightings are shown in Figure 12. All Dall's porpoise were sighted offshore. Sightings ranged from 1 to 19 animals with some sightings consisting of up to 3 subgroups of several animals each. Dall's porpoise were sighted far less often than harbor porpoise.

Sighting frequency per transect nm (excluding Shoreline Transects) did not vary significantly by region (chi-square, $p>0.05$), though this is primarily the result of the overall low number of Dall's porpoise sightings. No Dall's porpoise were seen in Sector 5 (Slip Point to Pillar Point), the east end of the study area, though they were seen east of this area. The closest sightings to Neah Bay were two sightings about .5 to 1 nm north of Waadah Island in the fall.

Dall's porpoise were generally seen further offshore than harbor porpoise. The distribution in numbers of Dall's porpoise seen per nm by distance from the shore (from Offshore Transects that extended to 3 nm from shore) is shown in Figure 13. The greatest number of Dall's porpoise per nm were seen at 1.5 to 2.5 nm offshore. Most of our surveys parallel to shore were conducted at about 1 nm from shore and therefore fell outside the area of higher concentration of Dall's porpoise.

People we interviewed who spent time offshore reported seeing Dall's porpoise and provided information that agreed with our survey findings. Four commercial or charter fishing boat operators out of Neah and Clallam Bays all thought Dall's porpoise were most common several miles offshore throughout the study area.

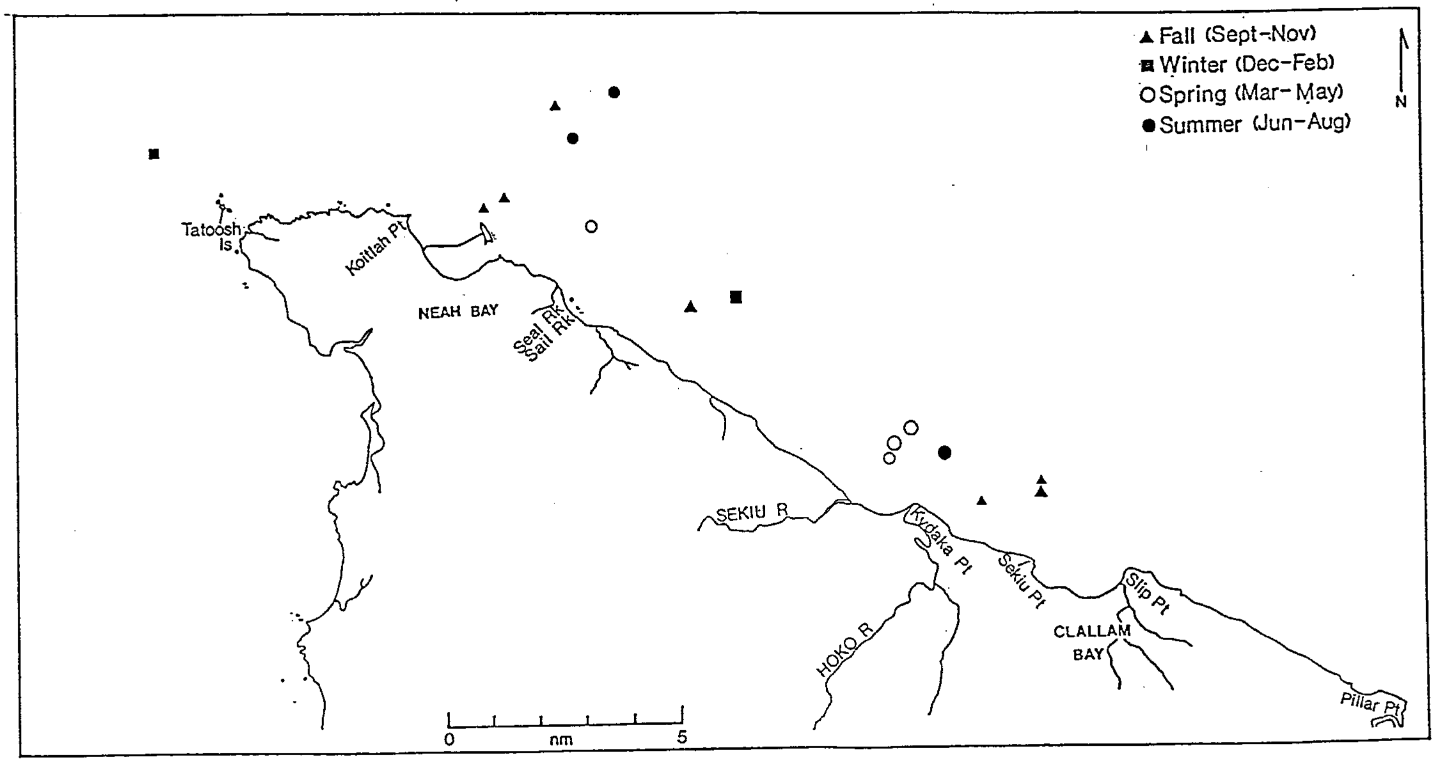


Figure 12. Locations where Dall's porpoise were seen by season. Larger symbols for each season indicate groups of five or more animals.

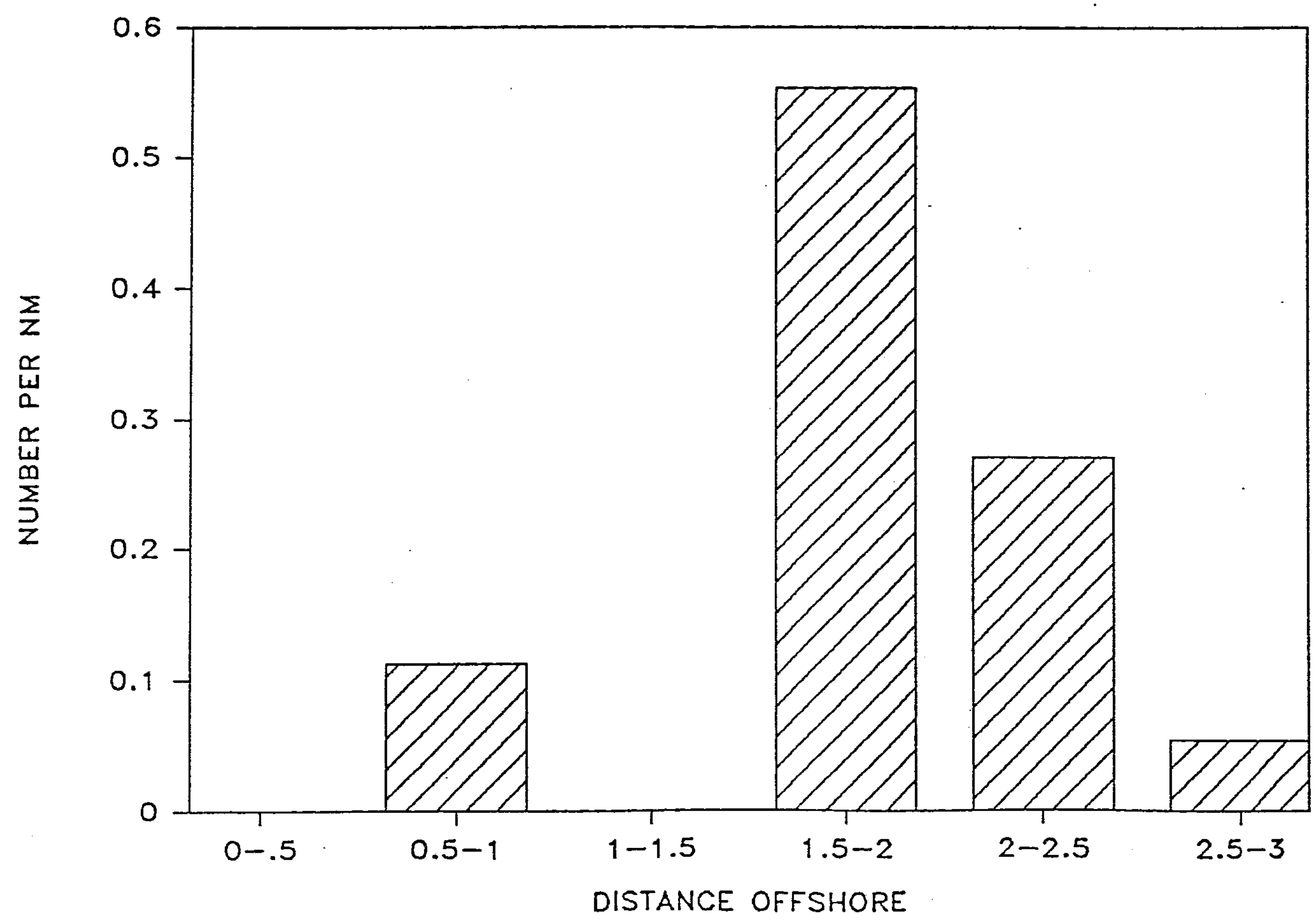


Figure 13. Number of Dall's porpoise per nm of Offshore Transect (perpendicular to shore). Minimum of 35 nm coverage in each block.

Seasonal abundance

Dall's porpoise sightings were too infrequent to allow statistical testing for seasonal differences. No Dall's porpoise were seen in January through March (Figure 14). Sightings were made during all other months except July and October, when offshore survey coverage was minimal.

The Whale Museum database includes one sighting of Dall's porpoise in the study area (in July) and the POP database contains 34 Dall's porpoise sightings in all months of the year except February, May, and June. Half the commercial and charter fisherman we interviewed reported that they encountered Dall's more often in summer than in winter, but the rest thought that they were equally common in winter and summer.

Historical occurrence

Historical occurrence is difficult to ascertain from the reports of Makah archaeological remains because bones were classified only as porpoise and not to species (Huelsbeck 1983, Wigen 1982). Most of these porpoise bones are likely harbor porpoise (Huelsbeck, pers. comm.; Wigen, pers. comm.). The Makahs, however, had a name for a porpoise that translates to "broken tail" and matches the description of a Dall's porpoise, with the large caudal peduncle that gives the porpoise a sharply bent appearance near the flukes when diving (Scheffer and Slipp 1948).

Comparison to previous research

Scheffer and Slipp (1948) reported sightings of Dall's porpoise at Swiftsure Bank off Cape Flattery but reported they rarely came in past Tatoosh Island. Everitt et al. (1980) reported that Dall's porpoise occur in the inland waters of Washington State in all months of the year, with more animals present in the eastern Strait if Juan de Fuca in the spring and summer compared to fall and winter, although they report sightings in our study area in fall and winter.

Summary

- Dall's porpoise occurred in all seasons in the study area.

- All sightings were offshore with highest numbers seen 1.5 to 2.5 nm offshore.

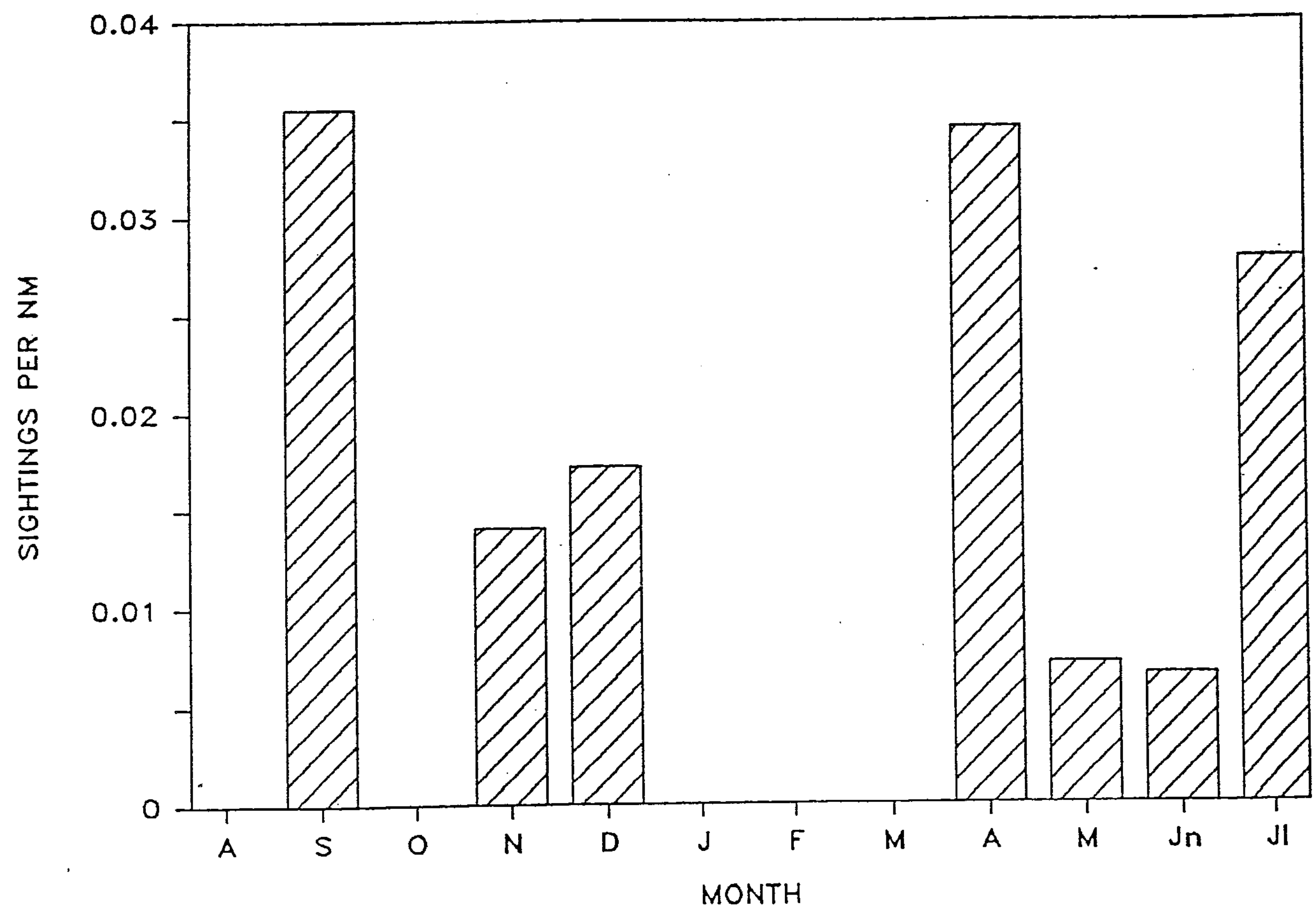


Figure 14. Monthly Dall's porpoise sightings per nm (not including shoreline transects).

Killer whale (*Orcinus orca*)

Background

Killer whales are cosmopolitan in distribution and are generally considered gregarious animals that form strong social bonds and travel in stable groups called pods (Leatherwood and Reeves 1983). They occur both inshore and offshore and feed on a variety of fish and marine mammals.

Distribution and abundance in the study area

Killer whales were not sighted in the study area during this study but we received several reports of sightings, indicating that they occasionally occurred in the study area. Dr. Paine (pers. comm.) reported three killer whale sightings at Tatoosh Island between 1975 and 1985 during June, August, and September.

Six sightings of killer whales in the study area were found in the Whale Museum sightings records. All these sightings occurred between April and September with three of the sightings in June. Only one killer whale sighting in the study area was reported in the POP database and this was in August. Number of animals in these sightings ranged from 2 to 40 with 5 of the 7 sightings composed of 6 or fewer animals.

Comparison to previous research

Killer whales occur in the protected waters of Washington State during all months of the year (Balcomb et al. 1980, Osbôrne et al. 1985). Individual whales are identifiable and have been tracked over several years. Three major groups, or communities of these pods -- southern resident pods, northern resident pods, and transient pods--have been identified in the waters off Washington and Vancouver Island, Canada. The transient pods appear to be more far-ranging and composed of fewer individuals than resident pods (Bigg 1982). Based on the small numbers of animals in sightings reported to us, we suspect that the killer whales in the study area are mostly members of transient pods.

Summary

- Killer whales occurred infrequently in the study area.

- The most sightings occurred in summer months.

Gray whale (Eschrichtius robustus)

Background

The gray whale's range extends from calving lagoons in Baja California during the winter to major feeding areas in the Bering and Chukchi Seas and as far as the eastern Beaufort Sea during summer. The animals migrate close to shore. The population is estimated at 16,000-17,000 animals (Reilly et al. 1983, Rugh 1984). Not all animals migrate to the Bering Sea. Summer sightings of gray whales have been reported in Mexico and California (Pattern and Samaras 1977), Oregon (Sumich 1984), Washington (Flaherty 1983), and British Columbia (Darling 1984). Though driven to near extinction by commercial whaling, the gray whale appears to be recovering to pre-exploitation levels. However, it is still federally and internationally listed as endangered.

A large percentage of the gray whale population passes within 8 nm of the entrance to Neah Bay and thus skirts the western edge of the study area. A small portion of these animals can be expected to enter the Strait of Juan de Fuca and be exposed to potential hazards associated with the development of Neah Bay. With these potential conflicts in mind, the Army Corps of Engineers asked for additional work to be devoted specifically to gray whale study.

Distribution and abundance in the study area

Survey results. There were 68 sightings of 80 gray whales in the study area. This does not include the sightings of migrating gray whales monitored from land and discussed later. The first gray whale was seen in the study area on 20 January 1986 and the last sighting was on 15 July 1986. Figure 15 shows the location of gray whales seen during surveys of the study area.

Gray whale sightings were not evenly distributed through the study area. Sightings per nm of shoreline transect were significantly different by sector (chi-square, $p<0.001$). The sighting rate in Sector 3 (Baadah Point to Shipwreck Point) was four times higher than any other area, with Sector 1 (Tatoosh Island to Baadah Point) having the next highest sighting rate. Sector 5 (Clallam Bay to Pillar Point) was the only sector where gray whales were not seen. All sightings in the study area were of animals within 300 m of the shore and commonly were less than 100 m from the shore.

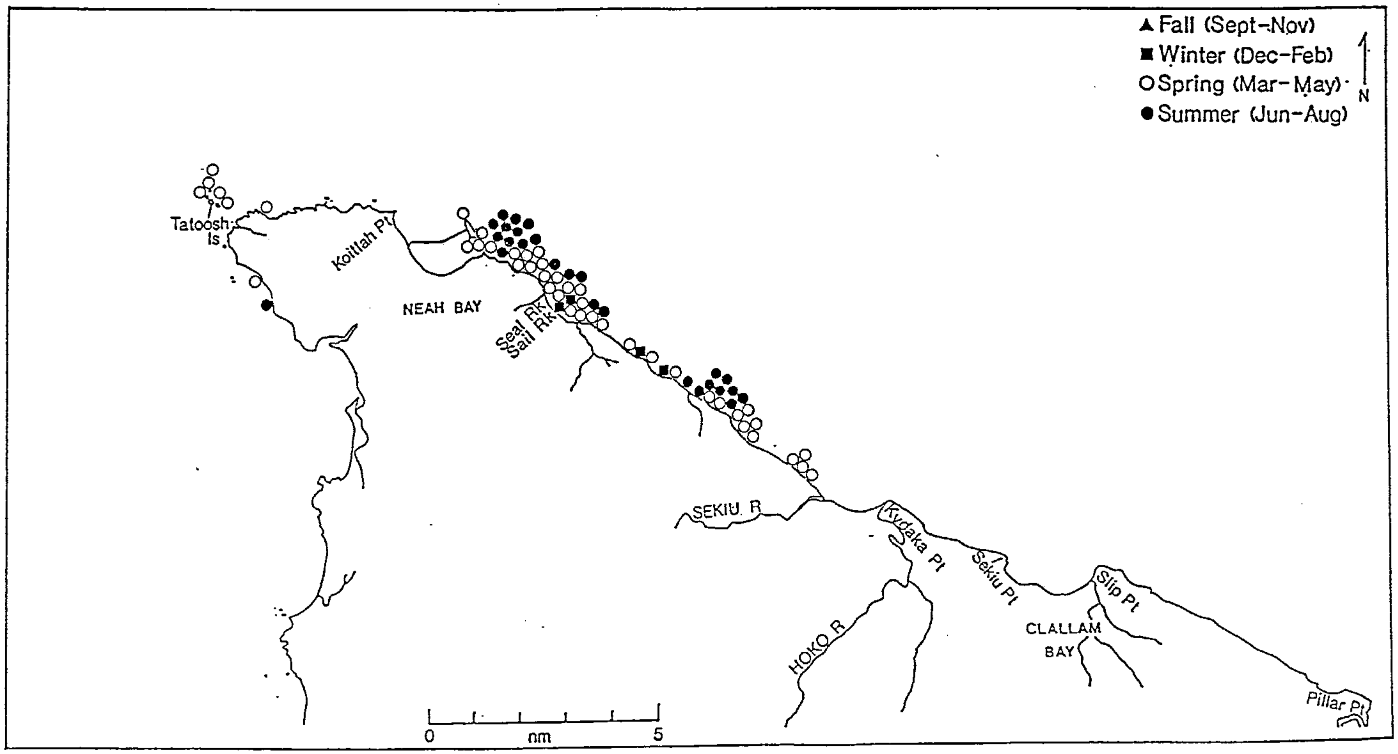


Figure 15. Locations where gray whales were initially sighted in the study area by season (see text for movements). Does not include sightings of migrating gray whales monitored by land.

Gray whales were repeatedly seen in several specific locations including the areas: 1) off Sail River, 2) just off Second and Third Beach, 3) between Rasmussen Creek and Shipwreck Point, and 4) 0.8 to 1.0 nm west of the Sekiu River. At these and other locations shown in Figure 16, gray whales were observed foraging. Whether feeding was actually taking place was difficult to determine from a boat, but could clearly be seen from the aircraft. Animals were seen from the air on eight occasions obviously feeding; either mud was streaming from the whales' mouths or they were on their sides in kelp beds with their mouths open. From these observations, we inferred that when animals were seen from boats or land, milling in the one area, going back and forth over the same area, they were likely feeding.

On six occasions gray whales were observed to enter Neah Bay and on two additional occasions gray whales were observed crossing the entrance to Neah Bay between Baadah Point and Waadah Island. A detailed plot of gray whale movements in and around Neah Bay is given in Figure 17. Most sojourns into Neah Bay were short but on one occasion a whale stayed a minimum of $3\frac{1}{2}$ hours. Though no foraging behavior was observed inside Neah Bay, it was seen near the entrance, off Waadah Island and off Second Beach.

Sighting data reported to us during the study supplemented our observations of gray whales in the study area, especially in the Chito Beach area, where two residents provided numerous sightings. A gray whale off Chito Beach in early December 1985 was the earliest sighting report we received. Our first sighting of a gray whale in this area was in January. From January to March 1986, two residents reported frequent gray whale sightings in this area (C. Averill and D. Gerber, pers. comm.), and starting in March began recording all sightings. Sightings of up to 3 whales were made from late March through early April, then infrequently after early April until late May. From late May to to 12 June sightings were again frequent. The only sighting reported after 12 June at Chito Beach was on 8 July 1986. At least one gray whale occurred in the study area past our last survey on 15 July 1986. Al Seda reported seeing a single small gray whale on 2-3 occasions between Neah and Clallam Bays as late as September 1986.

Reports received from various charter boat operators working out of Big Salmon Resort in Neah Bay indicated a high concentration of gray whales occurred from 12 April to about 20 April 1986 in the area between Waadah Island and Tatoosh Island. We did not conduct any observations in the study area during this time. Sixteen sightings were reported during this period of up to 5 gray whales together milling and feeding. The most

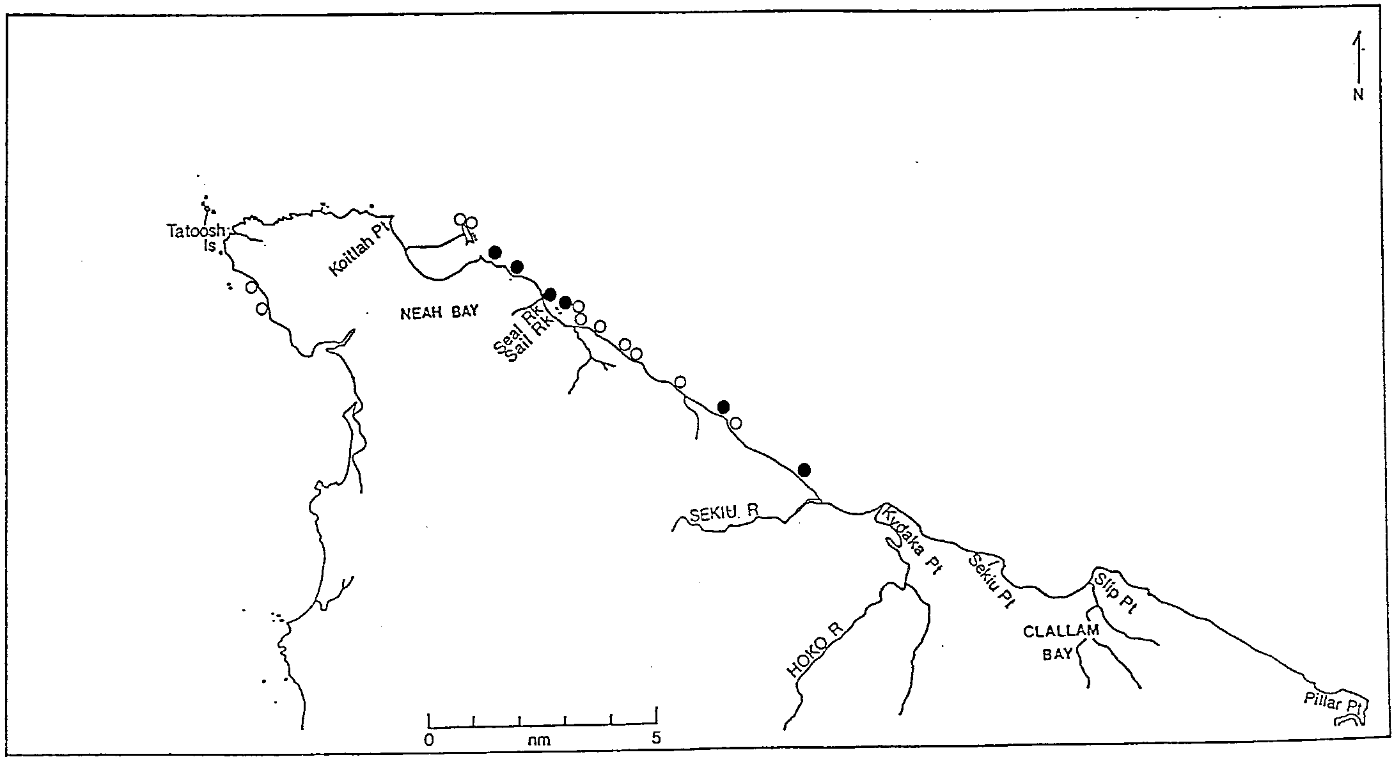


Figure 16. Locations where gray whales were observed foraging in the study area. Hollow circles indicate single occurrence, solid circles indicate location where gray whales were seen foraging on three or more occasions.

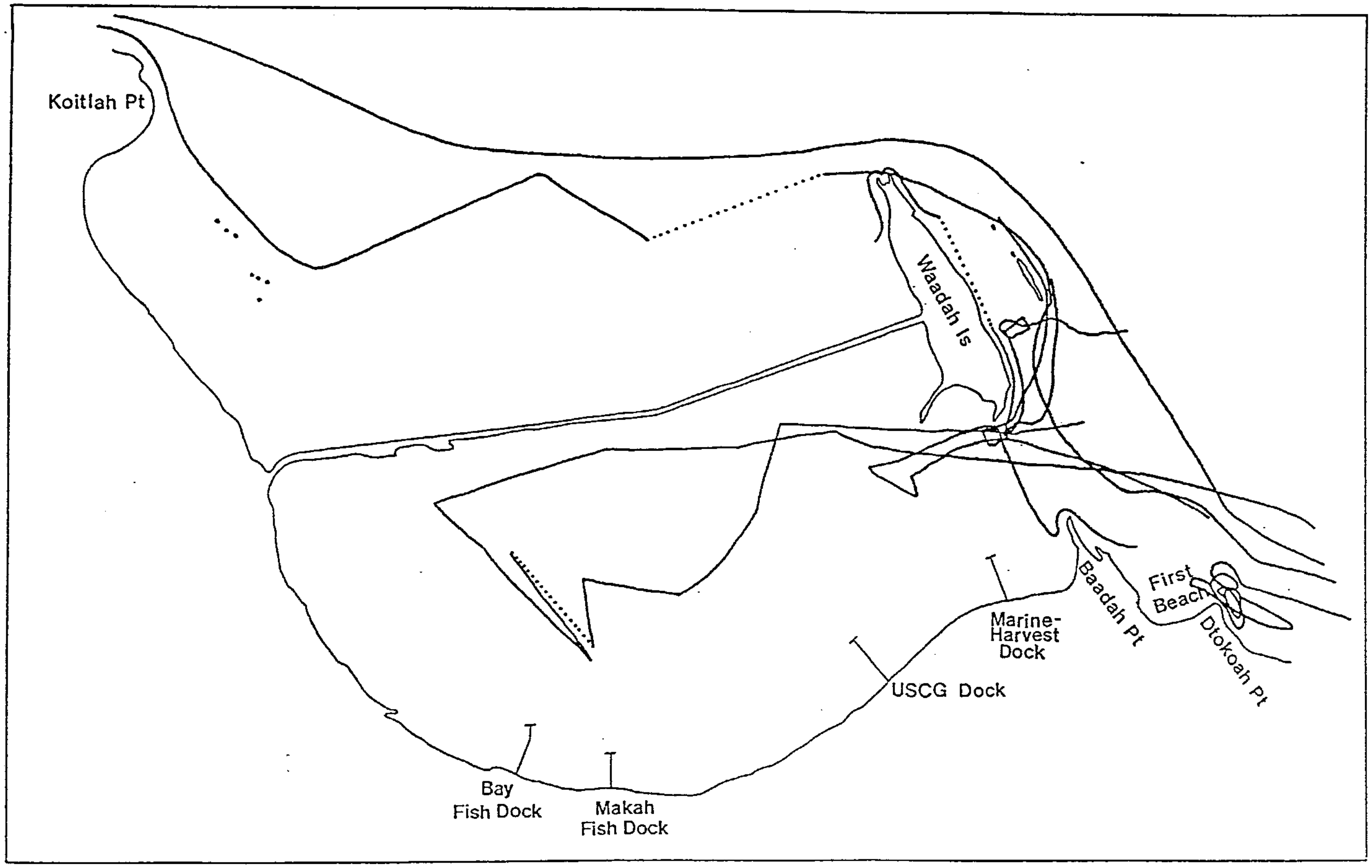


Figure 17. Gray whale movements in and around Neah Bay. Each line shows the route taken by a an individual gray whale.

common locations these animals were seen included the NW side of Waadah Island (near the breakwater) and about halfway between Waadah and Tatoosh Islands.

Sightings of gray whales (per nm of Shoreline Transect) were highly significantly different by season (chi-square, $p<0.001$). The sighting frequency of gray whales by month is shown in Figure 18. Sighting frequency steadily increased from January through the end of observations in July.

Identified animals. Individual animals seen in the study area were identified by coloration, scars, and other markings on their backs. Figure 19 summarizes the dates that different animals were seen in the study area. Seven different animals were photographed and identified in the study area with this technique. These seven animals account for 55 of the 68 gray whale sightings in the study area. Of these seven animals, five were observed on multiple occasions in the study area. These five animals were seen from 3-28 times on 2-17 different days. The number of days between the first and last sighting ranged from 1-110 days. Our sighting of a gray whale that was not identified on 20 January, and other reports of a gray whale in December and January in the same area, may well have been "Sneaky", a whale first positively identified on 26 January. This whale did not appear to make the winter migration south to the breeding lagoons in Baja California. Similarly, the repeated sighting of a gray whale in the late summer, after the end of our study (discussed above), may have also been of one of the identified whales.

The number of resightings would have been higher if the coverage had been more extensive. We conducted boat or aerial surveys on 3 to 8 days a month from January to July. Coverage was best from April to June when supplemental funding for gray whale research allowed 7-8 days of aerial or boat surveys each month.

In both cases where an individual gray whale was seen only once and photographed adequately to provide positive identification, the animal was traveling through the study area and was not observed to feed. In these two cases, occurring on 5 June 1986 and 8 July 1986, the animals were initially seen off Second Beach and were followed as they traveled west until just west of Chibahdehl Rocks where both animals were lost. These two animals travelled about 4.7 nm in 2 hours in one case and the other in 2.6 hours at a speed of between 1.8 to 2.4 knots.

On 13 occasions gray whales were seen in the study area and not identified. In 11 of these occasions, conditions did not allow any

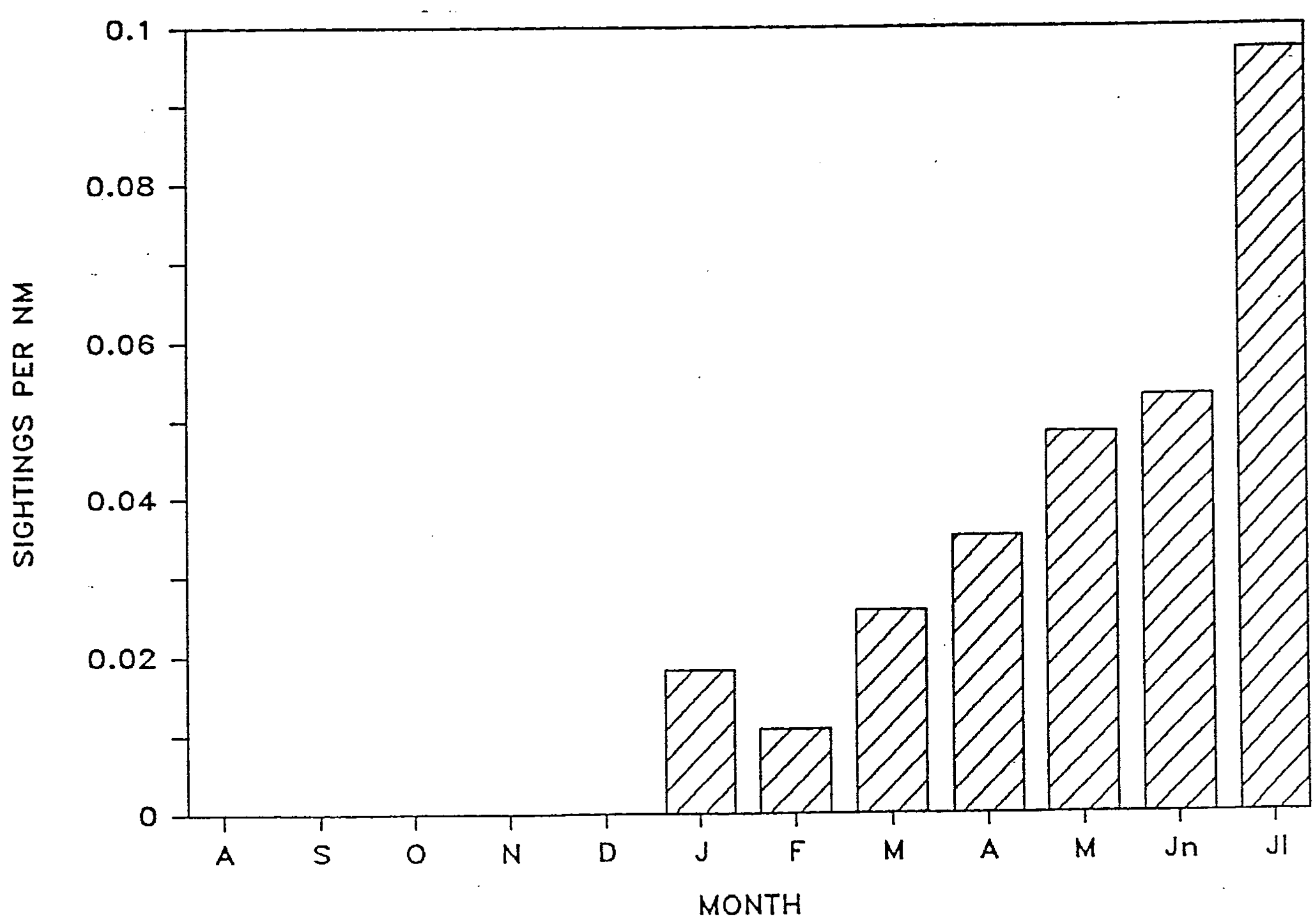


Figure 18. Gray whale sightings per nm of shoreline transect by month. Does not include migrating whales monitored from land or sightings outside the study area.

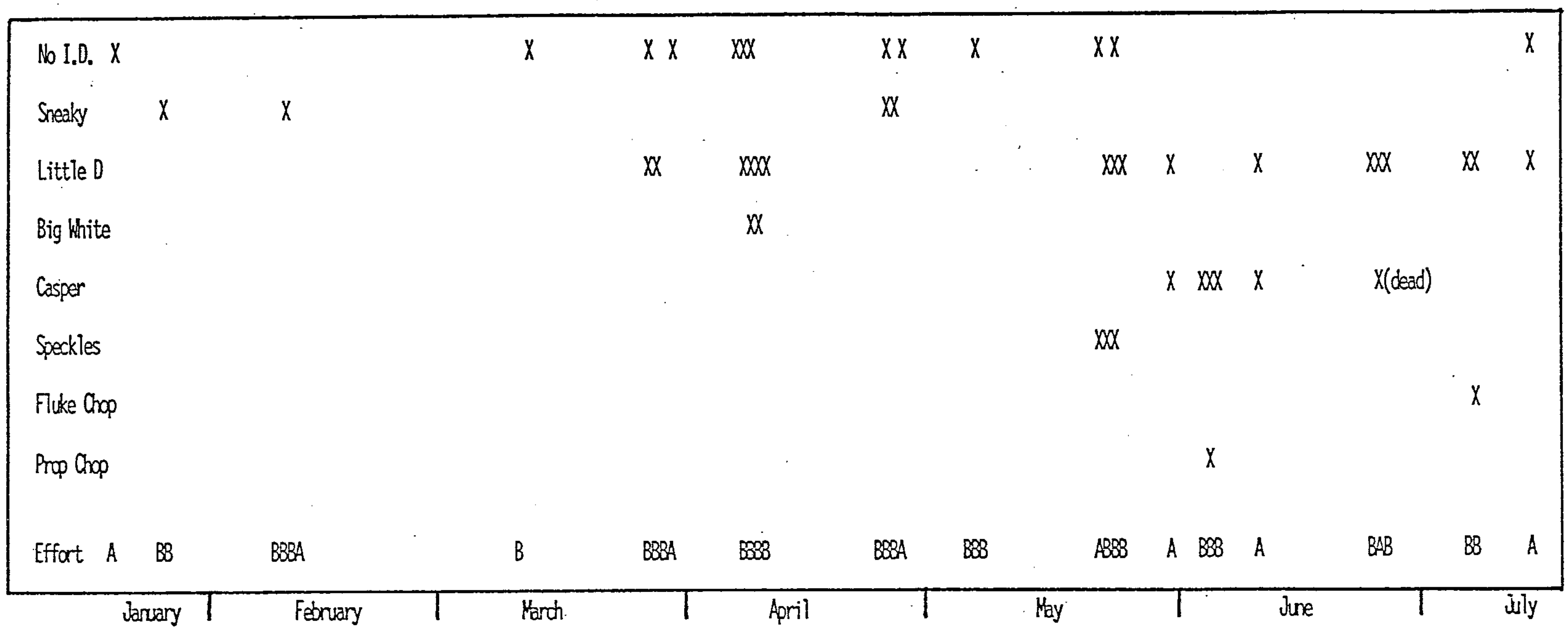


Figure 19. Days that identified and unidentified gray whales were seen in the study area. Does not include migrating gray whales monitored from land. Bottom line indicates days when boat (B) or aerial (A) surveys were conducted.

photographs to be taken. For the remaining two animals, photographs were taken at distances too far way to confirm identity.

In the locations where gray whales repeatedly foraged, different identified whales were seen. The area off Sail River was a common feeding area where four different whales were observed foraging. Three different identified whales were observed foraging at each of two other locations: approximately 1 nm west of the Sekiu River, and 300-500 m west of Shipwreck Point. We saw no evidence of territoriality in use of feeding areas. Locations where gray whales were repeatedly seen foraging likely held a food resource recognized by several individuals.

Behavior

Activity patterns of gray whales in the study area (excluding migrating whales off Tatoosh Island) were divided into milling, foraging, and feeding behavior, travelling behavior, and stationary behavior. Of 2,822 minutes of gray whale observation, gray whales were milling, foraging, or feeding 44% of the time, travelling 55% of the time, and stationary 1% of the time. There could be some bias towards greater travelling time because travelling gray whales were observed for longer periods to examine movements through the study area, particularly when these animals were headed in the direction of Neah Bay.

To characterize diving behavior 435 surface intervals were measured during 8 hours 41 minutes of observation of three different whales. The average dive interval was 71.8 seconds (SD=68.9). Figure 20 shows the frequency distribution of dive intervals in 30 second intervals. Dives of 30 seconds or less made up over one third of the dive intervals. The longest dives were just under 390 seconds. There were pronounced differences in the dive intervals of the three different whales that were examined (Figure 20). Two of the whales, "Little D" and "Sneaky" were primarily monitored while foraging, and the third whale, "Fluke Chop", was monitored while traveling throughout the study area. "Little D", the primary whale monitored, had a pattern most closely resembling the combined profile. "Sneaky", however, had a much higher proportion of short and long dives, and "Fluke Chop" had almost all intermediate dives (30 to 150 seconds) dives. Water depths at the major milling and feeding areas ranged from 3 to 13 meters.

From the dive profiles it is possible to calculate the average time a whale spends at the surface. We used an estimate of Harvey and Mate (1984) of 4 seconds for the time a whale is at the surface during each surfacing. Gray whales we monitored spent 5.5% of the time at the surface.

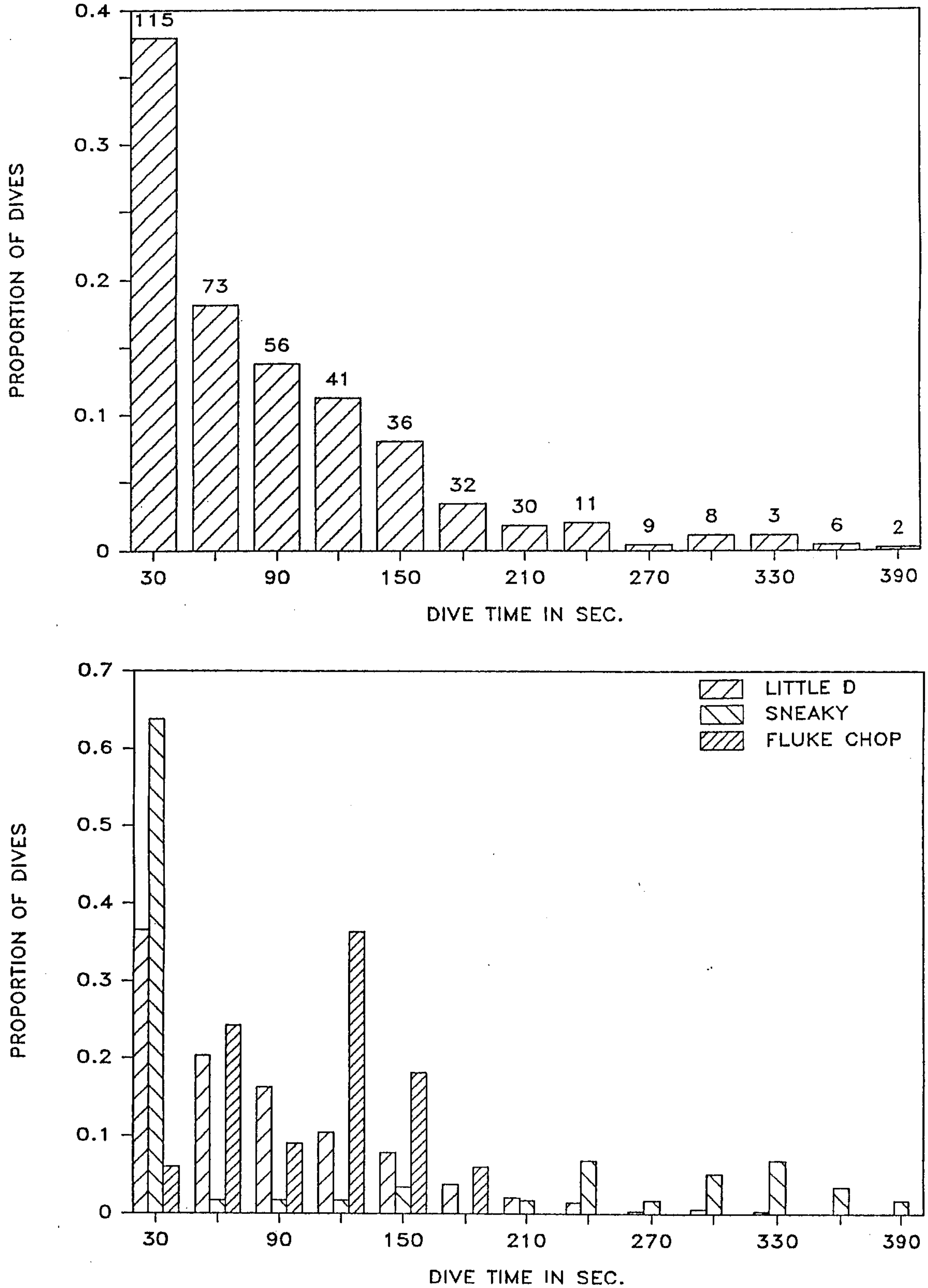


Figure 20. Dive durations of gray whales in the study area. X-axis shows the upper end of each 30 second interval. Top graph shows pooled data with number of dives listed. Bottom graphs shows dive durations by individually identified whale.

Occurrence in previous years

Figure 21 shows the number of gray whale sightings in the study area (east of Tatoosh Island and west of Pillar Point) collected through the telephone hotline operated by the Whale Museum and the NOAA Platforms of Opportunity program. These sightings have been totalled by month and show more whales in the study area during the summer than during the winter. Though these sightings are not effort-corrected for varying weather and observer presence throughout the year, these data probably reflect broad seasonal occurrence in the study area.

Interview results indicate that extended stays by gray whales in spring and summer in the Neah Bay area have been common in previous years. In most areas, people thought gray whales were more numerous in previous years than 1986. Areas where gray whales were repeatedly reported to visit in previous years included: between Tatoosh and Waatch Point, Duncan Rock, west of Slant Rock, west side of Waadah Island, off First and Second Beaches, off the Sail River, near Seal and Sail Rocks, off Bullman Beach, off Rasmussen Creek and the area from Chito Beach to the Sekiu River. Most of these areas corresponded to locations we commonly saw gray whales in our study. The numbers reported in previous years, however, were often higher than those we saw. Three different people reported more than 5 whales staying for prolonged periods in different portions of the study area. Two reports included the observation of an animal staying in the study area through the winter.

The occurrence of gray whales inside Neah Bay was also reported to be common in previous years. Al Seda of Big Salmon Resort recalled 5 gray whales staying in Neah Bay for several days in mid to late April 1985. He thought this was not unusual compared to most years. Other people similarly reported gray whales in Neah Bay as common occurrences, though not as often as some of the other locations mentioned above.

Compiling a picture of gray whale patterns by year was difficult because people had trouble accurately recalling years. It was clear, however, that there was a fair amount of variability between the number of gray whales staying each year. Few whales stayed into the summer of 1985. Conversely, several people reported 1983 as a year that a greater number of gray whales occurred in the study area for prolonged periods.

Several people were convinced that some of the same whales in the Neah Bay area returned in following years. These reports were not based on photographs and cannot be verified. It is consistent, however, with findings off Vancouver Island (see later section).

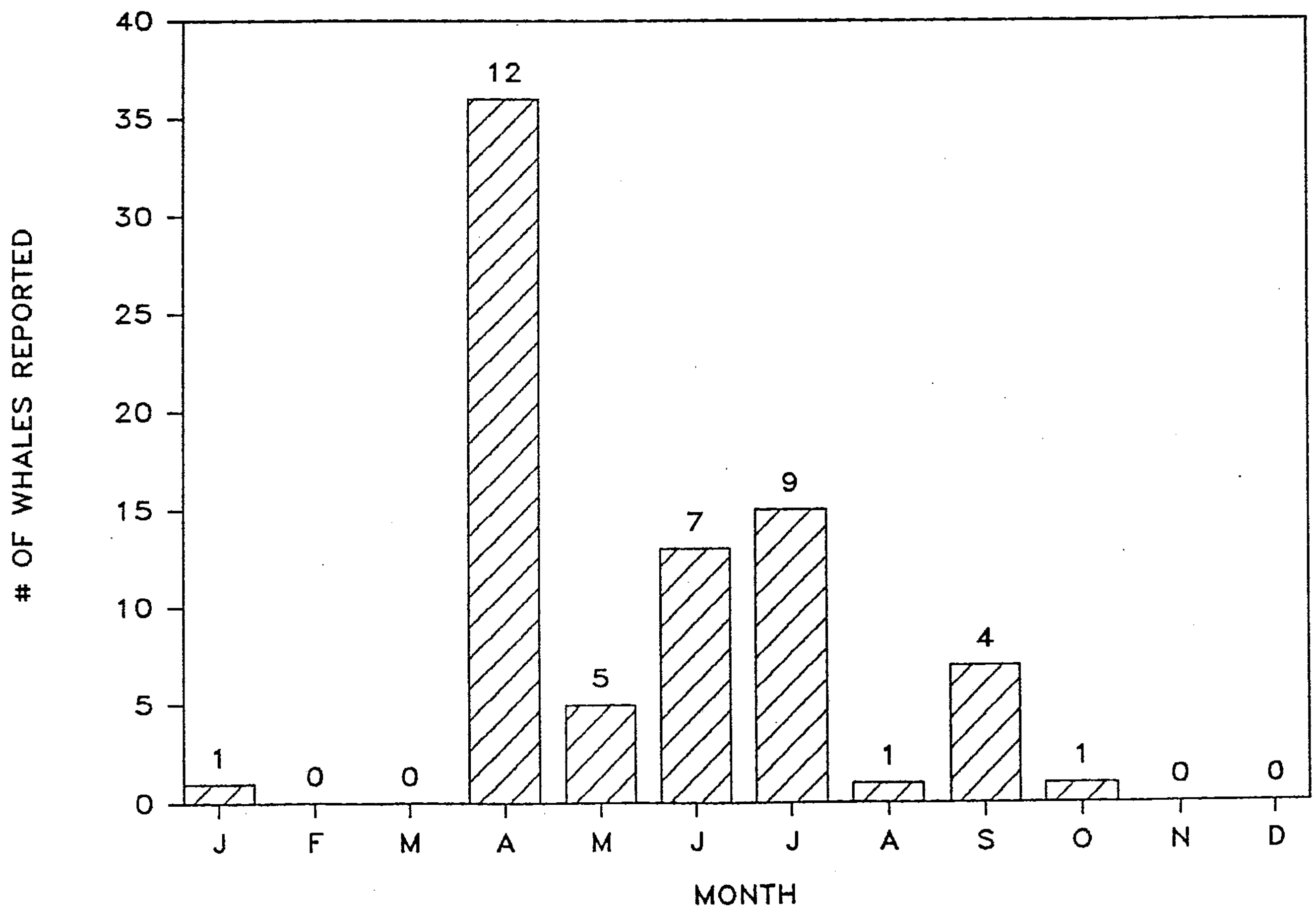


Figure 21. Number of gray whales by month in the study area reported to the Whale Museum (1976-1986) and Platforms of Opportunity (POP) database (1961-1985). Number of sightings is shown above each bar.

Age-class of animals in the study area

Lengths of gray whales in the study area were determined through photogrammetry. Three identified individuals had lengths ranging from 7.5 to 7.8m. Photos were taken between 22 May and 15 July. A fourth unidentified animal was measured east of Tatoosh Island on 22 May and was 7.3 meters long. One animal bordering on the study area south of Tatoosh was measured on 15 July and was 7.1 meters long. An animal in the Strait at Lyre River was 9.3 meters long. The five animals measured in the study area are comparatively small and were probably yearlings (Sumich 1986). Two of the seven whales that were individually identified in the study area appeared to be larger than those measured but were not photographed from the air.

Mortality and strandings

In 1986, an identified animal, "Casper", that we had observed feeding in the study area between 31 May and 11 June, was found dead on 26 June in Makah Bay. This gray whale had rope marks around its peduncle and flukes, leading us to conclude it had been entangled in a fishing net. One or two other dead gray whales were also reported floating dead off Duncan Rock and Makah Bay at this time. Dead gray whales have been reported in previous years at Neah Bay (J. Scordino, pers. comm.), but it is not likely that all dead gray whales in this area are washing ashore or being reported. Gray whale mortality in the study area occurred after the northward migration.

In our interviews, there were reports of gray whales caught in nets in the study area since 1981, including two caught in 1984. We observed gray whales between Baadah Point to Third Beach feeding in areas where 3 gillnets were set. During an aerial survey on 15 July 1986, we observed 13 set nets between Pillar Point and Tatoosh Island. It is possible that this fishery is having a detrimental effect on the summering population of gray whales in this area.

Migration timing and rate

Southbound. During the southward migration period no gray whales were found and only one animal reported in the study area. We expected to find animals migrating south along waters west of Tatoosh Island. During November and December, 4 different surveys totalling 3.6 hours were made from boats and aircraft in the probable migration lane on the western boundary of the study area. No whales were seen during this time.

<u>Northbound</u>. Table 9 reviews observation effort in this study to determine migration timing of gray whales. Most observations were conducted from two areas, Cape Flattery, and Cape "G", a clearcut ridge above Cape Flattery. Figure 22 shows the average migration rate for 4 periods of observation from all coastal sites. The highest counts were found on 11 March, the first day of migration observation. Counts steadily declined throughout the study period.

The majority of gray whales apparently migrated directly past the study area and did not loiter or enter the Strait of Juan de Fuca. From 3.5 hours of observation from Koitlah Point, inside the study area, no gray whales were seen during the migration time. This area was also checked by boats and aircraft throughout the migration season. From Cape "G" and Cape Flattery vantages, whales heading north were seen to generally head west around Tatoosh and continue north, though a small proportion headed along the east side of Tatoosh Island. On 9 April animals were seen both from Cape Flattery and Cape "G" to loiter and swim east between Cape Flattery and Tatoosh Island. Though animals were only migrating at about 1.3 animals per hour, over 12 animals were counted in the Tatoosh Island vicinity. During this loitering, whales were interacting and on two occasions penises were visible. It is not known if this behavior represents mating behavior. No other social interactions were seen that could be interpreted as mating.

April 9th was the last day whales were seen in abundance off Cape Flattery. Table 9 shows the migration rate of animals declined sharply on this date and after. These counts were made in equivalent observation conditions and thus weather conditions do not account for the steep drop in sightings. The loitering and mingling behavior seen on the 9 April was not seen before or after this date. However, local observers (reported above) saw whales from Tatoosh Island to Waadah Island from 12 to 20 April, during the apparent end of the migration period.

As the season progressed, the whales seemed to migrate closer along the shore. In late March, the higher vantage of Cape "G" provided higher counts than Cape Flattery at equivalent times. However, on April 9th, counts were compared between the two viewpoints with radios and some animals were migrating too close to shore to be counted from the high perch of Cape "G". Counts at Cape Flattery were slightly higher at this time and thus we suspect animals were migrating farther inshore towards the close of the migration.

We found no migrating whales on 26 April or during any observations following this date. Observations were made for 5 hours on the 26 and 27

Table 9. Observation effort and migration rates for northbound gray whales in 1986.

Date	Cape "G"			Cape Flattery			Waatch Pt.			Daily Mean		
	Hrs	#	# /hr*	Hrs	#	# /hr	Hrs	#	# /hr	Hrs	#	# /hr
3/11	2	40	20							2	40	20
3/12	2	28	14	1	10	10				3	38	12.6
Period Total										5	78	15.6
3/28	3.8	14	3.7							3.8	14	3.7
3/29	3.4	35	10.3	3.0	21	7	1.2	10	8.3	7.6	66	8.7
Period Total										11.4	80	7.0
4/7				2.2	9	4.1				2.2	9	4.1
4/8				4.1	23	5.6				4.1	23	5.6
4/9	6.7	7	1.0	6.5	12	1.8				13.2	17	1.3
4/10				3.0	4	1.3				3.0	4	1.3
4/11				3.5	9	2.6				3.5	9	2.6
Period Total										26.0	62	2.4
4/26				2.3	0	0				2.3	0	0
4/27	3.0	0	0							3.0	0	0
Period Total										5.3	0	0

* Hrs = Total observation hours
\# = Number of gray whales
\#/hr= Migration rate as gray whales passing site per hour

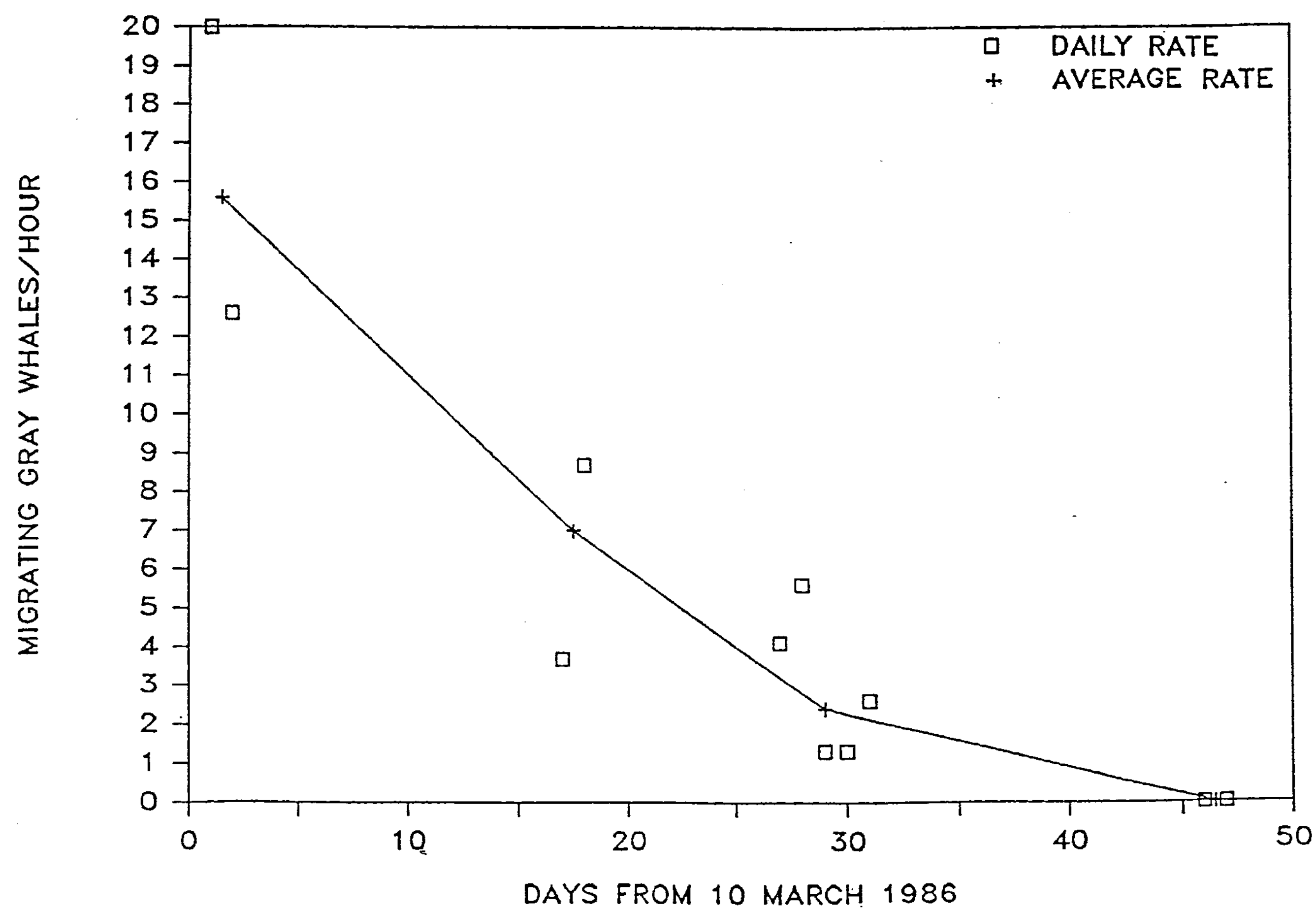


Figure 22. Migration rate of gray whales past Cape Flattery during 47.7 hours of land observations between 11 March to 27 April 1986. Average rate is pooled rate for several days.

April from both Cape "G" and Cape Flattery. From the lighthouse on Tatoosh Island, 1.3 hours were spent searching for migrants on 7 May, 2 hours on 23 May and 3 hours on 11 June. The evidence compels the conclusion that the northbound migration ended sometime between 11 and 26 April with the remaining sightings after this period composed of lingering foraging whales.

Historical

Gray whale bones were recovered from both Ozette (Huelsbeck, nd) and Hoko River (Wigen 1982). It is not known whether these animals were migrants or animals summering in this area.

Comparison to other research

Residents and foragers. Gray whales that are resident in the sense that they return to a locality annually have been reported off Vancouver Island (Darling 1984). These animals arrived as early as the middle of April and remained to middle September, when observations ceased. Through photoidentification, animals were found to return for up to eight years, though a majority (61%) of the animals are seen only in one year. Additional years of data would be necessary to determine if individual gray whales return to the Neah Bay area.

The resident animals off Vancouver Island appear to be primarily immature animals (Darling 1984). Up to 36 gray whales have been counted off the coast of Oregon during the summer (Sumich 1984). The whales have been measured photogrammetrically and the majority were immature. The predominance of immature whales at these two sites is consistent with our observations of summer gray whales being apparently exclusively immature.

If the major summer gray whale habitat in the study area is considered to extend from Kydaka Point west to Koitlah Point, the observed gray whale density in this area is between 0.14-0.42 whales/km. This density is comparable to that found in coastal Oregon (0.2-0.3 whales/km; Sumich 1984) and Vancouver Island (0.3 whales/km; Darling 1984).

Foraging animals were seen during this study. The type of prey is not known. Gray whales off Vancouver Island were found to be foraging primarily on mysids associated with kelp beds along the rocky coast (Murison et al. 1984). The kelp beds in the study area probably support similar prey. Plewes et al. (1985) reported a single gray whale feeding on ghost shrimp (*Callianassa californiensis*) and soft shell clam (*Cryptomya californicus*) off Vancouver Island. Oliver and Slattery (1985) found gray whales in Patchena Bay, Vancouver Island (31 nm from Neah Bay) fed on benthic ampeliscid and other amphipod crustaceans in an environment ecologically analogous to the major feeding areas in the Bering Sea. The ecology of coastal southern Vancouver Island is somewhat similar to the entrance to the Strait of Juan de Fuca (Kozloff 1983).

Migration. Due to its coastal habits, the gray whale has been studied along the coast through much of its range. Bracketing the study area are long term studies of migration in Oregon (Herzing and Mate 1984) and on Vancouver Island (Darling 1984). Through some interpolation of data, a fairly accurate long-term picture of migration past Washington can be assembled. The southbound migration probably peaks near the study area during the last week of December with 90% of the animals passing within a 35 day period centered over the peak. The northbound migration would be expected to peak during the third week in March near the study area.

We observed no southbound migrating gray whales. We made no observations between 14 December and 20 January. It is possible we missed the migration during this time or the southbound migration may have occurred farther offshore, out of view. The southbound migration appears to be more tightly clumped around the peak of migration as well as farther from shore than the northern (Herzing and Mate 1984).

From comparison to other research, the highest counts of northbound migrants in this study during the second week in March appears to be a bit early. The data from this year do not allow the discerning of the peak of migration, but because the counts we found were higher than the highest peak count in Oregon (14/hour) and the highest counts we made were apparently one week earlier than can be interpolated from other studies. We believe that the peak of migration in 1986 was not much earlier than 11 March.

Researchers in Oregon (Herzing and Mate 1984) and California (Poole 1984) describe two phases of the northbound gray whale migration where the first phase consists of all age categories and the second phase consists of mothers and calves. During the first phase, whales trend nearer to shore as the migration progresses. The second phase occurs very close to shore and is composed of a high percentage of cows with calves. We never found a second pulse of migrating animals after April. As evidence this pulse may occur in Washington, observers in 1985 along the coast of Washington did note greater percentages of cows and calves in mid-May (unpublished data, Wa. Dept. of Game, Marine Mammal Investigations).

Summary

- The northbound migration of gray whales past Cape Flattery appeared to reach a peak in early March, earlier than expected.
- Most northbound migrating gray whales traveled along the west side of Tatoosh Island and did not enter the waters east of Cape Flattery.
- Gray whales occurred in the study area from December through the summer.
- Most gray whales that remained in the study area after the migration were immature animals.
- Gray whale mortality has commonly occurred in the study area.
- Gray whales foraged in shallow water in the study area, primarily between Koitlah Point and the Sekiu River.
- Gray whales frequently entered Neah Bay or passed directly across the entrance to Neah Bay.
- Most of the sightings of gray whales in the study area were resightings of a small number of identified whales.

Minke whale (Balaenoptera acutorostrata)

Background

Minke whales are the smallest of the baleen whales and occur in the North Pacific, North Atlantic and in the Southern Hemisphere. In the eastern North Pacific the majority range in winter from the equator to central California and in summer from Baja California to the Bering and Chukchi Seas (Leatherwood and Reeves 1983). These ranges reflect the large seasonal north to south movement of North Pacific minke whales.

Distribution and abundance in study area

A single minke whale was sighted in the study area on 14 September 1985 at 48°21'30"N and 124°28'00"W. This is the only sighting of a minke whale in the study area, though on two occasions we encountered minke whales outside the study area while en route to or from the study area. Both sightings were in the eastern Strait of Juan de Fuca and consisted of five animals on 31 May 1986 and three animals on 15 July 1986. The single animal encountered in the study area appeared to be transiting through the area and quickly moved out of sight. By contrast the other two sightings were of whales milling and apparently feeding near concentrations of birds preying on fish.

Sources other than our observations provided a little sighting information on minke whales. Few people interviewed reported seeing minke whales in the study area. One person reported seeing a minke whale 12 miles northwest of Tatoosh Island several years previous and termed the sighting unusual. The Whale Museum records report only one sighting (in August) of a minke whale in the study area. No sightings of minke whales in our study area were reported in the POP database.

Comparison to previous research

Everitt et al. (1980) report that minke whales have been sighted in the inland waters of Washington State during most months of the year. Though they found a higher frequency of sightings in spring and summer months they suggest this may be the result of greater sighting effort during these periods. Dorsey (1983) found that sixteen identified minke whales in the San Juan Island area maintained exclusive adjoining ranges during the summer.

Summary

- Minke whales occurred offshore in the study area but only infrequently.

- Minke whales are most likely to occur in the summer.

Other Species

Based on historical records or range and ecology information, marine mammal species other than those covered in the earlier species accounts could occur in the study area. These other species are listed below.

Pinniped	
Northern fur seal	*Callorhinus ursinus*
Mysticetes	
Northern right whale	*Eubalaena glacialis*
Fin whale	*Balaenoptera physalus*
Humpback whale	*Megaptera novaeangliae*
Odontocetes	
Common dolphin	*Delphinus delphis*
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*
Risso's dolphin	*Grampus griseus*
False killer whale	*Pseudorca crassidens*
Shortfinned pilot whale	*Globicephala macrorhynchus*
Pygmy sperm whale	*Kogia breviceps*
North Pacific giant bottlenose whale	*Berardius bairdii*
Cuvier's beaked whale	*Ziphius cavirostris*
Beaked whales	*Mesoplodon spp*

Based on a thorough review of contemporary and historical sightings, Everitt et al. (1980) determined the relative probability of the occurrence of these animals in the Strait of Juan de Fuca and inland waters of Washington State. Everitt et al. (1980) speculated that fur seals may wander into western Strait of Juan de Fuca in fall and winter. Owing to its pelagic habits during these seasons, sightings near the study area would be rare. Historically, however, northern fur seals used to be common in the Strait of Juan de Fuca and were hunted by the Makahs (Swan 1868). Northern right whale occurrence in the study area would be extremely unusual because of its low population. R. Paine, however, reported sighting two right whales on 28 August 1983 at Swiftsure Bank. Fin whales must also be considered rare to accidental in the study area. Humpback whales, though rare in the waters of Washington, have been seen in the Puget Sound in 1976, 1978 and 1986. These animals probably transited the mouth of the Strait. This species still should be considered rare and it is unlikely to be affected by any activity in the study area. Huelsbeck (n.d.) found humpback, right, and fin whale bones at the Makah Village at

Ozette. For the odontocetes listed above, Everitt et al. (1980) concluded that 4 could be considered rare and the rest accidental and all are not to be expected to occur in the study area with any regularity.

Most of the relative abundance estimates above are based on the lack of sighting records. Of course, the lack of sightings can mean simply the lack of effort. However, local residents, Whale Museum Hotline data, and NOAA observations all reported species that were relatively abundant during our surveys: the sighting reporting systems seem to work. For the species listed above, the lack of sightings through these sources, the lack of sightings made on our dedicated surveys, and the low frequency with which the above species appear in the historical record for the area allow us to conclude these species are indeed rare in the study area and need not be considered in development plans in the study area.

POTENTIAL IMPACTS OF PROPOSED ACTIVITIES

Description of proposed activities

The proposed navigational improvements and developments at Neah Bay are still in early stages of planning and development. The project, if conducted as currently outlined, would include construction of a log export facility and a small boat marina in Neah Bay.

The log export facility would require construction of a deep water channel into Neah Bay. This channel would extend over 4,000 ft at a depth of 35 ft MLLW from just outside Neah Bay into the entrance (between Waadah Island and Baadah Point) and end at a 1,000 ft wide turning basin inside the bay. Blasting and dredging to remove approximately 200,000 yd^3 would be required for construction of navigational channel suitable for ocean-going ships. Logs would be stored in a log boom in the water and would be loaded aboard ships with deck cranes. An estimated 50 vessels per year would enter Neah Bay to use the facility.

A breakwater and access channel would also be constructed for a new commercial fishing and recreational boat basin. The location currently being considered for the boat basin is at the site of a former log dump on the southwest side of the existing breakwater that extends to Waadah Island. The facility would provide year-round moorage for the Makah Tribe fishing fleet, transient fishing boats, charter vessels, and commercial fishing boats. A rock breakwater would be constructed to provide protection from northeasterly weather inside Neah Bay. Other facilities including fueling, boat haul out, repair, and minor facilities would likely be constructed at the site.

Potential short-term impacts

The primary potential cause of direct mortality or injury to marine mammals in the vicinity is the shock wave created by blasting. Secondary disturbance caused by noise (including from blasting) and other construction activities could have potential short-term impacts.

Effects of shock waves from blasting

The underwater blasting required to construct the proposed channel will create an underwater shock wave that may harm marine mammals. The size and likely radius of impact of the underwater shock wave is dependent on the size of the charge, water depth of the charge, overall water depth, how deep the charge is buried, and the bottom substrate type (Hill 1978). Charges in shallow water with rocky substrate, conditions found in the Neah Bay entrance, tend to maximize the area of impact. Shock wave magnitude decreases with increasing depth under substrate. Furthermore, blast effects on marine mammals vary with the depth of the animal and the animals' size. Precise figures are not currently available for the size of the charges and the depth in the substrate of the charges planned for Neah Bay. Thus we are unable to estimate the specific radius of impact from blasting using formulas derived by Hill (1978).

Specific impacts of shock waves on marine mammals have not been well studied. Even Hill's (1978) formulas for estimating impacts of blasts on marine mammals are based on studies of submerged land mammals, generally under 40 kg. The adaptations marine mammals have made to withstand diving pressures and water temperature are likely to make them more able to withstand shock waves. The larger size of most marine mammals compared to the land mammals tested is also likely to increase their relative ability to withstand shock waves. Likely damages from shock waves occur at the interfaces of soft and hard tissues and especially where air pockets occur inside tissues. Most common damage sites are the lungs, ears, and hollow viscera with the shock wave causing destruction of tissue, hemorrhaging, ear drum rupture, and air emboli.

Other short-term effects

Underwater noise is another potential source of short-term impact collateral to blasting and other construction activities. Gray whales alter behavior and avoid experimentally played back sounds of typical oil and gas exploration and development activities (Malme et al. 1983). Whale responses included avoidance, startle, "annoyance", and slowed rate of travel. Whales responded to noise at distances of several km. Avoidance behavior first appeared at 110 dB (received level re 1 micropascal) and was seen in more than 80% of the animals exposed to levels higher than 130 dB (Malme et al. 1984). Sea otters, however, exposed to the same playback sounds as tested on gray whales, showed no reaction even at much closer distances than those affecting gray whales (Malme et al. 1984). Minor disturbance of some marine mammals may also be caused by other construction activities associated with project construction. These impacts would likely result in displacement of animals rather than any injury or mortality.

Species potentially affected

Without additional data on blast parameters it is difficult to precisely determine whether a given species would occur inside or outside a calculated radius of impact. It is possible, however, to rank the species encountered during this study, based on abundance and distribution, from most likely to least likely to be affected by construction activities. These species are ranked as follows: 1) California sea lions; 2) gray whales, harbor seals, sea otters, river otters, and northern sea lions; 3) harbor porpoise and Dall's porpoise; and 4) elephant seals, minke whales, and killer whales.

The high number (up to 30) of California sea lions in Neah Bay and the migration of large numbers past the entrance of Neah Bay makes them the most susceptible marine mammal to the short term impacts of the proposed blasting in Neah Bay. Animals inside Neah Bay congregate in the water in various locations throughout the bay, including some sites very close to proposed blasting areas. Their congregation in Neah Bay has been a recent phenomenon confined to the last two seasons; whether California sea lions will be found in Neah Bay in future years is not known. Habitation of Neah Bay may be a short term aberration or sea lion numbers may increase dramatically, a trend reported at some other sites. If California sea lion numbers in Neah Bay stayed at the same level as 1986, then blasting in any month except July or August would likely affect some animals unless they were discouraged from being in the area prior to each blast. Blasting would likely have the greatest impact on California sea lions in December through May when sea lion numbers in Neah Bay are greatest and when large numbers are migrating west both through and past the entrance to Neah Bay.

The gray whale, a federally listed Endangered Species, occurred in the study area from December to July, with sightings in August and September occurring in previous years. Gray whales entered Neah Bay repeatedly during the study and foraged at several sites just outside Neah Bay. Gray whales on several additional occasions traveled east and west along the shore past Neah Bay close to areas where blasting would need to occur. Lowest numbers of gray whales in the study area occurred in fall. Gray whale occurrence and use of the study area during the spring and summer appears to be variable from year to year and would be difficult to predict. The bulk of the gray whale population migrates past the western end of the study area, however, with the exception of the small proportion of animals that come into the inland waters, the migratory animals stay far enough away to not be affected by shock waves from blasting.

Sea otters, river otters, harbor seals, and northern sea lions also are potentially subject to the impacts of blasting. All four species were repeatedly seen in Neah Bay and the blasting area during this study. A sea otter was seen at the entrance to Neah Bay for 6 days, and could appear in the available habitat close to Neah Bay in the future. River otters were seen in all seasons with sightings in Neah Bay and near Baadah Point. Small numbers of harbor seals occasionally enter Neah Bay and a haul-out area used seasonally by a small number of seals is located just off Waadah Island. Northern sea lions occur in small numbers from fall to spring in and around Neah Bay. Other than the occasional single animal, any blasting conducted in September to December or April and May between Baadah Point and Waadah Island could impact the groups of northern sea lions migrating through the study area.

Two other species, harbor porpoise and Dall's porpoise, are common in the study area. Both these species, however, were seen almost exclusively more than a half mile offshore. There were no sightings or reports of either species occurring recently inside Neah Bay.

Elephant seals, minke whales, and killer whales all occur in the study area but only infrequently. We consider it highly unlikely that any of these species would happen to be close enough to the project area during blasting to be impacted.

Measures to mitigate short term impacts

Several procedures may reduce the impact of blasting on marine mammals. These methods can be grouped into categories; those that reduce the shock waves and noise produced by blasting and those that minimize the presence of any animals near the blast area. Methods to reduce the size and impact radius of shock waves include: 1) using smaller individual charges, 2) burying the charges as deep as possible in the substrate, and 3) using arrays of charges instead of single charges. Ways to minimize the presence of marine mammals in the blast area include: 1) timing blasting activities for seasons when the fewest marine mammals are present in the study area, 2) monitoring the movements of unpredictable marine mammals, such as gray whales and sea otters, near the blast area directly prior to blasting activities, and 3) provide negative stimuli to discourage marine mammals from staying in the area where blasting is about to occur.

A likely way to reduce the presence of California sea lions staying Neah Bay for prolonged periods would be to eliminate their primary food source they are using in Neah Bay: fish offal. If commercial fish docks and charter and recreational fishermen stopped discarding fish remains in Neah Bay the number of sea lions congregating in the bay would likely be reduced.

Potential long-term impacts

Potential long-term and indirect impacts of the proposed project on marine mammals is more difficult to evaluate than short-term impacts and is only discussed briefly here. Possible sources of long-term project impacts on marine mammals include: 1) disturbance of marine mammals from increased vessel traffic, 2) degradation of water quality, and 3) decreased prey availability. These potential long-term effects of Neah Bay development appear unlikely to occur at a level detrimental to marine mammals in the vicinity.

Disturbance of marine mammals could come from the ship traffic that would accompany development and operation of the log facility. Development of a small boat harbor is not expected to increase the volume of small boat traffic in and around Neah Bay (S. Babcock, pers. comm.). Harbor porpoise are known to be wary of boats and ships and might avoid areas of increased vessel traffic offshore. Pinnipeds hauled out at locations in the vicinity of Neah Bay would likely be more frequently disturbed by new ship traffic. Both harbor seals and California sea lions, however, appear to be thriving in some areas where boat traffic is heavier than at Neah Bay. There would be an increased probability of boat collisions with gray whales in the Neah Bay area. Several near-collisions were seen during the current study, primarily at the entrance to Neah Bay.

Water quality may be degraded due to: 1) ships pumping their bilges in the Neah Bay vicinity, 2) fuel spills and leaks, 3) leaching from bottom paints of ships, 4) leaching of organic materials from log booms and floating logs, and 5) temporary increases in turbidity as a result of initial and maintenance dredging. Any substantial fuel oil spills might have an impact on the otariid pinnipeds (California and northern sea lions), river otters, and sea otters. All of these animals rely in part on their fur for insulation and oil fouling causes dramatic losses in the fur's insulating ability (Kooyman et al. 1976). Other impacts of water quality on marine mammals in this relatively pristine area are likely minimal.

Any impacts of the proposed project on fish and other prey of marine mammals in the study area would eventually affect marine mammals. These impacts should be considered when the results of current studies on the impacts of the project on other marine life is completed.

A possible consequence of the proposed project that might benefit marine mammals is the creation of potential pinniped haul-out habitat. Log booms have been used extensively by harbor seals, California sea lions, and river otter in other areas. Over 500 California sea lions at Port Gardner, Washington, use log booms to haul out. In Puget Sound and the Hood Canal up to several hundred harbor seals haul out, give birth to young, and nurse their young on log booms at a number of locations.

The small boat harbor is not expected to alter current fishing levels in and around Neah Bay (S. Babcock, pers. comm.); therefore, fishery coflicts with marine mammals are not expected to increase. Conflicts between commercial and recreational fishing activities and marine mammals, however, are currently causing some problems for marine mammals and fishermen in the study area. Entanglement is currently a primary cause of death of summering gray whales in the study area. Harbor porpoise have been killed in large numbers in other areas by gillnets. Harbor seals and sea lions often have conflicts with both sport and commercial fishermen because these pinnipeds sometimes prey on hooked or netted fish.

Status of species potentially impacted

Potential impacts to marine mammals should be evaluated in the context of their legal status and their regional abundance. These factors affect the degree to which impacts to certain species may be considered acceptable or unacceptable to the Corps of Engineers, State, and Federal agencies involved in providing permits, and to the general public. We provide a brief evaluation of these issues for the six species identified in earlier sections as potentially susceptible to short-term or long-term impacts of the project.

The gray whale and sea otter are the two species seen in the study area whose status warrants the greatest concern. The gray whale is classified as endangered by both the federal government and Washington State Department of Game. Relatively few gray whales summer in Washington State. The sea otter is classified as endangered by Washington State. The population in Alaska is large and growing. The Washington population, however, is small (less than 100), though recent observations indicate it is increasing. One other marine endangered species, the leatherback sea turtle, was repeatedly seen in the study area, but is not considered in this report.

Harbor porpoise are considered a "sensitive species" by the Washington Department of Game. This classification refers to species that could become threatened if current water, land, and environmental practices continue. Harbor porpoise was once common in Puget Sound, but since the 1950s have only rarely been seen there. Harbor porpoise populations have also declined or been eliminated from several other portions of its range in the United States and Europe.

Northern sea lions are not considered either endangered or threatened on the federal or state level. Their population in the state, however, is far below some of the reports from the early 1900s. The population of northern sea lions has also been declining in portions of Alaska.

Harbor seal and California sea lion numbers have been increasing throughout their range and in Washington State. Both species have proven themselves extremely adaptable to human activities and even if impacted by the proposed project would likely continue to increase in the study area.

All species discussed in this report are protected under the Marine Mammal Protection Act of 1972, except the river otter. This species is still commercially trapped in Washington State and has not been afforded the same legal or public status as marine mammals. All species are also protected or managed by various Washington State regulations and codes (RCW and WAC) pertaining to wildlife.

RESEARCH RECOMMENDATIONS

This investigation determined the seasonal abundance and distribution of marine mammals in the study area over a one year cycle. Potential short-term and long-term impacts on these marine mammals caused by harbor construction were evaluated with regard to findings of seasonal occurrence and habitat use. Based on the results of this research, additional study approaches needed to abate potential impacts on marine mammals were identified and are outlined below.

Repeated sightings of California sea lions and gray whales in the vicinity of the proposed construction area, as well as their legal status and local abundance, make additional research on these two species important to ameliorating potential impacts from blasting. California sea lions first appeared in Neah Bay two years ago. The number and duration of stay of sea lions increased dramatically in the second year. Like the California sea lion in Neah Bay, gray whale abundance and occurrence in the study area is variable. Some reports indicate gray whale use of the area may be substantially different in other years. Patterns of annual abundance and timing of occurrence of both these species are poorly understood. These variations could potentially complicate efforts to plan construction to avoid conflicts with and impacts on marine mammals. For both species, we recommend additional research be considered in order to identify patterns through multiple years.

As construction plans progress, detailed information on the blasting in Neah Bay should become available. Pertinent information on weight of charges, their exact placement, and their depth in the substrate can provide a basis, coupled with predictive formulas (Hill 1978) and all available data, to more precisely determine both the radius of impact and species that may be affected within that radius.

As discussed in the section on mitigating measures, we recommend that during blasting activities, a biologist monitor the presence of gray whales and other marine mammals. This monitoring would allow an immediate determination if specified marine mammals are at risk from blasting activities at any particular time. This observation plan would provide time to allow negative stimuli or appropriate methods to be employed to prevent unacceptable impacts on marine mammals.

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Table A-1. Counts of harbor seals (from land, boat, and aerial surveys) between Slip Point and Pillar Point, from August 1985 to July 1986.

Date	Time	Number hauled	Number water (#pups)	Location
08/06/85	1111	1	0	3.3nm E of Slip Pt
08/06/85	1114	10(1)	1	1.1nm W of Pillar Pt
09/14/85	1448	17	0	1.6nm W of Pillar Pt
09/14/85	1507	0	1	Pillar Pt
09/23/85	1633	5	0	0.7nm W of Pillar Pt
09/23/85	1641	1	0	1.1nm W of Pillar Pt
09/23/85	1650	30	2	2.0nm W of Pillar Pt
09/24/85	1721	1	0	0.7nm W of Pillar Pt
09/29/85	826	6	0	0.7nm E of Slip Pt
09/29/85	838	5	0	3.0nm E of Slip Pt
09/29/85	845	9	1	3.3nm E of Slip Pt
09/29/85	851	5	0	2.9nm W of Pillar Pt
09/29/85	857	43	0	1.6nm W of Pillar Pt
09/29/85	910	33	0	0.5nm W of Pillar Pt
10/18/85	1336	14	1	2.5nm W of Pillar Pt
11/08/85	1429	0	1	50m W of Pillar Pt
11/08/85	1440	22	0	2.0nm W of Pillar Pt
12/04/85	1341	7	0	3.0nm E of Slip Pt
12/04/85	1344	30	1	2.0nm W of Pillar Pt
12/04/85	1347	13	0	0.7nm W of Pillar Pt
12/13/85	1400	0	1	Pillar Pt
01/20/86	1619	3	0	3.0nm E of Slip Pt
01/20/86	1620	40	0	2.0nm W of Pillar Pt
01/20/86	1621	1	0	0.7nm W of Pillar Pt
01/27/86	1108	10	0	2.5nm E of Slip Pt
01/27/86	1121	11	2	1.6nm W of Pillar Pt
01/27/86	1123	7	0	1.5nm W of Pillar Pt
02/12/86	1048	1	0	0.7nm W of Pillar Pt
03/28/86	1015	1	0	Pillar Pt
03/28/86	1020	14	0	0.7mn W of Pillar Pt
03/28/86	1030	40	0	2.0nm W of Pillar Pt
03/30/86	1126	1	0	Pillar Pt
04/28/86	1217	4	0	0.7nm W of Pillar Pt
04/28/86	1218	3	0	1.0nm W of Pillar Pt
05/07/86	1725	0	3	0.7nm E Slip Pt
05/22/86	954	10	1	2.0nm W of Pillar Pt
05/31/86	1511	1	0	1.5nm W of Pillar Pt
06/06/86	923	3	1	1.5nm E of Slip Pt
06/06/86	935	2	0	1.7nm E of Slip Pt
06/06/86	945	12	0	3.5nm E of Slip Pt
06/06/86	955	0	3	0.9nm W of Pillar Pt
06/06/86	1000	5	0	0.7nm W Pillar Pt
06/26/86	1155	0	1	1.0nm W of Pillar Pt
06/26/86	1155	3	0	0.7nm W of Pillar Pt
07/15/86	1422	15	1	2.0nm W of Pillar Pt

Table A-2. Counts of harbor seals at Tatoosh Island, August 1985 to July 1986.

Date	Time	Number hauled (#pups)	Number water
08/06/85	1036	50(1)	0
09/14/85	1919	15	0
09/23/85	1241	40	0
09/24/85	1612	55	0
09/29/85	1320	30	0
10/18/85	1233	1	0
12/14/85	1050	0	1
01/20/86	1505	3	0
02/12/86	947	15	0
03/28/86	1010	24	0
03/29/86	910	30	0
04/08/86	1730	11	0
04/26/86	830	10	0
04/29/86	900	30	0
05/07/86	1325	41	0
05/22/86	735	9	1
05/23/86	1735	30	0
05/25/86	1105	3	0
05/31/86	1610	47(1)	0
06/04/86	1430	37	0
06/05/86	1158	7	2
06/06/86	1730	38	3
06/11/86	1055	46	0
06/26/86	959	20(2)	3
06/27/86	1033	12(1)	0
07/07/86	1520	30(1)	0
07/15/86	1502	52(2)	0

Table A-3. Counts of harbor seals in the vicinity of Sail and Seal Rocks, August 1985 to July 1986.

Date	Time	Number hauled	Number water (#pups)	Location
08/06/85	1053	8	1	Rks E of Sail Rk
08/06/85	1055	0	1	1.1nm E of Sail Rk
08/11/85	730	5	0	Rks E of Sail Rk
09/13/85	1840	5	0	Rks E of Sail Rk
09/14/85	830	23	1	Seal/Sail and Rks E
09/14/85	1240	2	0	Rks E of Sail Rk
09/23/85	1126	8	0	Rks E of Sail Rk
09/24/85	1647	3	0	Seal/Sail Rks
09/24/85	1649	14	1	Rks E of Sail Rk
09/24/85	1652	0	2(1)	1nm E of Sail Rk
09/28/85	1518	9	0	Rks E of Sail Rk
09/28/85	1802	9	0	Seal/Sail and E Rks
10/21/85	1121	0	1	off Rks E of Sail Rk
11/02/85	900	7	0	S Sail Rk
11/03/85	950	10	1	S Sail Rk
11/09/85	840	3	0	Rks S of Seal Rk
11/09/85	1420	2	0	S Sail Rk
11/12/85	810	21	0	Seal/Sail and E Rks
12/04/85	1300	19	0	Rks S of Sail Rk
12/12/85	1645	5	1	SE Seal Rk and Rks E
12/13/85	919	11	0	S Sail Rk
01/20/86	1538	28	0	Seal/Sail and E Rks
01/26/86	1528	15	0	S Sail Rk
01/27/86	903	6	0	S Sail Rk
01/27/86	908	0	1	Bullman Cr
01/28/86	1019	4	1	Seal Rk
02/09/86	1011	0	1	500m E of Sail Rk
02/10/86	1120	0	1	Rks E of Sail Rk
02/10/86	1450	0	1	500m E of Sail Rk
02/11/86	750	17	0	S Sail Rk
02/12/86	730	10	0	S Sail Rk
02/12/86	1019	22	0	S Sail Rk
03/12/86	755	19	0	Sail Rk
03/27/86	840	17	0	W Sail and E Rks
03/27/86	1722	0	3	S of Sail Rk
03/28/86	830	35	0	E and W of Sail Rk
03/29/86	915	24	0	W Sail Rk
03/30/86	959	25	0	W Sail Rk
04/08/86	910	13	1	Rks E and W of Sail Rk
04/08/86	1500	0	1	.5nm E of Sail Rk
04/09/86	830	18	0	W Sail Rk
04/10/86	840	24	0	W Sail Rk
04/26/86	753	18	1	W Sail Rk
04/26/86	1158	0	1	Sail River
04/28/86	940	12	0	W Sail Rk
04/28/86	1316	0	2	Sail Rk
05/06/86	1620	0	1	10m SE Sail Rk
05/07/86	720	26	0	Rks W and 500m E of Sail Rk
05/08/86	855	21	1	W and 500m E of Sail Rk
05/22/86	855	8	0	W Sail Rk
05/31/86	1545	7	0	500m E of Sail Rk
06/04/86	920	1	0	500m E of Sail Rk
06/06/86	740	16	2	Rks between Seal/Sail Rks and 500m E of Seal Rk
06/11/86	1150	0	1	Seal/Sail Rks
06/26/86	1125	5	1	500m E of Sail Rk
07/07/86	1010	8	0	500m E of Sail Rk
07/07/86	1417	0	1	10m S of Sail Rk
07/15/86	1440	3	2	500m E of Sail Rk

Table A-4. Counts of harbor seals, August 1985 to July 1986, between Waadah Island and Koitlah Point (N side of Neah Bay breakwater). No pups were observed.

Date	Time	Number		Location
		hauled	water	
10/25/85	1030	0	1	E of Koitlah Pt in kelp
11/03/85	1209	8	0	Waadah Reef
11/08/85	747	4	0	Waadah Reef
11/08/85	945	7	0	Waadah Reef
11/09/85	805	1	0	Waadah Reef
11/09/85	845	1	0	Waadah Reef
11/11/85	806	0	1	off Waadah
11/12/85	1047	0	1	NW of Neah Bay breakwater
11/12/85	1051	0	1	NW of Neah Bay breakwater
11/12/85	1100	0	1	200m SE of Koitlah Pt
11/13/85	1022	0	1	off rks E of Koitlah Pt
12/04/85	1251	4	0	Waadah Reef
12/12/85	820	5	0	Waadah Reef
12/12/85	830	3	0	300m E of Koitlah Pt
12/13/85	900	8	0	Waadah Reef
12/14/85	927	6	0	Waadah Reef
12/14/85	942	4	0	Rks E of Koitlah Pt
01/26/86	831	6	0	Waadah Reef
01/26/86	842	2	0	Rks E of Koitlah Pt
01/27/86	846	5	0	Waadah Reef
02/09/86	940	5	0	Waadah Reef
03/28/86	840	4	0	Waadah Reef
03/29/86	840	6	0	Waadah Reef
04/09/86	1630	0	1	S of Waadah Reef
04/10/86	755	1	0	Rks 500m W Neah breakwater
04/11/86	815	3	0	Waadah Reef
04/26/86	734	7	0	Waadah Reef
04/27/86	830	3	0	Waadah Reef
04/27/86	855	7	0	Waadah Reef
05/06/86	1815	1	0	Rks between Koitlah/breakwater
05/08/86	838	5	0	Waadah Reef
05/22/86	834	1	0	Rks 100m E of Koitlah
06/05/86	743	1	1	Waadah Reef
07/15/86	1457	2	0	Waadah Reef

Table A-5. Counts of harbor seals between the Sekiu River and Shipwreck Point, August 1985 to July 1986. No pups were observed.

Date	Time	Number hauled	Number water	Location
12/13/85	1524	0	2	1.8nm W of Sekiu R
01/27/86	950	0	3	2.0nm W of Sekiu R
01/27/86	1321	0	1	2.0nm W of Sekiu R
02/10/86	1300	0	1	1.5nm W of Sekiu R
02/10/86	1307	0	2	1.9nm W of Sekiu R
04/08/86	955	0	1	0.7nm W of Sekiu R
04/09/86	924	0	3	0.7nm W of Sekiu R
04/10/86	1645	0	1	1.5nm W of Sekiu R
04/10/86	1655	0	1	W Chito Beach
04/25/86	1545	0	1	W Chito Beach
04/25/86	1552	0	1	1.5nm W of Sekiu R
04/25/86	1557	0	2	1.0nm W of Sekiu R
04/26/86	1649	0	1	0.7nm W of Sekiu R
04/26/86	1705	0	3	1.5nm W of Sekiu R
04/26/86	1716	0	1	Shipwreck Pt
05/08/86	953	1	1	0.7nm W of Sekiu R
05/22/86	915	0	1	Shipwreck Pt
05/22/86	924	0	4	0.7nm W of Sekiu R
05/23/86	1050	0	1	0.6nm W of Sekiu R
05/24/86	1010	1	0	1.5nm W of Sekiu R
05/24/86	1301	0	1	1.5nm W of Sekiu R
05/25/86	835	7	0	0.7nm W of Sekiu R
06/04/86	1714	0	2	1.5nm W of Sekiu R
06/06/86	840	2	1	1.5nm W of Sekiu R
06/06/86	844	2	3	0.8nm W of Sekiu R
06/07/86	545	10	0	0.7nm W of Sekiu R
06/25/86	1906	0	2	1.5nm W of Sekiu R
06/26/86	906	2	0	0.7nm W of Sekiu R
06/28/86	447	3	0	0.7nm W of Sekiu R
07/07/86	927	4	0	0.7nm W of Sekiu R
07/07/86	1730	0	1	1.5nm W of Sekiu R

Table A-6. Counts of harbor seals at Eagle Rock, August 1985 to July 1986. No pups were observed.

Date	Time	Number		Location
		hauled	water	
10/18/85	1312	0	1	off Eagle Rk
12/04/85	1326	14	0	Eagle Rk
06/06/86	905	2	0	Eagle Rk

Table A-7. Counts of harbor seals at miscelaneous locations in the study area, August 1985 to July 1986. No pups were observed.

Date	Time	Number		Location
		hauled	water	
10/18/85	1639	0	1	300m E of Sekiu R
11/08/85	1305	0	1	mouth of Hoko R
11/08/85	1535	0	1	mouth of Hoko R
01/27/86	1300	0	1	50m E of Kydaka Pt
01/27/86	1350	0	1	Rasmussan Ck
01/27/86	1359	0	1	Rasmussan Ck
02/10/86	1412	0	1	200m E of 3rd Bch
04/08/86	818	0	1	3rd Beach
04/25/86	1530	0	1	W Jansen Ck
04/25/86	1537	0	1	0.2nm W of Shipwreck Pt
05/08/86	910	0	1	500m E of E Bullman Beach
05/23/86	1425	0	1	3rd Beach
05/25/86	813	0	1	50m E of Rasmussen Ck
06/05/86	1815	0	2	Jansen Ck
06/25/86	1315	0	1	0.5nm W of Shipwreck Pt
07/07/86	1406	0	1	2nd Beach

Table A-8. Counts of harbor seals inside Neah Bay proper, August 1985 to July 1986. No pups were observed.

Date	Time	Number		Location
		hauled	water	
08/06/85	1051	0	1	E of Neah Bay entrance
09/24/85	1644	0	1	SE end of Waadah
09/28/85	1707	0	1	30m W of Baadah Pt
09/28/85	1716	0	1	off Makah Fish Dock
10/18/85	1249	0	1	SW Waadah
10/19/85	1050	0	1	SE Waadah
10/21/85	906	0	1	off SE Waadah
10/21/85	1433	0	1	off E Baadah Pt
10/22/85	1535	0	1	off Makah Fish Dock
10/23/85	1650	0	1	150m SW of USCG Dock
10/23/85	1710	0	1	off Makah Fish Dock
10/42/85	905	0	1	Off SE Waadah
11/02/85	1305	0	1	300m W end Neah Bay breakwater
11/02/85	1400	0	1	E off Makah Fish Dock
11/09/85	1519	0	1	off Makah Fish Dock
03/26/86	1641	0	1	N Baadah Pt
04/27/86	841	0	1	N Baadah Pt
05/31/86	1555	0	3	50m N of Makah Fish Dock

Table A-9. Counts of harbor seals observed offshore (> 100m) at miscellaneous locations in the study area, August 1985 to July 1986. No pups were observed.

Date	Time	Number water	Location	Distance offshore
08/06/85	1012	1	2.0nm W of Pillar Pt	1.0nm
09/24/85	1658	1	Sekiu R	2.2nm
09/14/85	1736	1	N of Kydaka Pt	1.0nm
09/23/85	1547	1	N of Sekiu Pt	1.0nm
10/18/85	1207	1	1.8nm E of Pillar Pt	1.5nm
10/18/85	1212	1	1.5nm W of Pillar Pt	1.0nm
04/28/86	1411	1	0.3nm W of Waadah Is	0.5nm

Table A-10. Sightings of harbor porpoise between August 1985 and July 1986. Platform type is abbreviated: B=boat, A=air, K=kayak, and L=from land.

Date	Time	#	Lat	Long	Plat
09/14/85	1705	40	48°18.0	124°20.7	B
09/14/85	1737	5	48°18.3	124°21.5	B
09/23/85	1456	7	48°19.5	124°23.1	B
09/23/85	1518	2	48°19.4	124°21.2	B
09/23/85	1530	2	48°18.1	124°19.4	B
09/24/85	1550	6	48°17.8	124°23.7	A
09/24/85	1553	14	48°18.3	124°23.7	A
09/24/85	1557	2	48°20.0	124°27.0	A
09/24/85	1605	4	48°23.7	124°35.7	A
09/24/85	1638	1	48°25.3	124°38.0	A
09/24/85	1641	2	48°23.7	124°38.0	A
09/24/85	1656	2	48°17.8	124°23.7	A
09/24/85	1657	2	48°18.3	124°22.8	A
09/24/85	1658	3	48°19.3	124°22.2	A
09/24/85	1706	2	48°19.3	124°12.3	A
09/24/85	1707	2	48°18.7	124°24.2	A
09/28/85	1850	4	48°16.7	124°18.5	B
09/29/85	1153	1	48°19.0	124°25.0	B
09/29/85	1705	9	48°17.8	124°20.7	B
09/29/85	1715	11	48°18.2	124°20.5	B
09/29/85	1725	1	48°18.9	124°19.8	B
09/29/85	1752	1	48°19.0	124°17.7	B
11/02/85	1110	4	48°23.8	124°35.7	K
11/03/85	1045	3	48°22.8	124°32.8	K
11/03/85	1054	2	48°23.0	124°32.8	K
11/03/85	1120	2	48°23.8	124°33.0	K
11/09/85	845	2	48°22.0	124°32.1	B
12/04/85	1210	1	48°16.8	124°14.3	A
12/04/85	1318	7	48°18.4	124°22.8	A
12/13/85	954	1	48°23.7	124°33.9	B
12/13/85	1018	7	48°23.1	124°33.0	B
12/13/85	1024	9	48°23.0	124°33.0	B
12/13/85	1046	2	48°21.8	124°30.2	B
12/13/85	1102	2	48°21.3	124°28.5	B
12/13/85	1112	1	48°21.3	124°27.7	B
12/13/85	1156	3	48°17.8	124°21.7	B
12/13/85	1249	1	48°16.2	124°15.3	B
12/13/85	1259	1	48°16.7	124°15.0	B
01/26/86	916	1	48°23.7	124°44.9	B
01/26/86	951	1	48'24.3	124°40.2	B
02/10/86	1635	1	48°18.0	124°22.0	B
04/28/86	1339	8	48°18.2	124°22.9	A
05/07/86	1300	1	48°23.6	124°44.7	L
05/07/86	1410	4	48°23.8	124°44.4	B
05/07/86	1546	4	48°18.4	124°20.5	B
05/22/86	936	2	48°18.2	124°24.3	A
05/23/86	2015	1	48°24.7	124°40.0	B
06/04/86	1442	1	48°24.4	124°43.8	B
06/04/86	1529	4	48°24.2	124°35.8	B
06/04/86	1612	1	48°20.6	124°26.0	B
06/05/86	1203	1	48°23.8	124°44.4	B
06/05/86	1212	3	48°24.2	124°44.0	B
06/06/86	1026	2	48°14.2	124°05.8	B
06/06/86	1034	1	48°14.3	124°06.4	B
06/06/86	1210	1	48°19.2	124°23.3	B
06/06/86	1545	1	48°22.6	124°31.7	B
06/11/86	1035	3	48°19.6	124°26.0	A
07/15/86	1550	1	48°23.5	124°36.0	A
07/15/86	1615	4	48°21.6	124°29.7	A
07/15/86	1621	2	48°19.4	124°25.3	A

Table A-11. Sightings of Dall's porpoise between August 1985 and July 1986. Platform type is abbreviated: B=boat, A=air, K=kayak, and L=from land.

Date	Time	#	Lat	Long	Plat
09/14/85	1635	7	48°17.7	124°17.7	B
09/14/85	1701	2	48°17.3	124°19.7	B
09/23/85	1346	3	48°23.5	124°35.7	B
09/23/85	1427	6	48°21.4	124°29.0	B
09/24/85	1630	2	48°23.7	124°35.0	A
09/29/85	1805	2	48°17.7	124°17.7	B
11/09/85	759	2	48°25.6	124°33.3	B
12/13/85	1117	6	48°21.6	124°27.5	B
12/14/85	1029	1	48°24.0	124°46.8	B
04/28/86	1332	10	48°18.9	124°21.9	A
04/28/86	1337	19	48°18.6	124°22.4	A
04/28/86	1338	3	48°18.2	124°22.6	A
05/07/86	1455	3	48°23.1	124°32.2	B
06/06/86	1515	5	48°25.9	124°31.4	B
07/08/86	1244	6	48°18.4	124°20.8	B
07/15/86	1607	3	48°24.9	124°32.8	A

Table A-12. Number of gray whales observed in the study area between August 1985 and July 1986.

Date	Time	#	Location	Distance offshore(m)
01/20/86	1554	1	2.0nm E of Bullman Beach	40
01/26/86	1325	1	2.0nm E of Sail Rk	50
02/10/86	1045	1	S of Sail Rk	100
02/10/86	1435	1	E of Sail Rk	75
03/12/86	830	1	between Baadah-SE Waadah	50
03/27/86	1000	2	1.0nm W of Sekiu R	20
03/27/86	1150	1	0.4nm E of Bullman Beach	50
03/28/86	1330	1	1.5nm E of Bullman Beach	20
03/30/86	1053	3	50m N of W Tatoosh	50
04/07/86	1422	1	1nm W of Rasmussen Ck	75
04/08/86	820	1	3rd Beach	15
04/08/86	1800	5	SE Duncan Rk	-
04/08/86	1800	3	NNE Tatoosh	30
04/09/86	802	1	3rh Bch	15
04/09/86	916	1	0.7nm W of Sekiu R	75
04/09/86	1415	1	0.8nm W of Sekiu R	25
04/09/86	1620	1	50 m N of Badaah Pt	30
04/10/86	845	1	20m N off rks 500m E Sail Rk	20
04/10/86	905	1	off Sail Rk	20
04/10/86	1715	1	200m E Bullman Beach	70
04/11/86	1425	1	Rasmussen Ck	50
04/26/86	916	1	W of Sland Rk	50
04/26/86	1115	1	Sail R	100
04/26/86	1516	1	E of Sail R	100
04/26/86	1740	1	between Seal/Sail Rks	50
04/27/86	924	1	3rd Beach	100
04/28/86	1402	1	200m NE of Tatoosh	50
05/07/86	1900	1	200m E Bullman Bch	100
05/22/86	810	1	E Tatoosh	20
05/22/86	900	1	0.5nm W Shipwreck Pt	20
05/23/86	935	1	0.5nm E of Shipwreck Pt	150
05/23/86	1012	1	0.6nm W of Sekiu R	75
05/23/86	1240	2	W Chito Beach	150
05/24/86	840	1	50m NW 3rd Beach	20
05/24/86	1331	1	200m W of Bullman Bch	150
05/24/86	1441	1	3rd Beach	5
05/24/86	1638	1	10m S Waadah Is	10
05/24/86	1720	1	3rd Beach	5
05/24/86	1746	1	between 3rd Bch and Sail R	10
05/24/86	1759	1	NW Waadah	5
05/24/86	1848	1	SE Waadah	30
05/25/86	928	1	off Sail R	10
05/31/86	1520	1	0.5nm W of Shipwreck Pt	50
05/31/86	1654	1	N of Sail Rk	50
05/31/86	1725	1	200m E of Shipwreck Pt	75
06/04/86	900	1	500m W Shipwreck Pt	100
06/04/86	1620	1	between Shipwreck/Jansen Ck	50
06/04/86	1740	1	500m W of Shipwreck Pt	90
06/05/86	800	1	50m E of Sail R	85
06/05/86	840	1	100m E 2nd Beach	200
06/05/86	1507	1	400m W of Shipwreck Pt	125
06/05/86	1820	1	200m W of Jansen Cr	70
06/06/86	757	1	50m E end Bullman Bch	100
06/11/86	1155	2	0.5nm W of Shipwreck Pt	70
06/11/86	1220	2	300m W of Shipweck Pt	30
06/25/86	1558	1	50m SE of Sail Rk	250
06/25/86	2002	1	100m S of Sail Rk	200
06/26/86	1046	1	3rd Beach	150
06/26/86	1748	1	50m W of Sail Riv	15
06/27/86	1433	1	150m NE of Dtokoah Pt	10
07/07/86	1303	1	300m W 3rd Beach	300
07/07/86	1426	1	between 1st & 2nd Beach	20
07/07/86	1911	1	off Dtokoah Pt	500
07/08/86	920	1	2nd Beach	100
07/08/86	922	1	100m off 2nd Bch	100
07/08/86	1632	1	2nd Beach	100
07/15/86	1445	1	Dtokoah Pt	50
07/15/86	1554	1	Dtokoah Pt	50