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~~Linda Maxson~~

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MARINE MAMMALS OF NORTHERN PUGET SOUND AND THE STRAIT OF JUAN DE FUCA

A Report on Investigations November 1, 1977 -- October 31, 1978

Robert D. Everitt
Clifford H. Fiscus
Robert L. DeLong

Marine Ecosystems Analysis Program
Boulder, Colorado
January 1979

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UNITED STATES
DEPARTMENT OF COMMERCE
Juanita M. Kreps, Secretary

NATIONAL OCEANIC AND
ATMOSPHERIC ADMINISTRATION
Richard A. Frank, Administrator

Environmental Research
Laboratories
Wilmot N. Hess, Director

Report Submitted to
MESA PUGET SOUND PROJECT
MARINE ECOSYSTEMS ANALYSIS PROGRAM
ENVIRONMENTAL RESEARCH LABORATORIES

by

MARINE MAMMAL DIVISION
NORTHWEST AND ALASKA FISHERIES CENTER
NATIONAL MARINE FISHERIES SERVICE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
SEATTLE, WA 98115

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November 1, 1977 - October 31, 1978

R.D. Everitt, C.H. Fiscus, and R.L. DeLong

ABSTRACT

This report describes the results of the first year of a two year study designed to determine the abundance and distribution of marine mammals in northern Puget Sound and the Strait of Juan de Fuca. An account describing each species of marine mammal in the study area was prepared with data collected during monthly aerial and small boat surveys and from an extensive literature review. The river otter (*Lutra canadensis pacifica*) is common in the area, and of the five pinnipeds that occur, only the harbor seal (*Phoca vitulina richardsi*) is a year round resident. Haul out behavior was studied to determine optimum survey times and an estimate in excess of 1,600 was made for harbor seals in August, the highest estimate for any month. Two sea lions, the California sea lion (*Zalophus Californianus*) and northern sea lion *Eumetopias jubatus*) are common during winter months. These two species arrive in the study area in October and leave by May. A maximum of over 260 individual sea lions were observed during 1977-1978. Fifteen species of cetaceans occur in these waters, most only rarely. Resident species include the minke whale (*Balaenoptera acutorostrata*), Dall porpoise (*Phocoenoides dallii*), harbor porpoise (*Phocoena phocoena*), and the killer whale (*Orcinus orca*). The first two species are most frequently seen in the spring and summer months; the latter two occur year round.

I. INTRODUCTION

The inland waters of Washington, Strait of Juan de Fuca and Puget Sound, are unique waterways ideal for commercial and recreational uses. Growth of the human population in this area and continued development, however, have caused increasing concern over potential environmental degradation, with primary interest focusing on a continuous flow of waste into Puget Sound. Of more recent concern has been the effect of increasing petroleum transport and associated refining operations on Puget Sound. The development of Alaska's oil reserves and consideration of Washington as a point of departure for transhipment of petroleum products to other areas of the country has also become cause for concern.

In response to these threats to the biological resources of Puget Sound, research has been instigated to document their effects. This research, which has been funded partly by the United States Environmental Protection Agency (EPA) and administered through the National Oceanic and Atmospheric Administration's (NOAA) Marine Ecosystems Analysis (MESA) Puget Sound Project Office, is designed to develop an understanding of the ecosystem of Puget Sound and the Strait of Juan de Fuca, to compile baseline data for the area, and to identify the potential consequences of petroleum transport and transfer operations.

A MESA funded study of the distribution and abundance of marine mammals in northern Puget Sound and the Strait of Juan de Fuca, is being conducted by NOAA's Marine Mammal Division (MMD), Northwest and Alaska Fisheries Center (NWAFC), National Marine Fisheries Service (NMFS), Seattle, WA. The objectives are to: 1) Determine the seasonal population status of each species of marine mammal in the area, 2) Describe specific locations used significantly by these populations, and 3) Characterize the various populations and their habits which may increase their vulnerability to petroleum related activities.

This report covers one year of research (November 1977 - October 1978), which is the first of a two year study. The second year activity, to be completed in the fall of 1979, will permit documentation of any annual variation and allow compilation of more information for areas not adequately examined in the first year.

I-A. Marine Mammal Research in Washington

Research on marine mammals in the United States was limited until passage of the Marine Mammal Protection Act of 1972, which obligated the Federal Government to determine status of marine mammal stocks of national interest. Generally only those species of commercial value or those regulated by international treaty (e.g., northern fur seal, *Callorhinus ursinus*) were studied significantly prior to 1972, and in Washington opportunistic research formed the basis for most of the early literature.

T.H. Scheffer, a biologist with the U.S. Fish and Wildlife Service, carried out research on the harbor seal (*Phoca vitulina richardsi*) and published some early accounts of its feeding habits under the impetus of concern over the impact of these animals on commercial fish species. Scheffer (1929; 1931) showed that salmonids comprised only a small portion of the total prey species and was an early voice calling for sound management of pinnipeds in the state (Scheffer, 1928).

Unusual observations and new species records have regularly appeared in the literature (e.g., Bonham, 1942; Stroud, 1969; Balcomb, 1972). Wilke (1943) described a methodology for collecting harbor seal drawing on the experience of local bounty hunters. A paper by Wilke and Kenyon (1952) relates the results of stomach content analysis of fur seals, sea lions, and one harbor porpoise (*Phocoena phocoena*) some of which were collected in Washington waters. Initial attempts to determine pinniped stocks on the Washington coast by aerial surveys were attempted in the 1940's and 1950's (Scheffer and Macy, 1944; Kenyon and Scheffer, 1952). The first records of California sea lions (*Zalophus californianus*) in Washington were reported in these studies.

V.B. Scheffer and J.W. Slipp (1944) compiled the first natural account of the local harbor seal since that of T.H. Scheffer. This work was the result of personal observations of the animals and interviews with local residents. Scheffer and Slipp (1948) also described cetaceans common to Washington in a report based on accumulated records, personal observations, and interviews.

M.A. Bigg (FRBC, Nanaimo, B.C.) has published results of work on the biology of local harbor seal populations (Bigg, 1969; 1973; 1974). Bigg and Wolman (1975) published a study of live capture of killer whales (*Orcinus orca*) in inland waters.

Under Dr. Murray Johnson, graduate students with the University of Puget Sound (UPS) have continued work with harbor seals since the late 1960's. Arnold (1969) reported on a feasibility study of Gertrude Island as a research site, and Newby (1971) presented additional details of the harbor seals of that island. A review of the population of harbor seals in the state documented a population decline over the years (Newby, 1973). With funding from the Marine Mammal Commission (MMC) and the NMFS, research conducted by UPS scientists expanded to the coast, concentrating in the Grays Harbor area (Johnson and Jefferies, 1977). This study continues and Johnson and Jefferies are presently studying movements of harbor seals using radio telemetry.

Undergraduate students of The Evergreen State College, Olympia, Washington studied the current abundance and distribution of the harbor seal, principally in southern Puget Sound and Hood Canal (Calombokidis et al., 1978), examined pollutant levels in tissue samples, and compared this level with previous work from the area by Arndt (1975).

The MMD has been involved with research on local marine mammals for several years. Pelagic collecting expeditions by the MMD off the Oregon and Washington coasts for northern fur seals have accumulated data on several species in the area. An attempt to collect large cetaceans in northern Puget Sound in 1965 was the first by MMD personnel to obtain marine mammal specimens in the inland waters of Washington (Fiscus and Kajimura, 1965). The Moclips Cetalogical Society initiated Orca Survey, a photo study of killer whales (Orcinus orca) in Washington waters, which was originally funded through the MMD in 1976. The current level of funding has been reduced to include only the toll free, public reporting system or "Whale Hotline". Important sighting records have been accumulated by this Society over the past few years as a result of this system.

In 1974-1975 a cooperative research program between the MMD and the Washington Department of Game (WDG) began. The primary objective was aerial and vessel surveys of killer whales in Puget Sound though the occurrence of other species were noted as well. Unpublished data from this work has been useful in preparing the present report.

The MMD has also attempted to coordinate the recovery of stranded animals locally by providing technical assistance, storage space, and logistic support. Sighting records of marine mammals that are accumulated opportunistically from various locations in Washington are maintained in a computer data bank as part of the Platforms of Opportunity Program (POP). These records come from NOAA research vessels, commercial fishing operators, and private individuals.

In addition to its work through MESA, the MMD may expand its research in Oregon and Washington, to include studies of marine mammal commercial fishery interactions.

I-B. A List of Marine Mammals of Northern Puget Sound and the Strait of Juan de Fuca

The marine mammals reported from this area represent three orders. Research effort was directed at those species of marine mammals which, from the literature, are known to have occured in the inland waters of Washington. No occurrences of new species were documented during this study. For the purpose of this report we use the nomenclature of Rice (1977), except for the subspecific spelling of *Phoca vitulina richardsi* which was recently corrected by Shaughnessy and Fay (1977).

Order: Carnivora

Family: Mustelidae

River Otter
(*Lutra canadensis pacifica*)

Family: Otariidae

California sea lion
(*Zalophus californianus*)

Northern (Steller's) Sea Lion
(*Eumetopias jubatus*)

Northern Fur Seal
(*Callorhinus ursinus*)

Family: Phocidae

Harbor Seal
(*Phoca vitulina richardsi*)

Northern Elephant seal
(*Mirounga angustirostris*)

Order: Mysticeti

Family: Eschrichtiidae

Gray Whale
(*Eschrichtius robustus*)

Family: Balaenopteridae

Minke Whale
(*Balaenoptera acutorostrata*)

Fin Whale
(*Balaenoptera physalus*)

Humpback Whale
(*Megaptera novaeangliae*)

Order: Odontoceti

Family: Delphinidae

Whitehead Grampus
(*Grampus griseus*)

Pacific White-sided Dolphin
(*Lagenorhynchus obliquidens*)

Saddleback Dolphin
(*Delphinus delphis*)

False Killer Whale
(*Pseudorca crassidens*)

Shortfin Pilot Whale
(*Globicephala macrorhynchus*)

Killer Whale
(*Orcinus orca*)

Harbor Porpoise
(*Phocoena phocoena*)

Dall Porpoise
(*Phocoenoides dallii*)

Family: Physeteridae

Pygmy Sperm Whale
(*Kogia breviceps*)

Family: Ziphiidae

Goosebeak Whale
(*Ziphius cavirostris*)

North Pacific Giant Bottlenose Whale
(*Berardius bairdi*)

II. METHODS AND MATERIALS

To achieve the research objectives of this project a strategy was devised using several different methods to obtain population data of marine mammals in the study area. Included were direct censusing of the larger populations of pinnipeds using aerial, small boat, and land observations. The compilation of records and observations from published and unpublished sources provided information on species which were not observed during field activities or are infrequent or rare visitors to the area.

II-A. Study Area

The research area is the waters of the Strait of Juan de Fuca and northern Puget Sound (lat. $48^{o}N - 49^{o}N$; long. $122^{o}30'W - 124^{o}50'W$) (Fig. 1). In the San Juan Islands area over 180 major and minor islands, islets, and reefs exist. Large tideflat areas are found in Padilla, Skagit, Bellingham, and Samish Bays. Long sand and cobble spits occur at Protection Island, Dungeness Spit, and Minor Island. Areas emphasized in this study were Dungeness Spit (Refuge), Smith-Minor Islands, and Protection Island. The important shipping lanes of Haro Strait, Rosario Strait, and the Strait of Juan de Fuca also warranted close scrutiny.

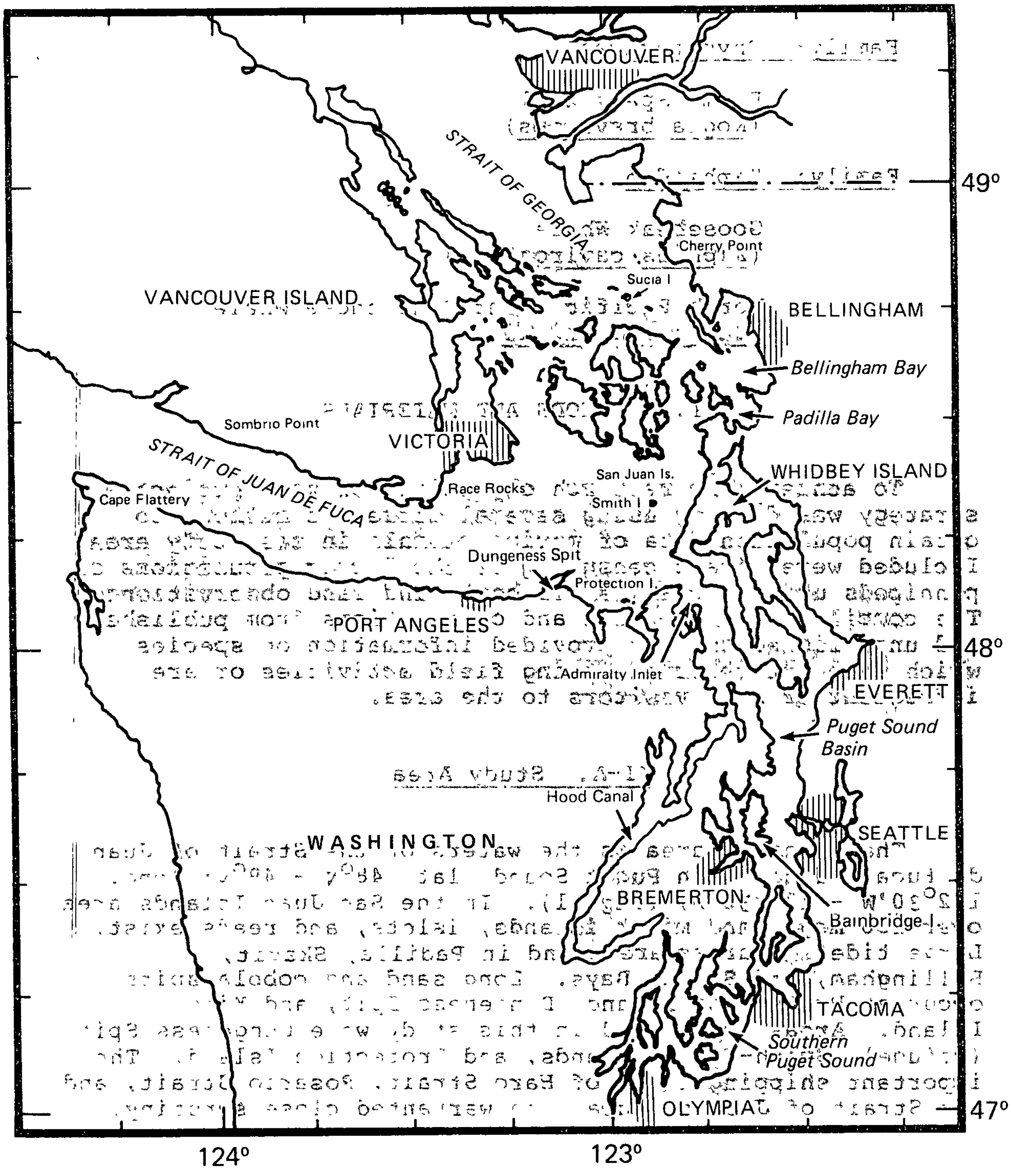

Figure 1. The waters of Puget Sound and the Strait of Juan de Fuca

II-B. Methodology

II-B-1. Aerial Survey

Aerial surveys of marine mammal populations is a common census technique (Chapman et al., 1977). It is particularly effective for pinnipeds which haul out on land and are readily visible. A total of 130.4 hours were flown in 29 flights (Table 1).[1] At least two observers (in addition to the pilot) participated in each flight. The primary observer sat forward next to the pilot. He directed the survey, made visual estimates of numbers of animals observed, and photographed all groups of pinnipeds hauled out when possible. Other observers sat aft and maintained observation and location records. Surveys were timed to coicide with monthly low tides. The entire survey area was covered, usually in 2 or 3 days; coastal surveys were flown at altitudes of 300-500 feet, and open water transects at about 700 feet. On occasion an observer from the MESA funded sea bird project accompanied our surveys at which times we attempted to accomodate their observations by flying at lower altitudes.

Photographs were taken with either a 35 mm Nikon-F2 or F2S camera with motor drive unit and 105, 135, or 200 mm lenses with automatic apertures. Overlapping photographs were taken if more than one photograph was required for complete coverage. High speed Kodak (ASA 200) ektachrome film was used because dark overcast conditions and high flight speeds (80-100 kts.) required the use of low aperture stops and shutters speeds of 1/250 sec. or faster. The developed slides were projected onto a large roll of white paper for counting animals and images marked to avoid duplication. These photograph counts replaced corresponding visual estimates in the field notes.

When local weather conditions occassionally prevented coverage of all portions of the survey area, attempts were made later in the month to survey the areas.

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[1] Aerial surveys were conducted using a four place Cessna 172 aircraft chartered first from Bison Air, Seattle, WA. from November, 1977 to March 1978. Air-Eze Ltd., Seattle, WA flew the remaining surveys (April - October, 1978) using a Cessna 172.

TABLE I.--Summary of field activities conducted by the Marine Mammal Division under contract with NOAA's MESA Puget Sound Office. Date activity occurred is given under each month. Dashed line means no activity took place that month. Information was taken from monthly reports.

Activity	1977 Nov	1977 Dec	1978 Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Total Days
1. Aerial Survey	30	8,21	26,28	9,24,28	14,15	25,28	23,25	9,27,28	4,19,20,27	14,28,29	12,13,14	14,31	29
2. Boat/Land Obs.			12,21	18-20	20-22	20-21	18	12	4-8,21-22,22-28	9-12,16-17	6-8,19-21	17-19	42
Protection I.	-	-		16		29	18		21	12	-	-	5
Smith-Minor I.	-	-			21	20			6	10	-	-	4
Dungeness Refuge	-	-			23-24					30	-	-	3
Haro Strait	-	-					20-21		6-7	31	-	-	5
Rosario Strait	-	-					26-28				3-4	-	4
Skagit Bay	-								6		-	-	1
Padilla Bay	-							14-15		31	-	-	3
Dinner I.	-				21	15					-	-	2
Discovery Bay	-												
3 Boat/Engine failure days lost 1/	-		7		3	17	5	10	2		-	-	44

1/ Estimate of total days/month that the MMD boat was inoperable due to equipment failure. This does not include days lost to foul weather.

Since several days were required to cover the study area each month the possibility of an animal occuring on successive days at different sites and thus being counted twice occurs. This factor cannot be evaluated without a understanding of local movements of animals which is lacking for most species of marine mammals. This question was not in the scope of the present research effort and for the purposes of this report duplicate sightings were considered negligible.

II-B-2. Small boat/land observations

We originally planned to make periodic surveys by boat to areas of known importance to harbor seals (i.e., Dungeness Refuge, Protection Island, and Smith-Manor Islands) and into the heavily traveled shipping lanes in Rosario and Haro Straits. For this purpose, we obtained a used 16-foot Pacific Mariner with a 55hp Evinrude outboard. Mechanical problems and smallness of the craft for the often rough and stormy water encountered in open areas prevented surveys in all except ideal weather conditions (Table 1). During surveys at least two observers were on board, with the boat operator serving as a secondary observer. The primary observer scanned open water areas and when in view of hauling areas made several counts aided by 7x50 mm Bushnell binoculars. The average of these counts was used as the best estimate of the number of animals present, and photographs were taken to document habitat type and to create a photo-catalogue of hauling areas.

Land observations were made primarily of harbor seals that haul out on Protection Island. Attempts to observe harbor seals at Dungeness Refuge and Minor Island were unsuccessful due to the low topography of those areas and our inability to stay for any length of time. We constructed a blind on Protection Island but were unable to place it in the most desirable location which limited its effectiveness. In addition, we did not use the blind in the spring and summer to avoid disturbing the many Glaucous-wing gulls nesting there.

Observations were made from cliffs overlooking the hauling area on Protection Island using a Bushnell 20x45 zoom telescope mounted on a tripod, and from a boat anchored 50-70 m offshore. The total number of animals were recorded and age classes noted, i.e., whether adult, immature, or pup, and behavioral notes were made when practicable. Notes were also made on such weather factors as: visibility, temperature, and wind speed and direction. Observation times varied, depending on weather conditions and suitability of the observation point, but were never more than 30 minutes. As conditions allowed, observations were made hourly through a tidal cycle, however if this was not possible, a minimum of three observation periods, low tide, mid-ebb/flood, and high tide were made.

The effectiveness of boat survey was hindered primarily by the size and quality of boat used which was not adequate for sustained, open water transect work. The boat served almost exclusively as a transportation vehicle from island to island and as an observation platform for areas not visible from land. Land observations suffered primarily from the difficulty of approaching harbor seals within viewing distance without disturbing the animals. An unknown number of animals may always be out of view so total counts were unreliable.

II-B-3. Sightings from other sources

Supplemental data from other sources were valuable additions to our own observations. Some records were obtained from published literature and reports, and the American Cetacean Society provided observations made during their "whale-watching" boat tours in Puget Sound. The Platforms of Opportunity Program (POP), which solicits sightings from NOAA research vessels, the Alaska State Ferry System, and commercial boat operators provided additional information. Other MESA funded projects, particularly the sea bird study, collected marine mammal sightings for us, and interviews with local residents and commercial fishermen produced a few new records. The Moclips Cetological Society and the general public provided data collected during the course of a study (Orca Survey) of killer whales partially sponsored by the MMD.

For some species, abundance data was taken from the Report of Administration of the Marine Mammal Protection Act, 1978 (MMPA, 1978).

III. RESULTS

The results of this study are presented here as individual species accounts for marine mammals occurring in the study area. The species are classified as follows: 1) Common - seen year round or seasonally; 2) Rare - a few specimen or sight records avalable but presence of the species in any given year cannot be predicted; 3) Accidental - single or very few records, indicating the species has traveled far beyond its normal range. For inclusion in this report actual specimens in hand rather than visual records (such as the report of a Beluga whale (Delphinapterus leucas) in Puget Sound in 1940 by Scheffer and Slipp, 1948) were used to substantiate accidental occurrences. In addition, species for which there are records in coastal but not in inalnd waters were not included.

III-A. Species Account

Included in each species account is a general biological description, with additional information on sighting records, behavior, growth, reproduction, feeding habits, and known predators. The distribution and abundance of each species is described generally worldwide and specifically for the study area, including known migrations or movement patterns. Finally, known ecological problems such as fishery/marine mammal interactions, the effects of environmental pollutants, or the harrassment by the public of the animals are described.

III-A-1. Order: Carnivora

Three families are represented by this order in the study area: Mustelidae, Otariidae, and Phocidae. The river otter (Lutra canadensis), northern fur seal (Callorhinus ursinus) and elephant seal (Mirounga angustirostris) were reported from the literature and other record sources since new observations were few. New information on the California sea lion (Zalophus californianus), northern sea lion (Eumetopias jubatus) and harbor seal (Phoca vitulina richardsi) is presented. A summary of the Carnivora species follows (Section IV), which includes their occurrences in four general areas (i.e., the Strait of Juan de Fuca (east and west), Haro Strait, Rosario Strait, and the protected waters among the San Juan Islands), and the seasonal vulnerability of these species to oil activities.

III-A-1-a. River Otter (Lutra canadensis)

Species Description

The river otter (Lutra canadensis) is represented west of the Cascade Mountains by two subspecies (Cowan and Guiguet, 1965). L. c. pericylyzome is confined to British Columbia, principally in the Queen Charlotte Islands, whereas L. C. pacifica occurs in most other areas.

In a report to the Washington Department of Game, Hirschi (1978) briefly discussed the Washington population and recommendations for their management. According to Hirschi, the river otter uses a variety of habitat types, and freshwater areas in inland portions of the state support populations of this species as does the marine environment. Peak of the pupping season is observed in April but may extend into July. The females usually produce more than two pups, and breed shortly after parturition.

By trapping river otters, man is the primary predator; some natural mortality is caused by domestic dogs and perhaps bald eagles. Other man-caused loss of otters include those killed by automobiles, boats, and drowned in crab pots (Hirschi, 1978).

Otter prey on sculpins, flounders, crayfish, and spawning salmon with some seasonal variability in feeding habits (Hirschi, 1978).

The river otter is often confused with the sea otter (Enhydra lutris) as both animals are similar in appearance and occur in marine areas. Kenyon (1969) stated that sea otters never occurred with any regularity in inland waters and that the species was eliminated from Washington by over-exploitation in the 19th century. Sea otters were transplanted to Washington in the early 1970's in an attempt to reestablish a population in the state. Jameson (1977) estimates that there are less than 30 of these animals in coastal Washington waters. These animals presently occur from Destruction Island north to Ozette Island (MMD files). The occurrence of sea otters in Puget Sound has never been verified, though many river otters in this area have erroneously been identified as sea otters. Kenyon (1969) provided a checklist of characteristics to separate these two species in the field by describing certain behaviors of sea otters that do not appear in river otters including:

1. On surface sea otters usually swim belly up with forepaws on chest while paddling with hind flippers. They float high in the water.

2. Sea otters are clumsy on land, seldom seen on shore except in isolated Alaskan areas.

3. Sea otters eat while floating on back, never eating on shore.

4. Sleeps (usually) in kelp beds or calm water while floating on its back.

5. Bears single young which is carried on the mother's chest as she swims on her back.

Abundance and Distribution

River otters are widely distributed in Washington from east of the Cascade Mountains to the Pacific coast, including adjacent islands (Cowan and Guiguet, 1965). Some animals utilize freshwater drainages and lakes and others are found only in the marine environment.

River otters are distributed widely in the study area. Hirschi (1978) reported trapping records and personal observations of otters from northern Puget Sound, throughout the San Juan Islands, and in the Skagit River system (Figure 2). For the Strait of Juan de Fuca he reported animals from the Dungeness area, Port Angeles, and Cape Flattery. During the present study sightings of otters were received in the San Juans only. All of the new records compiled during this study came from small boat surveys or personal interviews, but no otters were observed during aerial surveys. On 20 May, 1978 a river otter was seen in the water adjacent to Arimitage Island in Rosario Strait, and on 10 September, 1978 a single otter was observed on the north side of Puffin Island. Mr. R.W. Osborne (pers. commun., 1978) recorded 17 observations of otters seen in and near Andrews Bay, San Juan Island (west side of the island; Haro Strait) from December 1977 to May 1978 (Dec. = 1, Jan. = 6, Feb. = 4, Mar. = 0, Apr. = 6). Most of the animals were single, however, on 4 April 1978, five river otters were observed feeding near the shore. It appears that this species may be common in Haro Strait, at

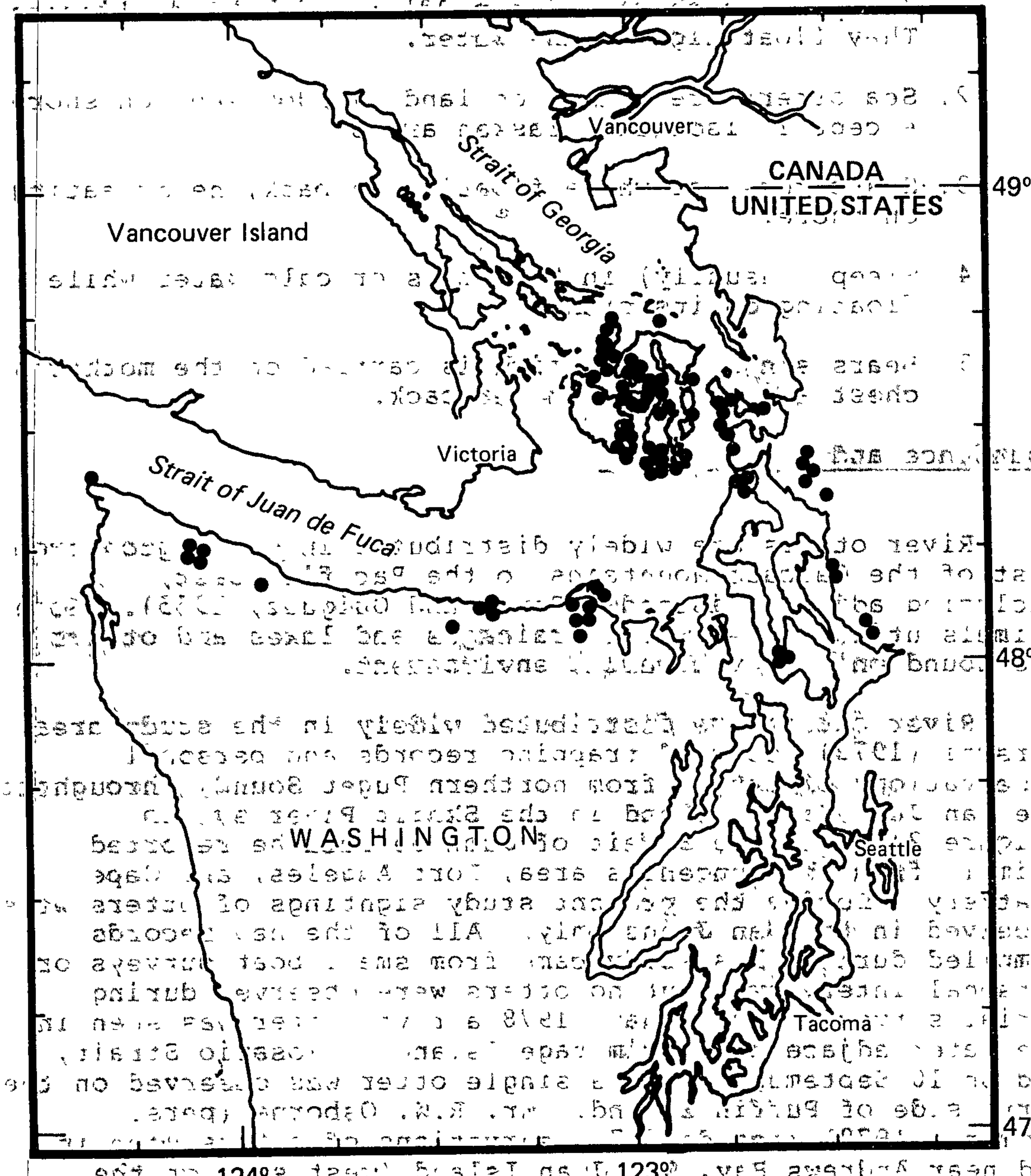


Figure 2. Distribution of recent records of river otters (Lutra canadensis) in northern Puget Sound and the Strait of Juan de Fuca. Records include trapping records and field observations (adapted from Hirschi 1978).

least in winter. Mrs. D. Ward (pers. commun., 1978) reported that at least five otters maintain dens and breed successfully each year on Dinner Island (San Juan Channel).

The data are insufficient for estimating total abundance, but population trends are being monitored by analysis of trapping data and population profiles obtained from sampling individuals. Hirschi (1978) considers the population in western Washington to be reasonably stable at this time but suggests that yearly harvests in excess of 600 animals cannot be sustained. A harvest of this magnitude is rare and when it occurs, trapping success in years immediately following are reduced.

Ecological Problems

As western Washington continues to develop economically, habitat loss resulting from human incursion will increase. In this situation it is questionable whether river otter populations can withstand current harvest levels (Hirschi, 1978).

River otters rely on a still air layer trapped between two fur layers for insulation, as does the sea otter (*Enhydra lutris*)and northern fur seal (*Callorhinus ursinus*). Oiling of the fur, which would occur if the animals contacted spilled crude oil, could be fatal since the insulative qualities of the fur are greatly reduced after oiling (Kooyman et al., 1976).

Interactions between the commercial fishery in Washington and the river otter, if any, are unknown.

III-A-1-b. California Sea Lion (Zalophus Californianus)

Sample Description

Three subspecies of *Zalophus californianus* have been described (Scheffer, 1958). On of these, *Z. c. japonicus*, inhabited the Sea of Japan and now may be extinct, a second subspecies, *Z. c. wollebaki*, occurs on the Galapagos Islands (Mate, 1976). *Z. c. californianus* occurs in the eastern North Pacific Ocean and is the only subspecies seen in Washington.

Males may attain a length of 2.5 m and weigh as much as 365 kg, while females are considerably smaller, measuring 1.6 m weighing 115 kg (Mate, 1978). As males mature, the sagital crest becomes prominent with the hair in that area turning lighter than surrounding pelage. Pelage appears dark brown when wet and dries to a slightly lighter color. *Zalophus* are regularly exhibited in aquariums and zoos and it is the pinniped most commonly collected for display; in 1976 over 423 specimens were in captivity (Cornell and Aspe, 1976).

The breeding season for *Zalophus* begins in May and continues into July. Breeding rookeries are located in the Sea of Cortez, and from the islands of Baja California, north to San Miguel Island (Lat. 34^{o}N). The males arrive at the rookeries first and establish territories. Adult females arrive after males and within a short period of time give birth to a single pup, they are bred by a territorial male within 10 days after parturition.

Zalophus are opportunistic feeders, exploiting a variety of prey items. Stomach content data from Washington are not known. However, some stomachs from other areas have been examined and a list of known prey items was presented by Antonelis and Fiscus (1978). Two difffernet approaches to food habit data collection have recently been reported. Ainley et al. (1977) examined spewings on Southeast Farallon Island and found Pacific hake to be an important seasonal prey species. Scats from San Miguel Island were collected and strained for remnants of prey. Hake was again the prominent fish in evidence (Antonelis and Fiscus, 1978).

Abundance and Distribution

Zalophus californianus is distributed along the west coast of North America from the Sea of Cortez and Baja California (approx. lat. 19^{o}N) and northward to Vancouver Island, B.C. (lat. 51^{o}N) (Rice, 1977). The northernmost record of this species comes from a photograph of an adult male taken on Elrington Island, Prince William Sound, Alaska, on 27 June 1973 (K. Sneider, ADF&G pers. comm.). During the breeding season (May-July) almost all of the population is found on the breeding range (south of lat. 34^{o}N). Bartholomew (1967) reported a northward movement of males after the breeding season and that females tend to remain in the vicinity of the breeding rookeries or move south. Most, if not all, of the animals occurring in Washington waters are males.

Bartholemew (1967) estimated that the breeding population in California had been reduced by exploitation to about 2,000 animals by 1940. Steady increases in the population have been reported since. Mate (1977) estimated the total population at over 75,000 animals. LeBeouf et al., (1976) estimated 125,000 animals in the population by 1976. LeBoeuf and Bonnell (1978) feel that these two figures still may underestimate the actual population size.

Cowan and Guiguet (1965) reported the first two records of Zalophus for British Columbia, from the west coast of Vancouver Island, and Pike and MacAskie (1969) reported animals of this species as regularly occurring in that area. Pike and MacAskie also mention that occasionally a single male is seen in a group of northern sea lions (Eumetopias jubatus) at Race Rocks off Victoria, B.C. Kenyon and Scheffer (1959) reported the first observations of Zalophus for Washington, that of a few males amongst northern sea lion on the outer coast in 1950. Hancock (1970) reported up to 30 Zalophus at Race Rocks. Bigg (1973) conducted aerial and land surveys in the inland waters of British Columbia for this species. He reported animals hauling out at Sombrio Pt., Race Rocks, and Dodd Narrows (eastern coast of Vancouver Island). These areas are the only known hauling sites for inland waters. Bigg surveyed Zalophus from June, 1971 to February, 1972, the numbers of animals sighted peaked in February. He did not survey in March and April, but after the June survey no Zalophus were present. The maximum number Bigg observed including the southwest coast of Vancouver Island was 473. On December 6, 1972, he observed 68 California sea lions on Sombrio Pt. and Race Rocks, the largest count for inland waters during his survey period.

Aerial surveys of selected areas in Washington conducted by the Marine Mammal Division, NWAFC, Seattle, WA in 1974-1975 as part of a killer whale (Orcinus orca) study included Race Rocks and Sombrio Pt. (Tables 2 and 3). No Zalophus were observed from June through November during this study. The first observations were made in December of 55 California sea lions. This number increased to a maximum of 155 in March and then rapidly declined through May.

During the present study all potential haul out sites were examined monthly. California sea lions were observed only at Sombrio Pt. and Race Rocks in the western Strait of Juan de Fuca (Figure 3). We did not survey further northward into Canadian waters beyond Victoria or westward beyond Port San Juan, Vancouver Island. During the November survey we did not examine Race Rocks. Thereafter complete surveys were made monthly.

TABLE 2.--Observations of northern sea lions (E.j.), California sea lions (Z.c.), California sea lions, tentative identification (Z.c.?), and unidentified sea lions (UNID.) from aerial surveys of Race Rocks, B.C., July 1974 to June 1975 and December 1977 to October 1978. 1974-1975 data were taken from files at the Marine Mammal Division, NWAFC, Seattle, WA and represent visual estimates. 1977-1978 data were collected during the present study and represent photographic counts.-- continued.

Year day/month	E.j.	Z.c.	Z.c.?	UNID.	Total sea lions
1974					
2 July	0	0	0	0	0
16	0	0	0	0	0
30	0	0	0	0	0
13 Aug	0	0	0	0	0
27	0	0	0	0	0
10 Sept	0	0	0	0	0
24	0	0	0	0	0
8 Oct	0	0	0	0	0
23	28	0	0	0	28
5 Nov	30	0	0	0	30
19	45	0	0	0	45
3 Dec	22	42	0	0	64
17	[——165——]		0	0	165
31	60	25	0	0	85
1975					
14 Jan	120	45	0	0	165
28	90	35	0	0	125
25 Feb	58	0	0	0	58
11 Mar	31	29	0	0	60
25	20	95	0	0	115
8 Apr	52	0	0	0	52
22	51	20	0	0	71
6 May	28	7	0	0	35
20	1	0	0	0	1
3 June	0	0	0	0	0
17	0	0	0	0	0
1977					
8 Dec	104	26	15	5	150
21	161	14	12	14	201
1978					
26 Jan	194	10	3	16	223
28	195	20	9	31	255
9 Feb	139	13	16	30	198
28	155	5	0	0	160

TABLE 2.--Observations of northern sea lions (E.j.), California sea lions (Z.c.), California sea lions, tentative identification (Z.c.?), and unidentified sea lions (UNID.) from aerial surveys of Race Rocks, B.C. July 1974 to June 1975 and December 1977 to October 1978. 1974-1975 data were taken from files at the Marine Mammal Division, NWAFC, Seattle, WA and represent visual estimates. 1977-1978 data were collected during the present study and represent photographic counts.

Year day/month	E.j.	Z.c.	Z.c.?	UNID.	Total sea lions
1978					
14 Mar	128	7	9	15	159
15	194	24	20	13	251
25 Apr	259	23	17	34	333
28	177	13	4	0	194
23 May	0	0	0	0	0
25	2	4	0	0	6
27 June	0	0	0	0	0
28	0	0	0	0	0
19 July	0	0	0	0	0
20	0	0	0	0	0
18 Aug	0	0	0	0	0
12 Sept	58	0	0	0	58
14 Oct	98	10	0	0	108
31	187	0	2	0	189

TABLE 3.--Observations of northern sea lions (E.j) and California sea lions (Z.c.) from aerial surveys of Sombrio Pt., Vancouver Island and Sucia Island, July 1974 to June 1975 and December 1977 to October 1978. 1974-1975 data were taken from files at the Marine Mammal Division, NWAFC, Seattle, WA and represent visual estimates. 1977-1978 data were collected during the present study and represent photographic counts.

Year day/month	Sombrio Pt. E.j.	Sombrio Pt. Z.c.	Sombrio Pt. Total sea lions	Sucia Island E.j.
1974				
2 July	0	0	0	*
16	0	0	0	*
30	0	0	0	*
13 Aug	0	0	0	*
27	0	0	0	NO
10 Sept	0	0	0	*
24	0	0	0	*
8 Oct	15	0	15	*
23	0	0	0	DATA
5 Nov	20	0	20	*
19	0	0	0	*
3 Dec	5	13	18	*
17	[40]		40	*
31	24	6	30	*
1975				
14 Jan	25	15	40	*
28	3	25	28	*
25 Feb	45	25	70	*
11 Mar	7	17	24	*
25	10	60	70	*
8 Apr	14	0	14	*
22	16	0	16	*
6 May	0	0	0	*
20	3	6	9	*
3 June	1	0	1	*
17	0	0	0	*
1977				
30 Nov	0	0	0	29
8 Dec	-	-	-	32
21	4	35	39	9
1978				
26 Jan	-	-	-	0
28	0	0	0	1
24 Feb	-	-	-	0
28	0	0	0	-

TABLE 3.--Cont.

Year day/month	Location			
	Sombrio Pt.			Sucia Island
	E.j.	Z.c.	Total sea lions	E.J.
1978				
14 Mar	-	-	-	0
15	0	7	7	-
25 Apr	-	-	0	0
28	0	0	0	-
23 May	9	11	20	0
25	-	-	-	0
27 June	-	-	-	0
28	0	0	0	-
4 July	-	-	-	0
19	-	-	-	0
20	0	0	0	-
27	-	-	-	0
18 Aug	-	-	-	0
29	1	0	1	-
13 Sep	-	-	-	0
14 Oct	-	-	-	1
31	0	0	0	-

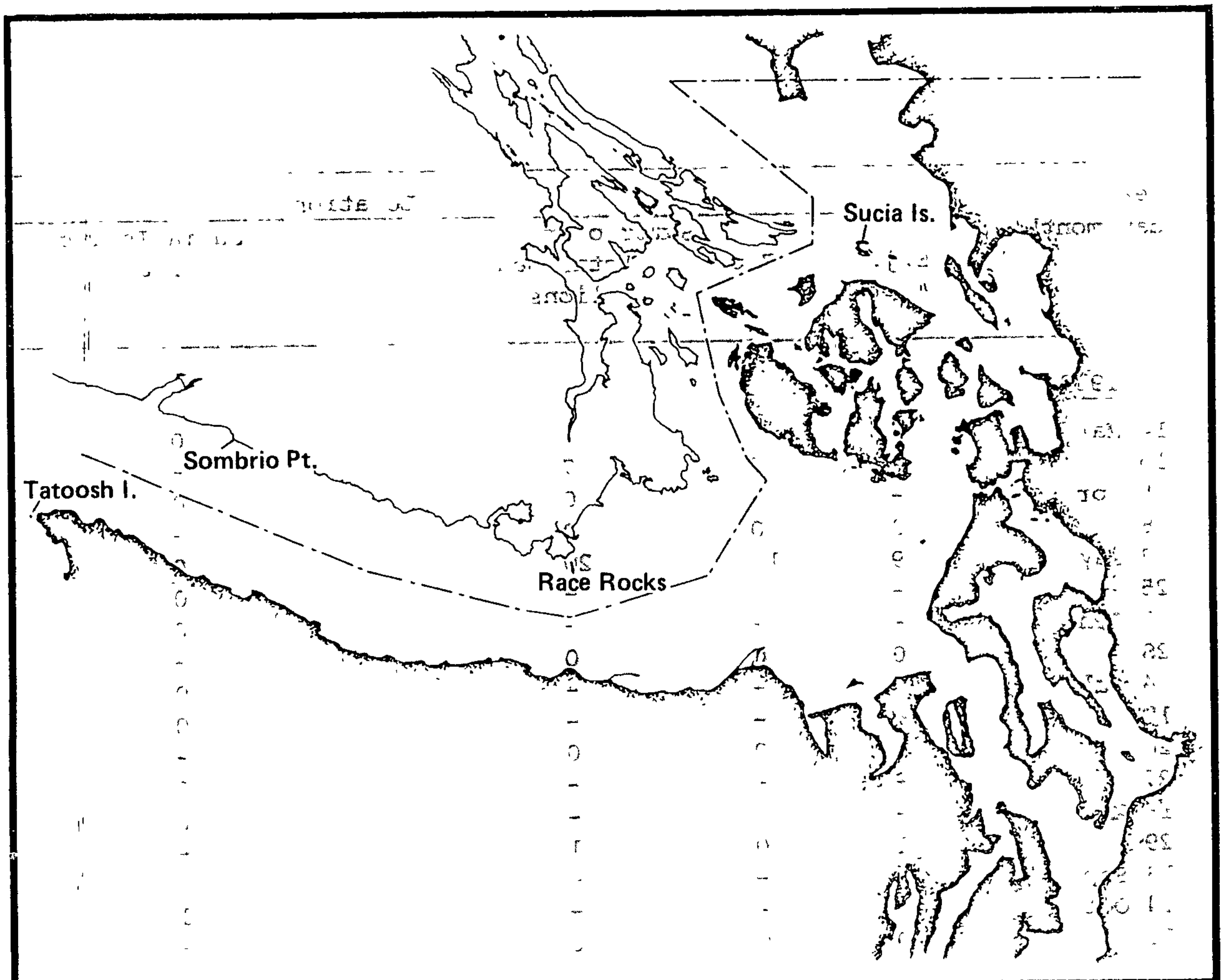


Figure 3. Location of three major (Sucia Is., Race Rocks, and Sombrio Pt.) and one minor (Tatoosh I.) haul out sites for northern sea lions (*Eumetopias jubatus*) and California sea lions (*Zalophus californianus*) in northern Puget Sound and the Strait of Juan de Fuca.

The first California sea lions hauled out in the study area were seen on 8 December 1978 when at least 41 were observed at Race Rocks among 104 northern sea lions, 26 of the 41 were positively identified and 15 only tentatively. At least 76 California sea lions were present in the study area in December, including animals observed later in the month at Sombrio Pt. This number is the greatest observed for any one month (Table 4). The total number of California sea lions then decreased through May. No animals were seen from June to September.

Table 4.--Total number of California sea lions (Zalophus californianus) by month observed hauled out at all areas in the inland waters of Washington, November, 1977 to October, 1978. Numbers observed include both positive and tentative identifications and are summarized from Tables 2 and 3.

Date	Number Observed	Date	Number Observed
1977			
November	0	April	40
December	76	May	15
		June	0
1978		July	0
January	29	August	0
February	5	September	0
March	51	October	2

During the 1974-75 surveys the peak number of Zalophus occurred in March (total = 155), the first animals appeared in December and left the area by June. Bigg (1973) observed maximum numbers for the inside waters during December 1972 (total = 68). While we observed fewer animals than in 1975, we were consistent with Bigg's finding. The timing of arrival and departure from the study area agreed closely with previous work. Fluctuating environmental conditions such as yearly variation in food supply may account for the differences in total number of animals moving north (Mate 1977).

We regularly saw California sea lions throughout the study area in the water in winter and spring months. A year around watch was kept from shore by the Moclips Cetological Society in Andrews Bay (west side of San Juan Island).

Zalophus were observed in the bay from December 1977 through April of 1978 (R. Osborne pers. commun. Sept. 1978), and on 18 January 1978 one animal hauled out on a reef in the bay and on 3 April 1978 two animals hauled out on the same reef. This indicates that individual animals will occasionally come ashore outside of established hauling areas.

A record of an adult male California sea lion on the east side of Whidbey Island hauled out on Belles Beach in May 1975 (MMD files) suggest they do occasionally occur in protected waters and may be sighted in southern Puget Sound, though we presently have not reports south of Elliot Bay.

Ecological Problems

Other than man, the only known predators of California sea lions are killer whales and sharks (Heller, 1904; Rice, 1968) though the effect of this predation on the population is not known.

Premature pupping in this species has been associated with high level organochlorine residues in tissue samples (DeLong et al., 1973). Since no breeding occurs north of California, this problem will not be evident in Washington waters.

Brownell and LeBoeuf (1971) reported on the effects of the 1969 Santa Barbara oil blowout on pup mortality. No conclusive evidence could be found to indicate that oil contributed greatly to mortality, though they could not exclude the possibility.

Conflict between this species and commercial fishermen is common. Mike Pitherick (pers. commun. Feb. 1978), a fisherman from Port Townsend, believes that damage to gill nets caused by "sea lions" is not uncommon. The extent of this problem in Washington is as yet unknown

III-A-1-c. Northern sea lion (Eumetopias jubatus)

Species Distribution

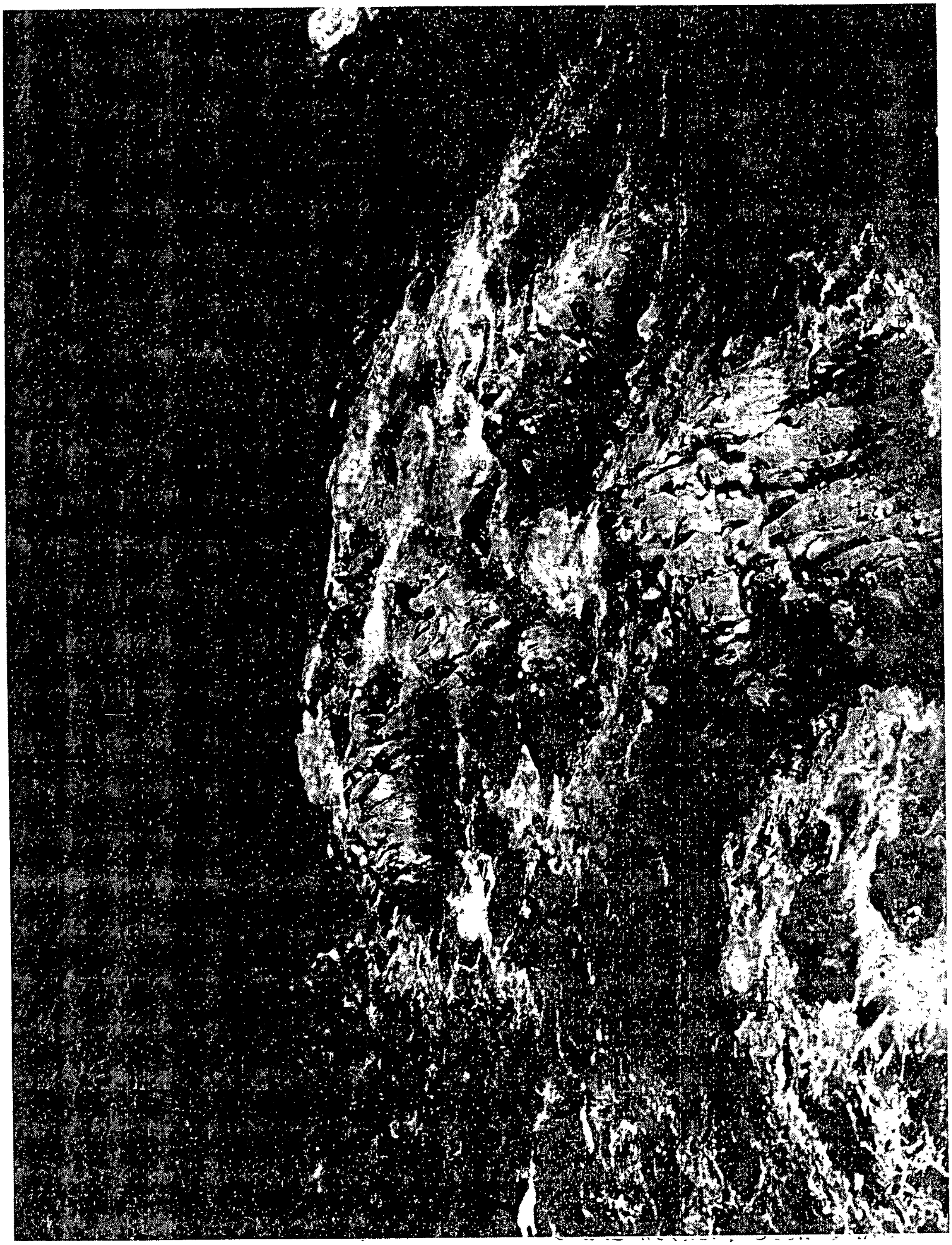
The northern (Steller) sea lion is the largest member of the family Otariidae. It can be quickly distinguished from California sea lions by size alone, although some difficulty may be experienced when separating the two species from aerial photographs. If the photograph is less than ideal and/or the posturing of the animal is not obvious some questions arise between large male Zalophus and smaller Eumetopias (young males or females) (Figure 4). Adult male Eumetopias weigh up to 1,000 kg and reach 3.2 m in length, adult females are considerably smaller weighing over 275 kg and reaching 2.19 m in length (Gentry and Withrow 1978). Pelage color is tan to light brown when dry. Males have darker coloration about the neck and chest. In the water they appear very light, almost white.

Eumetopias breed throughout its range. the southernmost breeding colony is located on San Miguel Island, California (Rice 1977). In 1977, only four adult females and two adult males comprised the breeding population on San Miguel (Antonelis and Fiscus 1978). Larger rookeries are found further north with most breeding taking place in Alaska. Breeding lasts from mid-May to mid-July. The adult males are the first to arrive on the rookeries and immediately establish territories. Shortly thereafter females arrive and within a few days give birth to single pup. Females are bred by a territorial male within two weeks after parturition.

Eumetopias exploit a wide variety of prey items which vary with season and location (Spaulding 1964). No data is currently available from the inland waters of Washington. Fiscus and Baines (1966) in a study of Eumetopias stomach contents collected from California, Oregon and Alaska indicated that this species may not prey on commercially important fishes to any significant degree. Spaulding (1964) presents evidence that the impact of Eumetopias on commercial fish populations is negligible.

Abundance and Distribution

Eumetopias ranges as far north as St. Lawrence Island in the Bering Sea, in the Okhotsk Sea, and along the west coast of North America south to San Miguel Island (lat. 34^{o}N). During the breeding season most of the population occurs in the Aleutian Islands and Gulf of Alaska (Mate, 1976). A northward movement of males from California occurs at the end of the breeding season followed later in the year by females and immatures (Mate, 1976). Both sexes occur in Washington waters but no breeding activity takes place here (Kenyon and Scheffer 1959).



Kenyon and Rice (1961) estimated the world population of Eumetopias between 240,000 - 300,000 individuals. No other world estimates have been presented since. The population off the California coast has experienced a decline from earlier published accounts and now numbers about 2,200 animals (Antonelis and Fiscus, 1978). Pearson and Verts (1970) estimated the Oregon population at about 1,000. Mate (1973) reported six breeding and hauling areas in Oregon and gave population estimates for two of these areas at over 1,000 animals. A total population estimate for Oregon is placed at about 2,000 (Mate, 1975).

Kenyon and Scheffer (1959) reported the results of aerial surveys along the Washington outer coast and north coast of the Olympic Peninsula. They stated that the Washington population of northern sea lions does not exceed 500 animals. Pike and Maxwell (1958) reported 11,000 - 12,000 northern sea lions in British Columbia with the southernmost breeding rookeries located in the Scott Islands (north of Vancouver Island). A concentrated effort to reduce Eumetopias was conducted in these waters in the 1960's and recent abundance was estimated to be about 4,000 during the breeding season (Pike and MacAskie, 1969). These animals congregate at a few breeding rookeries in the summer and spread out along the coast of British Columbia in the winter. Smith (1972) estimated that over 1,900 Eumetopias winter off the west coast of Vancouver Island.

No breeding occurs in the inland waters of Washington, and only four hauling areas are known, (Figure 3). Two of these areas are along the southern coast of Vancouver Island, where animals have been reported to haul out in large numbers at Race Rocks and Sombrio Pt. (Smith, 1972; Bigg, 1973). This species was first reported utilizing rocks on the north side of Sucia Island in 1973 (R. Peterson pers. commun. to C.H. Fiscus, 1973). Occasionally a few Eumetopias are seen hauled out on Tatoosh Island (Kenyon and Scheffer, 1959; present study).

Smith (1972) reported no more than 160 Eumetopias at Race Rocks and Sombrio Pt. in November of 1970. During aerial and land surveys for Zalophus californianus in inland waters Bigg (1973) also reported the occurrence of Eumetopias. He surveyed from June 1971 to February 1972 and examined coastal areas of Vancouver Island as well as inland areas. On 6 December 1972 he reported 35 Eumetopias on Race Rocks and 16 on Sombrio Pt. The number at Race Rocks increased to 71 by February, none were observed at Sombrio

Pt. Bigg did not survey in the early spring, but in June 1971 no Eumetopias were observed at these two sites. The maximum number observed including the southwest coast of Vancouver Island was over 900 animals in December.

During aerial surveys in Washington conducted by the Marine Mammal Division, NWAFC, Seattle, Washington from 1974 to 1975 Race Rocks and Sombrio Pt. were examined (Table 2 and 3). Sucia Island was occasionally surveyed but no Eumetopias were observed there. No Eumetopias were observed in the Strait of Juan de Fuca or northern Puget Sound from June through September during these surveys. The first observations were made in the fall on 8 October 1974 of 15 animals at Sombrio Pt. The numbers increased to a maximum of 103 animals 25 February 1975 and then began to decline. By the end of May only 4 animals were reported.

During the present study all potential haulout sites were surveyed monthly, except for Race Rocks in November. Our survey did not include the west coast of Vancouver Island or Canadian waters north of Victoria. The results of these surveys are included in Tables 2 and 3.

The first northern sea lions observed in the study area were seen on 30 November 1977 at Sucia Island. Twenty-nine animals were hauled out on rocks on the north side of the island. The first time Race Rocks were surveyed, 8 December 1977, 104 Eumetopias were counted; 4 were seen on Sombrio Pt. on 21 December 1977. The total number of northern sea lions in the study area remained between 150-200 animals from December through March. The highest count was taken in April of 259 animals. This was followed by a rapid decrease in May and by June no Eumetopias were observed in the study area. They reappeared in September (total = 59) and rapidly increased to 188 by the end of October (Table 5).

Table 5.--Total number of northern sea lions (*Eumetopias jubatus*) by month observed hauled out at all areas in the inland waters of Washington, November, 1977 to October, 1978. Data are summarized from Tables 2 and 3.

Date	Number Observed	Date	Number Observed
1977			
November	29	April	259
December	197	May	11
		June	0
1978		July	0
January	196	August	0
February	155	September	59
March	194	October	188

During the 1974 to 1975 aerial surveys peak numbers of northern sea lions were seen in January (total = 145) and gradually decreased through May. They were first observed in the fall by October during this study. Bigg (1973) data were not as complete but did show this species present in the inland waters in December and February and absent in June. From these data it is apparent that *Eumetopias* begin to arrive at hauling areas in the Strait of Juan de Fuca in the early fall (September-October), are present in maximum numbers by late winter and early spring, and then rapidly leave the area in late spring for breeding rookeries north along the British Columbia coast or south to Oregon.

We regularly observed *Eumetopias* in the water throughout the study area during winter and spring months. They were observed in the water near Tatoosh Island on five occasions, although we saw them haul out there only twice (Table 6). Middle Channel (near Cattle Pt., San Juan Island) was another common location where this species was observed. Since the possibility that animals observed in the water may later be counted on land and included in total estimates cannot be discounted, the data in Table 6 are not included in total population estimates for this species.

Table 6.--Pelagic observations of northern sea lions (Eumetopias jubatus) in the water in northern Puget Sound and the Strait of Juan de Fuca from November, 1977 to October, 1978.

Date Mo/Day/Yr	Number Observed	Location
11/30/77	10	Patos I.
12/21 77	10	Waadah I.
1/28/78	9	Tatoosh I.
3/15/78	4	Whale Rks.
4/25/78	1	Mummy Rks.
4/25/78	9	Whale Rks.
4/25/78	3	Trial I.
4/25/78	1	Dungeness Spit
4/28/78	8	Tatoosh I.
9/12/78	1*	Tatoosh I.
9/12/78	8	Tatoosh I.
10/03/78	6*	Tatoosh I.

* hauled out

We observed animals in the water through April, but not again until September coinciding with the decreased abundance in the area during late spring and summer. During a watch kept from shore in Andrews Bay, San Juan Island by the Moclips Cetalogical Society. Eumetopias were seldom recorded. Of the 57 data recordings made, only five (9%) were of this species (R.W. Osborne pers. commun.). These observations made from January to April, 1978. While certainly not conclusive, this may indicate limited use of Haro Strait by this species.

Reports of Eumetopias in southern Puget Sound are not uncommon. Animals have been known to use floats and small boats to haul out on. At this time we do not know how far south into the Sound they occur although it seems likely that in the winter when northern sea lions are at peak abundance in Washington, they could occur in any of the protected waters.

Ecological Problems

Northern sea lions are known to have damaged fishing gear including halibut longline, purse seine, gillnet, and troll fisheries. Damage to fish is also known and they may also destroy crab pot buoys. An unknown level of mortality is a result of shooting by fishermen.

The Alaska Department of Fish and Game (1973) estimates over 200,000 *Eumetopias* in that state which may be at a near carrying capacity. Braham et al., (1978) have documented a 50% decline in population in the eastern Aleutian Islands, an area where large and important breeding rookeries are located. Since the population in the western Aleutian Islands has not been surveyed recently the true status of this species in Alaska is in doubt.

III-A-1-d. Northern Fur Seal (*Callorhinus ursinus*)

Species Description

This species is commercially valuable for its fur and as a result a great deal of research and management efforts have been expended on it. With the signing of the North Pacific Fur Seal Treaty of 1911 a concerted conservation and management program was begun for this species. This treaty between the United States, Great Britain, Russia, and Japan was abrogated in 1941 and replaced in 1957 by the Interim Convention which included the same four governments. The Interim Convention called for cooperative research and harvest between member nations. Pelagic sealing which is most detrimental to the population since pregnant females are taken indiscriminately, was banned in 1911 although a provision of the treaty allowed aboriginal hunting by traditional means. Native Indians took seals off Washington, British Columbia, and Southeast Alaska. An estimated 50,000 fur seals were taken by aborigines in British Columbia from 1912-1940 of which approximately 85% of the annual take was from the west coast of Vancouver Island (Pike and MacAskie, 1969). During the 29-year period from 1913 to 1941 over 12,000 fur seals were taken by subsistence Indian hunters in Washington waters of which 58% were females (Table 7). These animals were taken between the months of January through June, primarily from native boats out of Neah Bay, Washington. Fur seals have also been taken pelagically under the auspices of the 1957 treaty by member nations for both commercial and scientific purposes. On the breeding islands 48,000 males have been commercially harvested from 1956-1972.

Callorhinus adult males in prime condition weigh 140-280 kg and measure 2.5 m in length. Females are

Table 7.--Yearly take of northern fur seals (*Callorhinus ursinus*) by native Indians in Washington waters from 1913 to 1941. Dashed lines (-) indicate missing data.

Year	Male	Female	Total Take
1913	1	90	91
1914	2	12	14
1915	-	-	-
1916	66	313	379
1917	209	304	513
1918	251	142	393
1919	251	303	554
1920	656	630	1,286
1921	-	-	567
1922	641	462	1,103
1923	271	569	840
1924	606	423	1,029
1925	823	883	1,706
1926	291	715	1,006
1927	95	178	273
1928	252	456	799
1929	166	421	587
1930	131	319	450
1931	24	141	165
1932	26	47	73
1933	23	18	41
1934	6	17	23
1935	10	70	80
1936	2	26	28
1937	10	35	45
1938	4	88	92
1939	-	-	30
1940	2	26	28
1941	1	20	21
Total	4,820	6,708	12,216

Sources: Alaska Fisheries and Fur Industries, Bureau of Fisheries. Documents.

considerably smaller weighing 30 to 50 kg and are as long as 1.7 m. Males arrive on the breeding grounds in early May, followed shortly thereafter by females. Females give birth to a single pup within three days of their arrival and breed with a dominant male within the following week. Females nurse pups for two days then leave them for about 8 days while feeding offshore. Females leave the breeding islands in August and September after weaning their pups to assume a pelagic existence through the winter. Most animals have left the breeding areas by December.

A large amount of data has been accumulated describing food habits by age, sex, location, and season. A joint data analysis effort is currently underway between American and Canadian scientists to combine this information. Stomach contents from seals taken in coatal Washington waters contained walleye pollock, shad, rockfish, Pacific herring, northern anchovy, capelin and salmonids (Wilke and Kenyon, 1954; Fiscus and Kijimua, 1971). Animals taken off the entrance of the Strait of Juan de Fuca had stomachs which contained primarily herring (Fiscus and Kajimura, 1971).

Abundance and Distribution

Most of the population of northern fur seals is found on the breeding grounds from mid-June through early November. Breeding rookeries are found at San Miguel Island, California; the Pribilof and Commander Islands in the Bering Sea; the Kuril Islands and the Robben Islands in the Okhotsk Sea (Rice, 1977). In other months fur seals maintain a pelagic existence along the continental shelf from the Bering Sea and south along both sides of the North Pacific to about lat 32°N. Adult males remain in the northern portion of the range with females and immatures occupying all areas.

After years of intensive harvesting only about 200,000-300,000 fur seals survived on the Pribilof Island (the largest breeding rookery) by the beginning of the nineteenth century. Management controls over the years has returned this stock to near optimum levels. A recent population estimate of the breeding rookeries was in excess of 1.7 million animals: Pribilof Islands, 1,300,000; San Miguel Island, 2,000; Commander Islands, 254,000; Robben Island, 165,000; and the Kuril Islands 33,000 (Johnson, 1972).

Pelagic research conducted by the United States from 1958 to 1974 periodically centered efforts off the Washington coast. Seals were commonly encountered and collected offshore. Only two observations of *Callorhinus* were made in the Strait of Juan de Fuca. Three animals were sighted and two collected in March 1961, 11 miles northeast of Slip Pt. (lat 48°20'; long 124°10') (Fiscus et al., 1961). In 1958, two tagged yearling were found in Puget Sound, one in February and one in March. In 1959, a tagged yearling was found near Port Townsend, WA. Two tagged yearlings were found near Neah Bay in 1959 (Niggol et al., 1959). A few seals, mostly yearlings, venture into the Strait of Juan de Fuca and Puget Sound waters every year. Most sightings occur during January to March. A recent observation was made of a single animal in Haro Strait on 26 January 1978 (R.W. Osborne, pers. commun.).

Ecological Problems

Entanglement of fur seals in discarded or lost net scraps is a problem that results in some mortality. Attempts to educate commercial fishermen have been implemented by the North Pacific Fur Seal Commission to reduce the amounts of netting discarded into the sea.

Increased use of the Bering Sea by commercial fishery interests may compete directly with *Callorhinus* for some prey species. The extent of this competition is not yet known.

Callorhinus rely on their dense fur for insulation from cold marine waters. Oiling of this fur is detrimental to the health of individual animals and may result in their death (Kooyman et al., 1976). Kenyon (1971) suspects that *Callorhinus* which become accidentally oiled at sea do not survive to return to the breeding rookery. Major oil catastrophes in areas where this species is abundant could adversely affect the population.

III-A-1-e. Harbor Seal (*Phoca vitulina richardsi*)

Species Description

The Pacific harbor seal (*Phoca vitulina richardsi*) is the most abundant marine mammal found in Washington waters (Figure 5) (Scheffer and Slipp, 1944). Four subspecies of *P. vitulina* are recognized (Rice, 1977). These subspecies are separataed by geographical distribution and some morphological characters. *P. v. richardsi* occurs in the eastern North Pacific Ocean, *P. v. vitulina* inhabits both sides of the Atlantic, *P. v. kurilensis* is found in the western North Pacific, and *P. v. mellonae* is restricted to the Seal Lakes in northwestern Canada.

Sexes of *P. v. richardsi* are indistinguishable on the basis of size. Lengths of adults are 1.25 m to 1.88 maximum; weight may reach 600 kg (King, 1964). Pelage varies in color from almost completely black to entirely light gray. The most commonly occurring coloration is gray with dark spots on the back and sides (Stutz, 1966a).

During the present study we were able to collect more new data on this species than any other marine mammal. To facilitate the discussion of harbor seals in the study area a departure from the species account format used elsewhere in this report will be made. Specific topics will be considered separately utilizing literature sources and new data including: food habits, reproduction, abundance, distribution and ecological problems.

Food Habits

Analysis of otoliths contained in harbor seal scats to describe prey species was first described in an undergraduate study at Oregon State University, Corvallis, Oregon (Drager, 1977). A more thorough treatment of this technique was applied recently in Puget Sound by a research group from The Evergreen State College, Olympia, Washington (Calambokidis et al., 1978). During the present study scats were collected opportunistically at Protection Island. Few samples have been taken to date (eight) and no attempt was made at analysis this year. Collections will continue through 1978.

Figure 5. Pacific harbor seals at Protection Island.

Scheffer (1931) reported some of the first stomach content data from harbor seals in Washington. Of the 100 stomachs reported over 90% of the contents were fishes, including Pacific tomcod, flounder, herring, sculpin, hake, cod, pollack and perch. Squid and octopus comprised less than 6%. Trace amounts of shrimp were also present. Only two of the full stomachs held any salmon and 19 of the stomachs were empty.

Fisher (1952) reported the food habits of harbor seals collected in British Columbia. The important prey items reported were rockfish, octopus, and herring. Salmon comprosed the largest percentage of total volume of stomach contents. Fisher suggests that harbor seals are opportunistic feeders and prey most heavily on seasonally abundant species. Spalding (1964) compared the feeding habits of the pinnipeds along the coast of British Columbia and found a preference for prey items similar to those found by Fisher. His sampling throughout the year indicated eulachon to be the most important prey item in the winter. Herring and rockfish comprised most of the volume collected in summer. Salmon appeared most important during the fall. Spalding (1964) estimated that the predation on salmon by harbor seals was insignificant to the commercial catch.

Studies in areas outside of Washington show major food items to include pollack, herring, cottids, mackerel, and molluscs (Imler and Sarber, 1947; Wilke, 1954; Kenyon, 1965; Pitcher, 1977). Juvenile harbor seals appear to prey on smaller fishes than adults (Pitcher, 1977). Size of prey taken increases with increasing size in the harbor seal (Spalding, 1964).

Reproduction

In the Pacific harbor seal the pupping period occurs progressively later southward from Alaska to Puget Sound and earlier from the Washington coast to the southern extent of the range (Bigg, 1969a). Scheffer and Slipp (1944) established that on the outer coast pupping begins in May. They suggested that this season begins one or two months later in Puget Sound. Newby (1973) described three distinct pupping periods in Washington waters. His conclusions based on personal observations, interviews, and the literature put the coastal season to occur during May; northern Puget Sound from late July through August; and in southern Puget Sound from mid-August to late September. The period for southern Puget Sound was based on the large population found on Gertrude Island and was later confirmed by Johnson and Jeffries (1977).

Calambokidis et al., (1978) reported similar pupping periods for Puget Sound, by mid-June at Smith Island and by early July in the San Juan Islands. Pups were first observed in early August in Hood Canal and southern Puget Sound. New pups were observed on the Skokomish Delta in Hood Canal from August until the end of the study period in November 1978. The reason for ths protracted pupping was not known.

Bigg (1969a) speculates that the range of pupping periods for harbor seals may be in response to seasonal variation in food resources. Local populations may have evolved in response to these differences. Bigg and Fisher (1975) show that photoperiod may be the proximate factor stimulating timing in harbor seals based on studies of captive animals. Boulva (1975) found the reproductive cycle to be fairly constant and attributed yearly differences in exact timing of births as being controlled by air and water temperatures.

During the present study the northern Puget Sound area was examined for pups. Pups were first observed in the study area on 27 June 1978 at Minor Island. Peak pupping was observed in the month of August; 143 pups were counted that month. The pupping season lasted 11 weeks with the last obvious pups seen on 13 September. Regular surveys were made along the coastline in the western Strait of Juan de Fuca but few pups were observed there. Thirty-nine sites were observed with pups (Table 8), of these 24 (62%) are protected as wildlife refuges either in the San Juan Wilderness Area or Dungeness Wildlife Refuge. These areas are administrated by the Nisqually Wildlife System, U.S. Fish and Wildlife Service, Olympia, Washington. The most important pupping area in northern Puget Sound is Smith-Minor Islands, which is part of the refuge system. A high count of 44 pups was made there on 27 July 1978. This represents 23.7% of all pups. The entire refuge system accounted for 61.3% of the pups counted in 1978. These protected areas will prove to be important sanctuaries to the harbor seal population in years to come.

Table 8 lists the percentage of pups for each hauling area where pups were observed. Certainly some pups went unobserved or may have been mistaken as immatures and included in the total count of each area. Therefore, an

TABLE 8.-- Observations of pups in northern Puget Sound and the Strait of Juan de Fuca by month from June to September 1978. Pup counts and total number of animals are the highest for the survey period. Total number of animals include adults and immatures but not pups. Percentage of pups to total animals is given.

Map reference	Location	Pup count	Total animals	%
	San Juan Wilderness Area[1/]			
9	Unnamed I	2	9	.22
24	Harbor Rk	1	2	.5
26	Halftide Rk	2	32	.06
32	Sentinel Rk	4	34	.12
35	Ripple I	5	87	.06
37	L. Cactus I.	3	20	.15
42	Skipjack I.	5	58	.09
43	Unnamed I.	2	28	.07
49	Unnamed Islet	1	4	.25
50	Tift Rks	1	7	.14
54	Flower I.	1	10	.10
57	Pointer I.	2	7	.29
62	S. Peapod Rk	1	17	.06
63	Peapod Rks	4	57	.07
64	N. Peapod Rk.	1	4	.25
65	Eliza Rk	1	6	.17
74	Unnamed Rks.	7	57	.12
76	Minor I.	44	206	.21
78	Puffin I.	5	91	.05
80	Bird Rocks	8	112	.07
81	Williamson Rk	2	4	.50
83	Buck I.	1	13	.08
84	Bare I	4	51	.08
	Northern Puget Sound[2/]			
C	Samish Bay	6	49	.12
D	Padilla Bay	7	70	.10
G	Sinclair I	1	3	.33
H	Boulder Reef	4	27	.15
I	Pt. Migley	7	74	.09
K	Barnes I	3	28	.11
L	Echo Bay	8	40	.20
M	Sentinel I	1	1	1.0
O	Twin Rks	2	16	.13
R	Bell I	1	1	1.0
S	Leo Reef	1	9	.11
T	Pear Pt	2	15	.13
V	Whale Rk	2	16	.13
W	Protection I	19	113	.17
X	Marrowstone I.	1	11	.09
	Olympic Peninsula[2/]			
2	Kulakala Pt.	2	20	.10
3	Dungeness Refuge	8	54	.15
4	Green Pt	1	1	1.0
	Vancouver I [2/]			
10	Chain I.	1	135	01
12	Race Rks	2	69	03
			$\bar{x}$ = .15	S=.11

1/ Map reference refer to figure 10 .
2/ Map reference refer to figure 11 .

estimate of productivity based on visual observation in the wild is conservative. An average reproductive rate of 15% was found which is low when compared to other rates in the literature. Venables and Venables (1955) reported a 22% reproductive rate for *Phoca vitulina vitulina* in Shetland. Bishop (1967) reported 32% of the harbor seals on Tudigak Island, Gulf of Alaska bore pups. Bigg (1969b) found 88% of mature females pregnant in a population of 53% females indicating a birth rate of 26% for harbor seals of British Columbia. Boulva (1975) reported 20.5% productivity for animals in Nova Scotia. Pitcher, 1977 found a reproductive rate of 18.8% for harbor seals in the Copper River Delta, Alaska and speculated that Bishop's figure may be high due to sampling bias. Calambokidas et al. (1978) found 15-19% pups in northern Puget Sound in the summer of 1977. Thus the literature suggests birth rates from 18-32%. It seems likely that the low rates observed in the present study may be attributed to difficulty in assessing this population parameter using only visual observations from aerial surveys, although a 95% confidence interval for the present data provides an upper limit of reproduction at 18.4%.

Distribution

The Pacific harbor seal ranges in the eastern North Pacific from Baja California north and west to the Aleutian Islands (Rice, 1977). Harbor seals are common in estuaries, coastal waters, and inland waters throughout its range. While primarily a near shore species observations of single animals have been reported up to 50 km from shore (Calkins et al., 1975). During the present study 50 haulout sites were observed in northern Puget Sound and the Strait of Juan de Fuca (Figure 6). Fifteen of these sites were observed in the Strait of Juan de Fuca; three are found in Admiralty Inlet; six in Skagit, Padilla, Samish, and Bellingham Bays; and the remainder (26) are located in the San Juan Islands, Haro and Rosario Straits. These 50 areas are used consistently by harbor seals. Occasionally animals would be observed in other areas but with no predictability. Tables 9-14 list all areas where harbor seals were observed during aerial surveys. No new haulout areas were found during small boat surveys and we did not survey in Canadian waters north of Victoria. Aerial surveys in Canada conducted by the Marine Mammal Division, NWAFC, from 1974-75 identified a minimum of ten hauling sites in the Strait of Georgia and one other in Haro Strait that was not surveyed in the present study (Table 15).

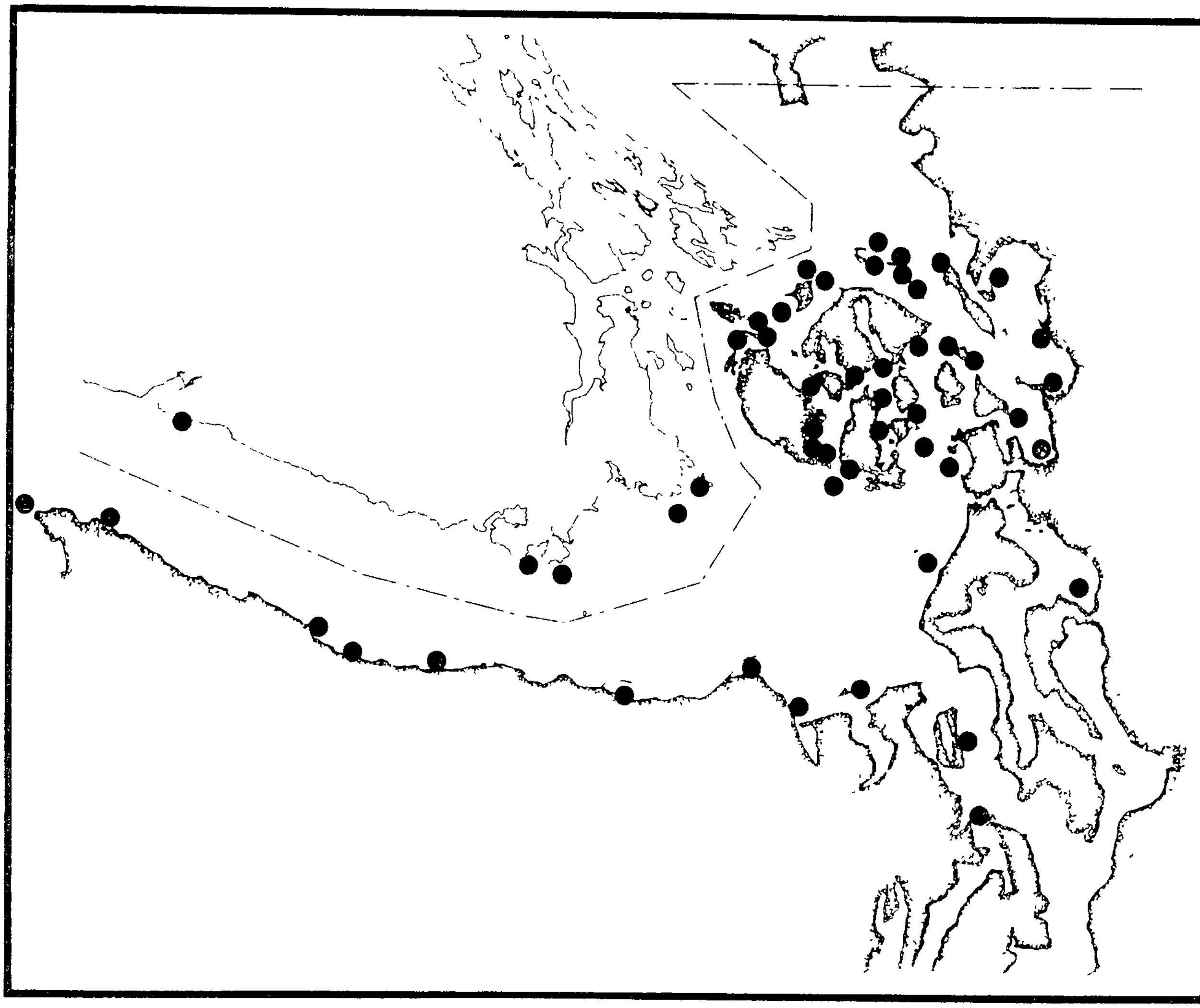


Figure 6. Distribution of locations of all haul out sites for harbor seals (Phoca vitulina richardsi) in northern Puget Sound and the Strait of Juan de Fuca.

TABLE 9.--Aerial survey counts of harbor seals taken from November 1977 to May 1978 for the San Juan Wilderness Area. Dashed lines (-) indicate the area was not surveyed; zeros (0) mean no animals were present; map reference numbers refer to Figure 10. These numbers refer to the Federal Register: Vol. 40, No. 172, September 4, 1975, and Vol. 41, No. 147, July 29, 1976.

Map Reference Number	1977			1978								
	Nov 30	Dec 8	Dec 21	Jan 26	Jan 28	Feb 9	Feb 24	Mar 14	Mar 15	Apr 25	May 23	May 25
1. Small I.	-	0	-	-	-	-	0	0			-	0
2. Unnamed I.	-	0	-	-	-	-	0	0	-	-	-	0
3. Fortress I.	-	0	-	-	-	-	0	0	-	-	-	0
4. Skull I.	-	1	-	-	-	-	0	-	-	-	-	0
5. Crab I.	-	0	-	-	-	-	0	0	-	-	-	0
6. Boulder Is.	-	0	-	-	-	-	0	0	-	0	-	0
7. Davidson Rk.	0	0	0	0	-	-	0	0	-	0	-	0
8. Castle I.	0	-	0	0	-	0	0	0	-	0	-	0
9. Unnamed I.	0	-	0	0	-	0	0	0	-	0	-	0
10. Aleck Rks.	0	-	0	0	-	0	0	0	-	0	-	0
11. Swirl I.	0	-	0	0	-	0	0	0	-	0	-	0
12. Unnamed Rk.	0	-	0	0	-	0	0	0	-	0	-	0
13. Unnamed Is.	0	-	0	0	-	0	0	0	-	0	-	0
14. Unnamed Is.	-	-	0	1	-	0	0	0	-	0	-	0
15. Hall I.	0	-	0	0	-	0	0	0	-	0	-	0
16. Unnamed I.	0	-	0	0	-	0	0	0	-	0	-	0
17. Secar Rk.	0	-	0	0	-	0	0	0	-	0	-	0
18. Round Rk.	0	-	0	0	-	0	0	0	-	0	-	0
19. Unnamed Is.	0	-	0	0	-	0	0	0	-	0	-	0
20. Unnamed Is.	0	-	0	0	-	0	0	0	-	0	-	0
21. Mummy Rk.	0	-	13	15	-	0	0	0	-	0	-	0
22. Islets & Rks.	0	-	0	0	-	0	0	0	-	0	-	0
23. Shark Reef	-	-	0	0	-	0	0	0	-	0	-	0
24. Harbor Rk	-	-	0	-	-	-		0	-	-	-	0
25. N. Pacific Rk	-	-	0	-	-	-	-	0	-	-	-	0
26. Halftide Rk.	-	-	0	-	-	-	-	0	-		-	26
27. Unnamed Is	-	-	0	-	-	-		-	-	-	-	-
28. Low I.	-	-	0	-		-			-	-	-	-

TABLE 9.--Continued.

Map Reference Number	1977 Nov 30	Dec 8	Dec 21	1978 Jan 26	Jan 28	Feb 9	Feb 24	Mar 14	Mar 15	Apr 25	May 23	May 25
29. Pole I.	0	-	0	-	-	-	-	-	-	-	-	-
30. Barren I.	0	-	0	-	-	-	0	0	-	0	-	-
31. Battleship I.	0	-	0	-	-	-	0	0	-	0	-	-
32. Sentinel Rk.	0	-	0	0	-	-	13	35	-	23	-	34
33. Center Reef	0	-	0	0	-	-	0	0	-	0	-	0
34. Gull Reef	0	-	0	0	-	-	0	0	-	0	-	0
35 Ripple I.	0	-	0	20	-	-	37	38	-	124	-	35
36. Shag Reef	0	-	0	0	-		0	0	-	0	-	0
37. L. Cactus I.	17	-	19	0	-	-	7	18	-	0	-	0
38. Gull Rk.	0	-	-	0	-	-	0	0	-	0	-	-
39 Flattop I.	0	-	-	0	-	-	0	0	-	0	-	-
40. White Rks.	0	-	0	16	-	-	0	31		24	-	34
41. Mouatt Reef	0	-	0	-	-	-	0	0	-	0	-	0
42. Skipjak I.	0	-	0	2	-	-	0	12	-	58	-	19
43. Unnamed I.	0	-	0	0	-	-	0	0	-	0	-	0
44. Clements Reef	0	0	0	0	0	-	0	0	-	0	0	0
45. Unnamed I.	1	33	45	51	0	-	25	68		51	56	60
46. Parker Reef	-	-	-	-	-	-	0	-	-	-	-	-
47. The Sisters	0	0	0	0	0	-	0	0	-	0	0	0
48. L. Sister	0	0	0	0	0	-	0	0	-	0	0	0
49. Unnamed Islet	-	0	0	-	-	-	0	0		0	-	0
50. Tift Rks.	-	16	1	-	-	-	8	-	-	21	-	22
51. Unnamed Rk.	-	-	0	0	-	-	0	-	-	0	-	0
52. Turn Rk.	-	-	1	-	-	-	-	-	-	0	-	0
53. Shag Rk.	-	-	-	-		-	0	-	-	0	-	0
54. Flower I.	0	0	-	-	-	-	0	0		-	0	0
55. Willow I	0	0	-	-	-	-	0	0	-	-	0	0
56. Lawson Rk.	0	0	0	-	-	-	0	0	-	0	0	0
57. Pointer I.	0	0	0	-	-	-	0	0	-	0	0	0

TABLE 9.--Continued.

Map Reference Number	1977 Nov 30	1977 Dec 8	1977 Dec 21	1978 Jan 26	1978 Jan 28	1978 Feb 9	1978 Feb 24	1978 Mar 14	1978 Mar 15	1978 Apr 25	1978 May 23	1978 May 25
58. Black Rk.	0	0	0	-	-	-	22	9	-	0	0	0
59. Unnamed Rks.	0	-	-	-	-	-	0	0	-	0	0	0
60. Brown Rks.	-	-	-	-	-	-	0	0	-	-	0	0
61. Unnamed Rk.	-	-	-	-	-	-	-	0	-	-	0	0
62. S. Peapod Rk.	0	0	0	0	0	-	0		-	0	0	0
63. Peapod Rks.	0	25	0	23	0	-	0	17	-	29	2	0
64. N. Peapod Rk.	0	0	0	0	0	-	0	0	-	0	0	0
65. Eliza Rk.	-	0	-	-	0	-	0	4	-	0	0	0
66. Viti Rk.	-	0	-	-	-	-	0	0	-	1	-	0
67. Dot I.	-	0	-	-	0	-	0	0	-	0	-	0
68. Unnamed Rk.	-	-	0	0	-	-	-	0	-	0	-	0
69. Unnamed I.	-	-	0	0	-	-	-	0	-	0	-	0
70. Low I.	-	0	0	0	-	-	-	0	-	0	-	0
71. Nob I.	-	0	0	0	-	-	0	0	-	0	-	0
72. Unnamed I.	-	0	0	0	-	-	0	0	-	0	-	0
73. Unnamed I.	-	0	0	0	-		-	0		0	-	0
74. Unnamed Rks.	-	-	7	-	-	0	-	-	-	-	-	25
75. Smith I.	0	0	0	0	0	0	0	0	0	0	25	25
76. Minor I.	50	164	125	57	165	29	257	89	116	74	0	0
77. Matia I.	0	26	32	24	3	-	0	9	-	24	19	29
78. Puffin I.	0	0	0	0	0	-	0	0		9	0	43
79. Turn I.	-	-	1	-	-	-	-	0	-	0	-	0
80. Bird Rks.	0	9	0	15	0	-	19	22	-	28	28	20
81. Williamson Rks.	-	0	-	-	-	-	0	0	-	-	0	-
82. Colville I.	0	0	0	0	-	0	0	0	-	0	-	0
83. Buck I.	0	-	0	0	-	0	0	0	-	31	-	43
84. Bare I.	0	-	30	52	-		41	41	-	27	-	4

TABLE 10.--Aerial survey counts of harbor seals taken from June 1978 to October 1978 for the San Juan Wilderness Area. Dashed lines (-) indicate the area was not surveyed; zeros (0) mean no animals were present; map reference numbers refer to Figure 10. These numbers refer to the Federal Register: Vol. 40, No. 172, September 4, 1975, and Vol. 41, No. 147, July 29, 1976.

Map Reference Number	Jun 9	Jun 27	Jun 28	Jul 4	Jul 19	Jul 20	Jul 27	Aug 14	Aug 18	Aug 29	Sep 13	Sep 14	Oct 14	Oct 31
1. Small I.	0	0	-	-	0	-	-	6	5	-	-	0	0	-
2. Unnamed I.	0	0	-	-	0	-	-	0	0	-	-	0	0	-
3. Fortress I.	0	0	-	-	0	-	-	0	0	-	-	0	0	-
4. Skull I.	0	0	-	-	0	-	-	0	0	-	-	0	0	-
5. Crab I.	0	6	-	-	0	-	-	0	0	-	-	0	0	-
6. Boulder Is.	-	0	-	-	0	-	-	0	0	-		0	0	-
7. Davidson Rk.	0	0	-	0	0	-	0	-	0	-	-	0	0	-
8. Castle I.	0	0	-	0	0	-	0	-	0	-	-	0	0	-
9. Unnamed I.	0	0	-	0	0	-	0	-	9(2)	-	-	0	0	-
10. Aleck Rks.	0	0	-	0	0	-	0	-	0	-	-	0	0	-
11. Swirl I.	0	0	-	0	0	-	0	-	0	-	-	0	0	-
12. Unnamed Rk.	0	0	-	0	0	-	0	-	0	-		0	0	-
13. Unnamed Is.	0	0	-	0	0	-	0	-	0	-	-	0	0	-
14. Unnamed Is.	0	0	-	0	0	-	0	0	0	-	-	0	0	-
15. Hall I.	0	0	-	0	0	-	0	0	0	-	-	0	0	-
16. Unnamed I.	0	0	-	0	0	-	0	0	0	-	-	0	0	-
17. Secar Rk.	0	0	-	0	0	-	0	0	0	-	-	0	0	-
18 Round Rk.	0	0	-	0	0	-	0	0	0	-	-	0	16	-
19. Unnamed Is.	0	0	-	0	0	-	0	0	0	-	-	0	0	-
20. Unnamed Is	0	0	-	0	0	-	0	0	0	-	-	0	0	-
21. Mummy Rk.	0	0	-	0	0	-	0	7	2	-	-	0	17	-
22. Islets & Rks.	0	0	-	0	0	-	0	0	0	-	-	0	6	-
23. Shark Reef	0	0	-	0	0	-	0	0	0	-	-	0	0	-
24. Harbor Rk	0	0	-	0	2(1)	-	1	16	15	-	-	0	0	-
25. N. Pacific Rk.	0	0	-	0	0	-	0	0	0	-	-	0	0	-
26. Halftide Rk.	36	0	-	4	32(2)	-	0	13(2)	10	-	-	4	7	-
27. Unnamed Is.	-	-	-	-	-	-	-	-	-	-	-	0	0	-
28. Low I.	-	-	-	-	-	-	-	-	-	-	-	0	0	-

TABLE 10.--Continued.

Map Reference Number		Jun 9	Jun 27	Jun 28	Jul 4	Jul 19	Jul 20	Jul 27	Aug 14	Aug 18	Aug 29	Sep 13	Sep 14	Oct 14	Oct 31
29.	Pole I.	-	0	-	-	-	-	-	-	0	-	-	0	0	-
30.	Barren I.	-	0	-	-	-	-	-	-	0	-	-	0	0	-
31.	Battleship I.	-	0	-	-	-	-	-	-	0	-	-	0	0	-
32.	Sentinel Rk.	-	34(4)	-	46	36	-	2(1)	-	33(4)	-	-	14	25	-
33.	Center Reef	-	0	-	0	0	-	0	-	0	-	-	0	0	-
34.	Gull Reef	-	0	-	0	0	-	0	-	0	-	-	0	0	-
35.	Ripple I.	-	60(2)	-	13	0	-	35(2)	-	87(5)	-	-	37	25	-
36.	Shag Reef	-	0	-	0	0	-	0	-	0		-	0	0	-
37.	L. Cactus I.	-	0	-	0	0	-	0	-	20(3)	-	-	37	62	-
38.	Gull Rk.	-	-	-	-	0	-	-	-	0	-	-	-	0	-
39.	Flattop I.	-	-	-	-	0	-	-	-	0	-	-	-	0	-
40.	White Rks.	-	0	-	0	0	-	0	-	24	-	-	18	30	-
41.	Mouatt Reef	-	0	-	0	0	-	0	-	0	-	-	0	0	-
42.	Skipjak I.	-	19	-	5	11	-	58(5)	-	22	-	-	21	30	-
43.	Unnamed I.	-	0	-	0	28(2)	-	16(2)	-	0	-	-	0	16	-
44.	Clements Reef	-	0	-	0	0	-	0	-	0	-	0	-	0	-
45.	Unnamed I.	-	38	-	45	53	-	6	-	40	-	43	-	92	-
46.	Parker Reef	-	0	-	-	-	-	0	-	0	-	0	-	-	-
47.	The Sisters	-	0	-	0	0	-	0	-	0	-	0	-	0	-
48.	L. Sister	-	0	-	0	0	-	0	-	0	-	0	-	0	-
49.	Unnamed Islet	-	0	-	0	0	-	0	0	4(1)	-	-	-	0	-
50.	Tift Rks.	14	2	-	0	0	-	0	7(1)	11	-	-	-	24	-
51.	Unnamed Rk.	0	0	-	0	0	-	0	0	0	-	-	-	0	-
52.	Turn Rk.	0	0	-	0	0	-	0	0	0	-	-	-	0	-
53.	Shag Rk.	0	0	-	-	0	-	0	0	0	-	-	-	0	-
54.	Flower I.	0	0	-	-	0	-	0	15	10(1)	-	-	0	0	-
55.	Willow I.	0	0	-	-	0	-	0	0	0	-	-	0	0	-
56.	Lawson Rk.	-	0	-	0	0	-	0	0	0	-	-	0	0	-
57.	Pointer I.	-	0	-	0	1	-	0	13	7(2)	-	-	1	7	-

TABLE 10.--Continued.

Map Reference Number	Jun 9	Jun 27	Jun 28	Jul 4	Jul 19	Jul 20	Jul 27	Aug 14	Aug 18	Aug 29	Sep 13	Sep 14	Oct 14	Oct 31
58. Black Rk.	-	0	-	0	0	-	0	0	2	-	-	0	0	-
59. Unnamed Rks.	-	0	-	0	0	-	0	0	0	-	-	0	0	-
60. Brown Rks.	-	0	-	0	0	-	0	0	0	-	-	0	0	-
61. Unnamed Rk.	-	0	-	-	0	-	0	0	0	-	-	0	0	-
62. S. Peapod Rk.	-	0	-	0	0	-	2	17(1)	18	-	13	-	0	-
63. Peapod Rks.	-	17	-	0	22	-	21(1)	27(3)	20(4)	-	57(4)	-	49	-
64. N. Peapod Rk.	-	0	-	0	0	-	4(1)	0	0	-	5	-	2	-
65. Eliza Rk.	-	0	-	-	0	-	-	3	6(1)	-	16	-	22	-
66. Viti Rk.	-	0	-	-	0	-	-	-	0	-	0	-	-	-
67. Dot I.	-	0	-	-	0	-	-	0	0	-	0	-	-	-
68. Unnamed Rk.	0	0	-	0	0	-	-	0	0	-	-	0	0	-
69. Unnamed I.	0	0	-	0	0	-	0	0	0	-	-	0	0	-
70. Low I.	0	0	-	0	0	-	0	0	0	-	-	0	0	-
71. Nob I.	0	0	-	0	0	-	0	0	0	-	-	0	0	-
72. Unnamed I.	0	0	-	0	0	-	0	0	0	-	-	0	0	-
73. Unnamed I	0	0	-	0	0	-	0	0	0	-	-	0	0	-
74. Unnamed Rks.	35	39	-	0	24	-	0	44(4)	57(7)	-	-	46	63	-
75. Smith I.	15	0	0	0	0	0	0	-	0	-	-	2		0
76. Minor I.	15	64(8)	162(20)	92(20)	93(3)	71(12)	196(44)	-	206(17)	194(4)	-	0	155	145
77. Matia I.	-	0	-	0	4	-	3	-	45	-	10	-	48	-
78 Puffin I.	-	3	-	21	59(5)	-	25(7)	-	27(2)	-	91(2)	-	28	-
79. Turn I.	0	0	-	0	0	-	0	-	0	-	-	-	0	-
80. Bird Rks.	49	18	-	0	26	-	21(1)	35(2)	112(8)	-	-	19	33	-
81. Williamson Rks.	-	0	-	-	-	-	-	-	4(2)	-	-	0	0	-
82. Colville I.	0	0	-	0	0	-	0	-	0	-	-	0	0	-
83. [illegible] I.	[illegible]	[illegible]		[illegible]	[illegible]		[illegible]	5(1)	13(1)	-		0	0	-
	-	0	-	7	13	-	17(3)	-	51(4)	-	-	9	39	-

TABLE 11.--Aerial survey counts of harbor seals taken from November 1977 to May 1978. Dashed lines (-) indicate the area was not surveyed; zeros (0) mean no animals were present; map reference refers to Figure 11.

Map Reference	1977			1978										
	Nov 30	Dec 8	Dec 21	Jan 26	Jan 28	Feb 9	Feb 24	Feb 28	Mar 14	Mar 15	Apr 25	Apr 28	May 23	May 25
A. Bellingham Bay	-	-	-	10	-	-	1	-	0	-	0	-	-	0
B. Wildcat Cove	-	-	-	-	-	-	0	-	0	-	-	-	-	-
C. Samish Bay	-	-	-	0	-	-	0	-	0	-	-	-	-	-
D. Padilla Bay	0	0	0	1	0	-	0	-	11	-	38	-	-	12
E. Hat I.	0	5	0	0	0	-	0	-	0	-	0	-	-	0
F. Fidalgo Bay	-	-	-	-	-	-	-	-	-	-	-	-	-	-
G. Sinclair I. (SE)	-	7	2	12	0	-	0	-	0		0	-	-	0
H. Boulder Reef	0	5	0	5	0	-	0	-	6	-	0	-	-	14
I. Pt. Migley	-	3	-	-	-	-	-	-	0	-	-	-	-	-
J. Clark I.	0	5	0	4	3	-	0	-	0	-	0	-	0	0
K. Barnes I.	0	1	0	2	0	-	0	-	18	-	9	-	4	18
L. Echo Bay	0	0	0	5	0	-	0	-	19	-	0	-	0	0
M. Sentinel I.	0	-	0	0	-	-	0	-	0	-	0	-	-	0
N. Satellite I.	0	-	0	0	-	-	3	-	3	-	0	-	-	0
O. Twin Rocks	-	19	-	12	-	-	0	-	-	-	-	-	1	24
P. Bald Bluff	0	-	-	0	-	-	4	-	-	-	-	-	-	0
Q. Blind I.	-	-	-	0	-	-	0	-	0	-				
R. Bell I.	-	-	-	0	-	-	0	-	0	-				
S. Leo Reef	-	0	-	-	-	-	0	-	0	-	-	0	-	0
T. Pear Pt.	-	-	0	0	-	-	-	-	-		0	-	-	0
U. Deadman I.	0	-	0	1	-	2	2	-	0	-	8	-	-	0
V. Whale Rks.	0	-	1	0	-	0	0	-	0	-	0	-	-	0
W. Protection I.	100	139	183	134	131	26	155	38	75	164	149	104	37	87
X. Marrowstone I.	-	-	-	-	-	-	-	-	0		0	9	0	6
Y. Colvus Rks.	-	24	24	-	6	9	10	-	14	21	0	0	2	0
Z. Port Gamble	-	0	-	-				-		-	-	-	-	-

TABLE 12.--Aerial survey counts of harbor seals taken from June 1978 to October 1978. Dashed lines (-) indicate the area was not surveyed; zeros (0) mean no animals were present; map reference refers to Figure 11. Pup counts are in parenthesis and are not included in the adult totals.

Map Reference	Jun 9	Jun 27	Jun 28	Jul 4	Jul 19	Jul 20	Jul 27	Aug 14	Aug 18	Aug 29	Sep 12	Sep 13	Sep 14	Oct 14	Oct 31
A. Bellingham Bay	-	0	-	-	0	-	0	0	0	-	-	0	-	-	-
B. Wildcat Cove	-	0	-	-	0	-	0	0	0	-	-	24	-	-	-
C. Samish Bay	-	0	-	-	0	-	0	34(6)	0	-	-	49(1)	-	-	-
D. Padilla Bay	25	27	-	0	35	-	0	5	70(7)	-	-	50	-	-	-
E. Hat I.	0	0	-	0	0	-	0	0	0	-	-	20	-	-	-
F. Fidalgo Bay	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-
G. Sinclair I. (SE)	-	0	-	-	0	-	0	3(1)	9	-	-	0	-	13	-
H. Boulder Reef	-	0	-	-	11	-	0	15(1)	21(4)	-		27(3)	-	31	-
I. Pt. Migley	-	-	-	-	0	-	0	-	74(7)	-	-	17	-	47	-
J. Clark I.	-	0	-	0	0	-	0	-	0	-	-	0	-	15	-
K. Barnes I.	-	5	-	0	6	-	0	-	28(3)	-	-	28	-	14	-
L. Echo Bay	-	0	-	0	4(4)	-	12(5)	-	31(8)	-	-	40(1)	-	35	-
M. Sentinel I.	-	0	-	0	0	-	1(1)	-	0	-	-	-	56	33	-
N. Satellite I.	-	0	-	-	0	-	-	-	0	-	-	-	-	0	-
O. Twin Rocks	23	1	-	-	18	-	0	16(2)	12(2)	-	-	-	0	38	-
P. Bald Bluff	-	0	-	-	0	-		0	0	-	-	-	0	0	-
Q. Blind I.								3	0	-	-	-	-	0	-
R. Bell I.								1(1)	0	-	-	-	-	0	-
S. Leo Reef	0	0	-	-	0	-	3	0	9(1)	-	-	-	15	21	-
T. Pear Pt.	0	0	-	0	2	-	-	14(1)	15(2)	-	-	-	-	3	-
U. Deadman I.	0	0	-	0	0	-	0	0	0	-	-	-	0	0	-
V Whale Rks.	0	0	-	0	0	-	0	16(2)	25	-	-	-	0	11	-
W. Protection I.	30	50	71	24	113	47(2)	31(15)	-	113(19)	35(1)	66	-	128	223	220
X. Marrowstone I.	13	0	0	-	3	-	0	-	11(1)	-	0	-	-	13	0
Y Colvus Rks.	0	0	1	0	0	-	-	-	9	-	3	-	-	0	5
Z. Port Gamble	-	-	-	-	-	-	-	-	-	-	28	-	-	36	-

TABLE 13.--Aerial survey counts of harbor seals taken from November 1977 to May 1978. Dashed lines (-) indicate the area was not surveyed; zeroes (0) mean no animals were present; map reference refers to Figure 11.

Map Reference	1977 Nov 30	1977 Dec 8	1977 Dec 21	1978 Jan 26	1978 Jan 28	1978 Feb 9	1978 Feb 24	1978 Feb 28	1978 Mar 14	1978 Mar 15	1978 Apr 25	1978 Apr 28	1978 May 23	1978 May 25
Olympic Peninsula														
1. Kiapot Pt.	-	-	-	-	-	-	0	0	-	35	0	0	0	0
2. Kulakala Pt.	-	-	-	22	18	0	20	0	0	21	19	0	0	0
3. Dungeness Refuge	0	0	0	59	69	1	70	18	50	34	9	81	10	35
4. Green Pt.	0	-	0	-	0	-	-	0	-	0	-	0	0	-
5. Low Pt.	45	-	1	-	8	8	-	6	-	3	-	0	1	-
6. Deep Creek	0	-	0	-	0	-	-	0	-	0	-	1	0	-
7. Pillar Pt.	6	-	0	-	0	-	-	10	-	6	-	6	0	-
8. Seal Rk.	0	-	0	-	0	-	-	0	-	0	-	0	0	-
9. Tatoosh I.	0	-	0	-	0	-	-	0	-	0	-	0	0	-
Vancouver Island														
10. Chain I.	-	-	-	75	23	95	39	-	41	68	28	81	115	69
11. Trial I.	-	-	-	2	0	45	0	-	0	0	0	23	0	0
12. Race Rks.	-	26	8	43	27	0	-	102	127	175	99	126	220	92
13. Becher Bay	-	-	0	-	0	-	-	0	-	0	0	-	0	0
14. Possession Pt.	-	-	0	-	0	-	-	0	-	0	0	-	0	0
15. Sherringham Pt.	-	-	0	-	0	-	-	0	-	0	0	-	0	0
16. Jordan R.	-	-	0	-	0	[illegible]	[illegible]	0	-	0	0	-	0	0
17. Providence Cove	-	-	0	-	0	[illegible]	-	35	-	0	-	20	0	-

TABLE 14.--Aerial survey counts of harbor seals taken from June 1978 to October 1978. Dashed lines (-) indicate the area was not surveyed; zeros (0) mean no animals were present; map reference refers to Figure 11. Pup counts are in parenthesis and are not included in the adult totals.

Map Reference	Jun 9	Jun 27	Jun 28	Jul 4	Jul 19	Jul 20	Jul 27	Aug 14	Aug 18	Aug 29	Sep 12	Sep 13	Sep 14	Oct 14	Oct 31
Olympic Peninsula															
1. Kiapot Pt.	-	0	1	-	0	0	-	-	0	0	0	-	-	0	0
2. Kulakala Pt.	-	0	0	-	20(2)	18	-	-	5	0	0	-	-	6	0
3. Dungeness Refuge	41	20	26	45	40	41	33(1)	-	30(2)	54(8)	8	-	-	43	66
4. Green Pt.	-	-	1	-	2	1(1)	-	-	0	2	2	-	-	-	3
5 Low Pt	-	-	1	-	-	1	-	-	-	38	33	-	-	-	0
6. Deep Creek	-	-	1	-	-	1	-	-	-	9	-	-	-	-	3
7 Pillar Pt.	-	-	0	-	-	0	-	-	-	0	4	-	-	-	0
8 Seal Rk	-	-	0	-	-	0	-	-	-	0	0	-	-	-	0
9 Tatoosh I.	-	-	0	-	-	0	-	-	-	3	0	-	-	-	0
Vancouver Island															
10. Chain I.	-	144	75	-	67	135(1)	-	-	78(1)	0	-	-	-	58	64
11. Trial I.	-	0	0	-	0	6	-	-	0	0	-	-	-	0	19
12. Race Rks.	-	42	46	-	0	69(2)	-	-	67	51(2)	83	-	-	86	20
13. Becher Bay	-	-	0	-	-	0	-	-	-	0	6	-	-	-	42
14. Possession Pt.	-	-	0	-	-	2	-	-	-	0	-	-	-	-	0
15. Sherringham Pt	-	-	2	-	-	2	-	-	-	0	-	-	-	-	0
16. Jordan R.	-	-	0	-	-	1	-	-	-	0	-	-	-	-	0
17. Providence Cove	-	-	0	-	-	4	-	-	-	0	0	-	-	-	0

TABLE 15.--Maximum counts of harbor seals (*Phoca vitulina richardsi*) from aerial surveys of islands in British Columbia, July 1974 to August 1975. Counts are from visual estimates only. Data was taken from files at the Marine Mammal Division, NWAFC, Seattle, WA.

Location	Estimate
Strait of Georgia	
Miami I.	6
Mayne I.	55
Samuel I.	25
Tumbo I.	20
Saturna I.	45
Prevost I.	8
Saltspring I.	35
N. Pender I.	4
Portland I.	17
Zero Rk	11
Haro Strait	
Sidney I.	13
Chain Islets	25
Discovery I.	26
Strait of Juan de Fuca	
Trial I.	7
Race Rocks	135

For a hauling area to be attractive to harbor seals it must possess three characteristics: isolation from unseen approach by land, immediate access to deep water or channels, and be near food resources (Scheffer and Slipp, 1944). Calambokidis et al. (1978) described five categories of hauling sites of which four are present in this study area. These are: cobble or sandy beaches, such as Violet Point on Protection Island and the spit exposed at low tide between Smith and Minor Islands (Figure 7); rocky reefs and island ledges exposed at low tides such as Puffin Island (Figure 8); mudflats exposed at low tides found at Dungeness Wildlife Refuge and all the bays in the area (Figure 9); and anchored log booms in Fidalgo Bay and Port Gamble.

Abundance

Abundance estimates for P. v. richardsi are difficult to obtain. Population estimates for the Pacific area are in excess of 300,000 animals (MMPA, 1978), of which most can be found in Alaskan waters. Mate (1977) estimated 12,000 animals along the west coast from Washington to Baja California from surveys that did not include Puget Sound.

Scheffer and Slipp (1944) estimated the Washington population of harbor seals to be 6,000-10,000 animals. Newby (1973b) assumed the historical population nearer to 6,000 and produced evidence of a possible decline to 2,000 animals. He attributed this decline primarily to bounty pressure and habitat loss. Between 1943 and 1960 over 10,000 harbor seals were taken for bounty in Washington, which is undoubtedly considerably less than what was actually killed (Newby, 1973b). Assuming a 40% loss to unretrievable animals, the total kill may have actually exceeded 17,000 (Scheffer and Slipp, 1944; Newby, 1973b). In summary of 9,503 bounty records from Washington claimed between 1947 and 1960, 3,619 animals were killed in the northern Puget Sound area (Johnson and Jeffereis, 1977).

A minimum estimate of harbor seals in northern Puget Sound in 1972 was about 600 animals (Newby, 1973b) and Johnson and Jefferies (1977) estimated 650 harbor seals in this region. In a more comprehensive census of this area in 1977, Calambokidis et al., (1978) reported at least 1,200 animals. The Strait of Juan de Fuca was not considered in any of these estimates.

During the present study intensive aerial surveys of the study area for harbor seals were made monthly. All

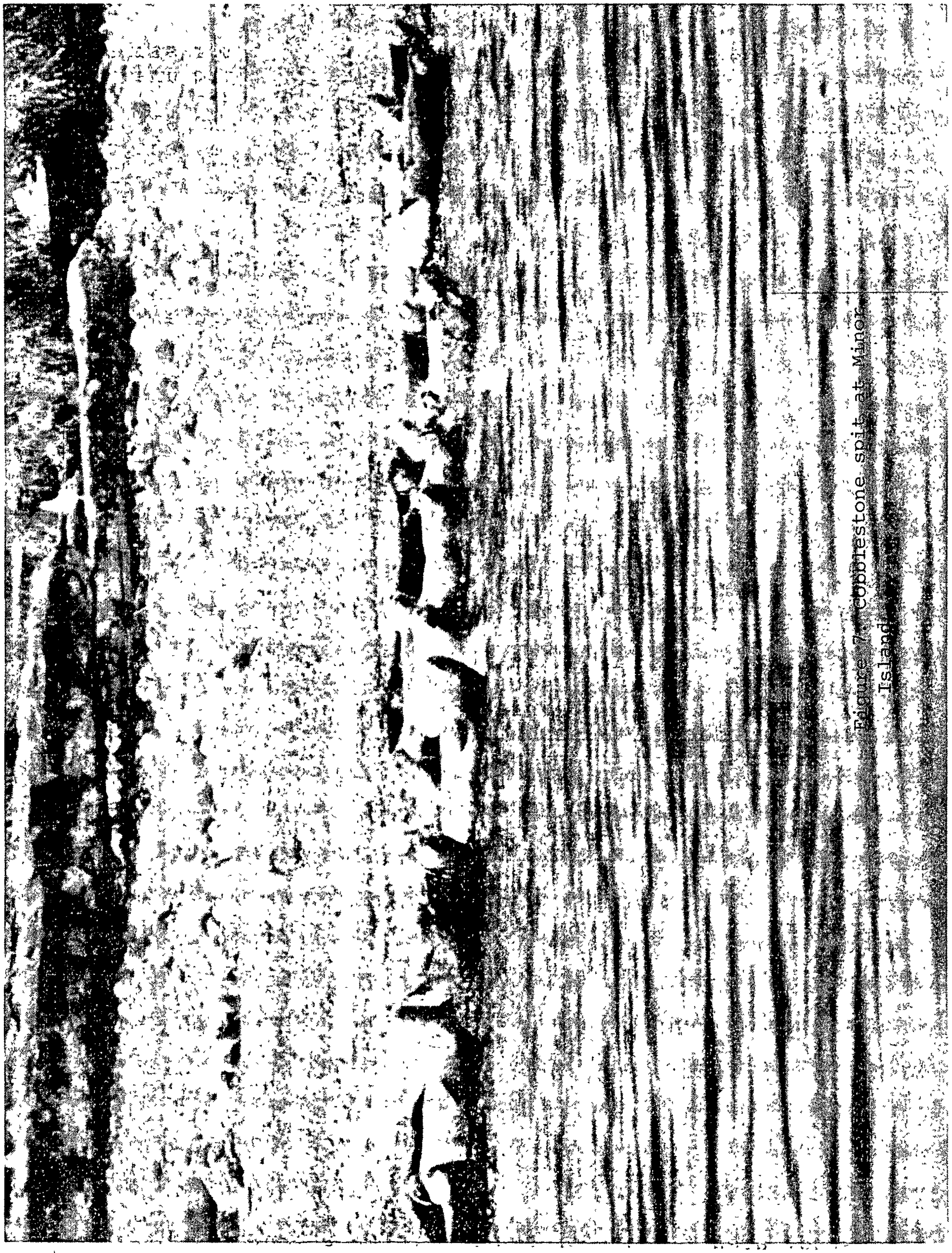


Figure 7. Cobblestone spit at Minor Island

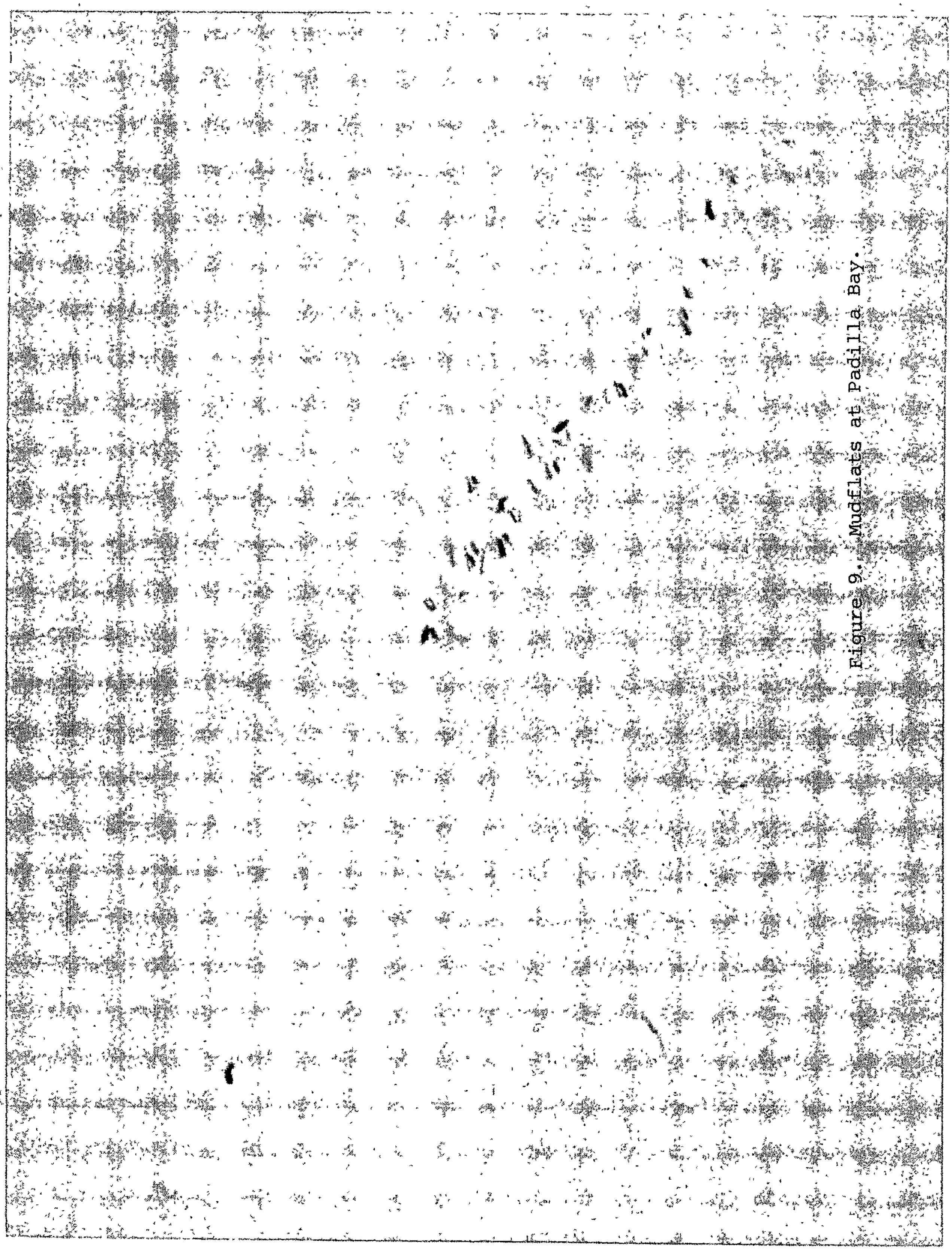


Figure 9. Mudflats at Padilla Bay.

known hauling areas and potential hauling habitat were surveyed. All islands and islets included in the San Juan Wilderness area were surveyed, effort, and number of animals observed are presented in Tables 9 and 10. Specific locations of these refuges are given in Figure 10. Areas not included in this refuge system which are utilized by harbor seals are presented in Tables 11 through 14, with specific locations given in Figure 11.

To aid in the presentation of this data, the study area was divided into 17 sampling areas (Figure 12). A summary table by month, using counts from the maximum survey days is presented in Table 16. The lower totals observed in November through January is probably the result of the minimal tidal range encountered during winter months. Tidal influence on hauling behavior has been reported in the literature often (Scheffer and Slipp, 1944; Bishop, 1967; Newby, 1971; Johnson and Jeffries, 1977; Calambokidis et al., 1978). We expect this influence may have contributed to the low counts in these periods. From February through July 1,000 animals were consistently observed, a figure which is comparable to the 1,200 reported by Calambokidis et al., (1978). This may represent the number of easily observable animals at any time. Johnson (1976) has reported an increase in observable animals during the molting periods when supposed physiological stress forces more animals to haul out longer. In local waters the molt may occur as early as February or as late as October (Scheffer and Slipp, 1944; Stutz, 1967b). Most of the population is involved in the molt from July to September (Stutz, 1967b). This period coincides with our high count in August of 1,600 harbor seals (not including 143 pups), which is our estimate of the summer population in the study area. The count in October of over 1,500 animals is comparable to the August estimate. The lower count in September is attributed to poor aerial survey conditions, primarily local fog during 12-14 September 1978. A more complete analysis of this phenomena locally and other aspects of daily and seasonal population fluctuations will be made with an increased data base collected during 1979.

For the purposes of this report a summary of each sampling area follows. The numbers in parenthesis refer to Figure 12.

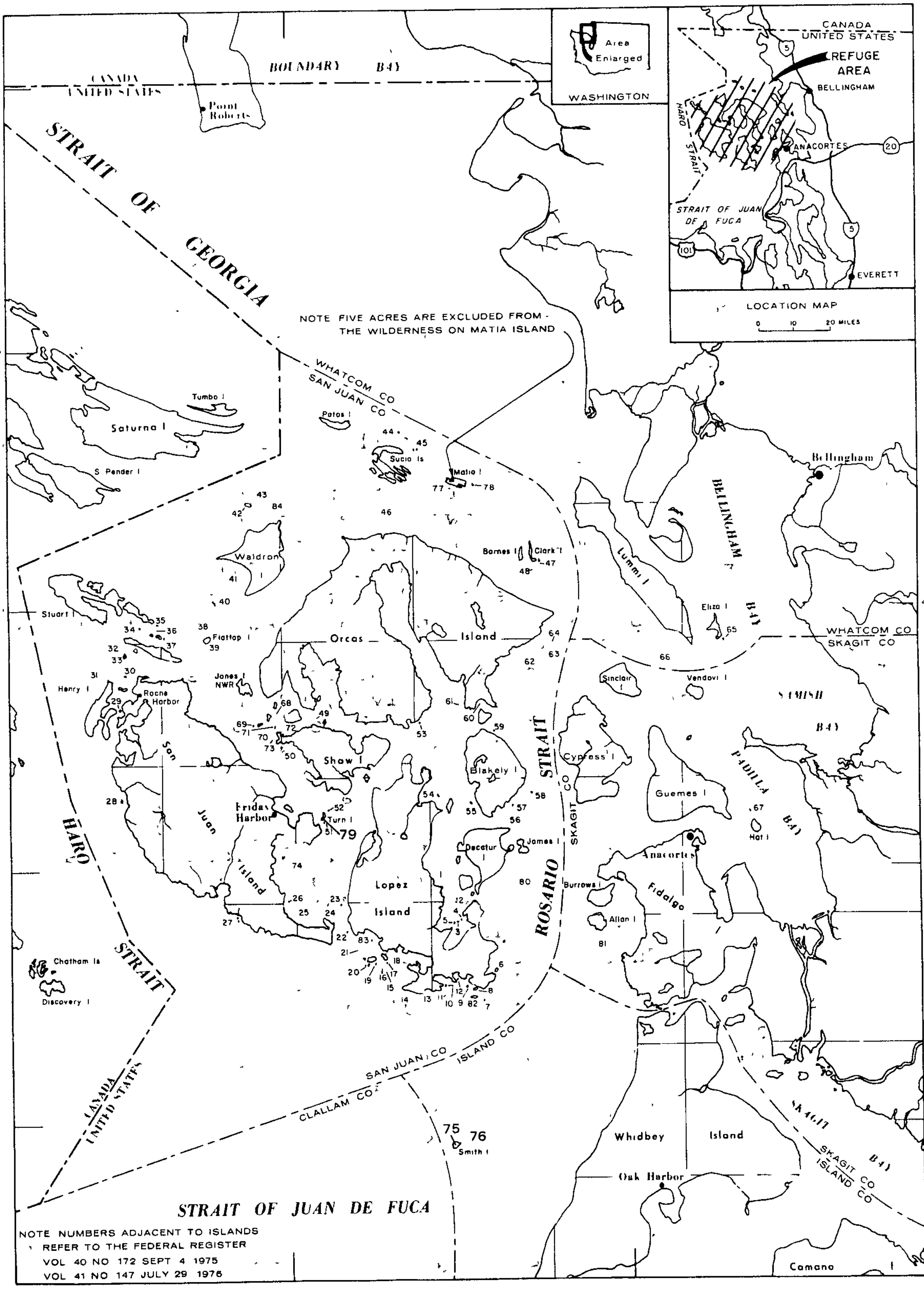


Figure 10. Locations of areas included in the San Juan Wilderness Area, numbers refer to Tables 9-10.

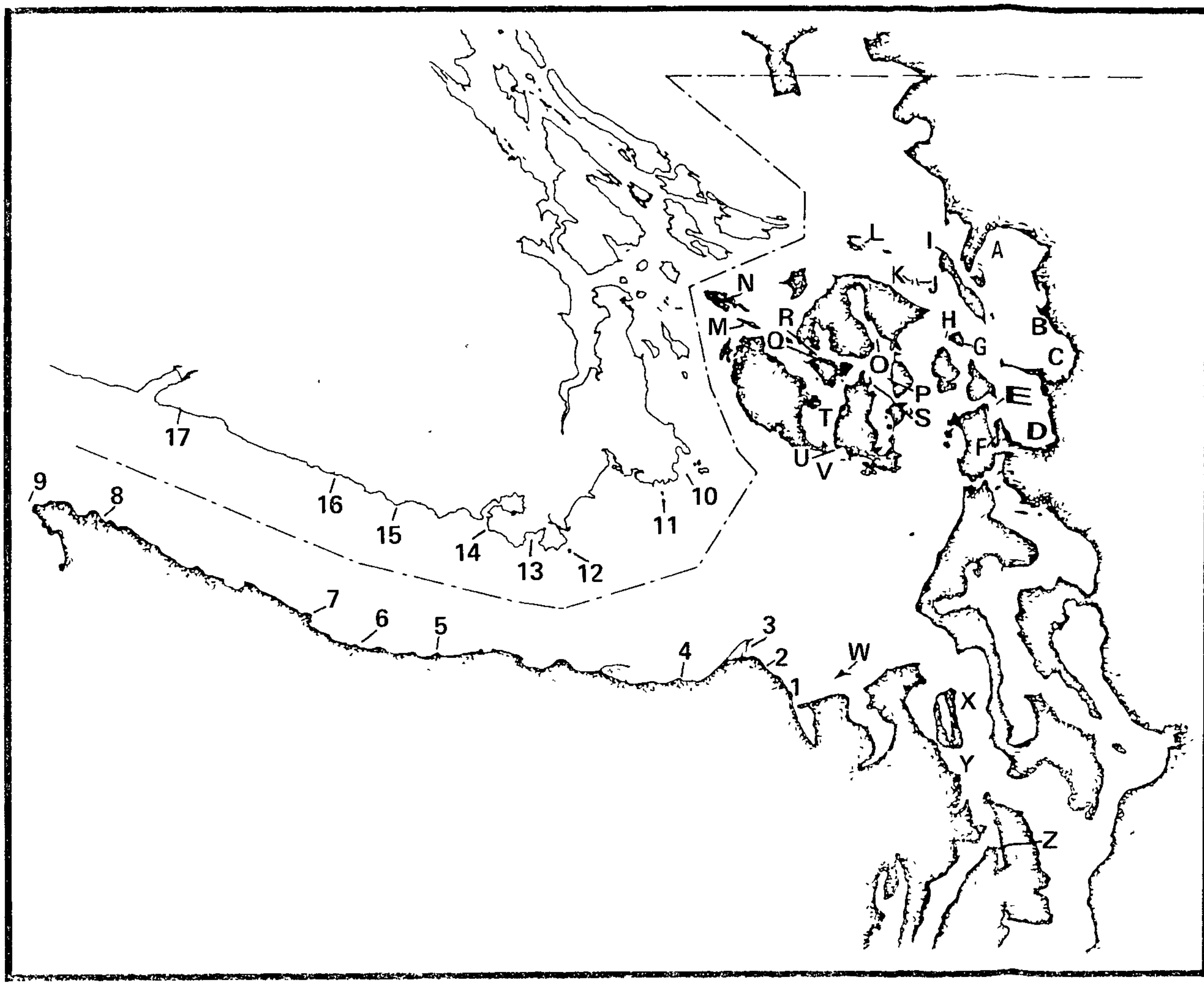


Figure 11. Harbor seal (Phoca vitulina richardsi) haul out site locations in northern Puget Sound and the Strait of Juan de Fuca. Letters A-Z refer to T. 11-12, numbers 1-17 refer to T. 13-14. This figure does not include locations in the San Juan Wilderness Area (refer to Figure 10.)

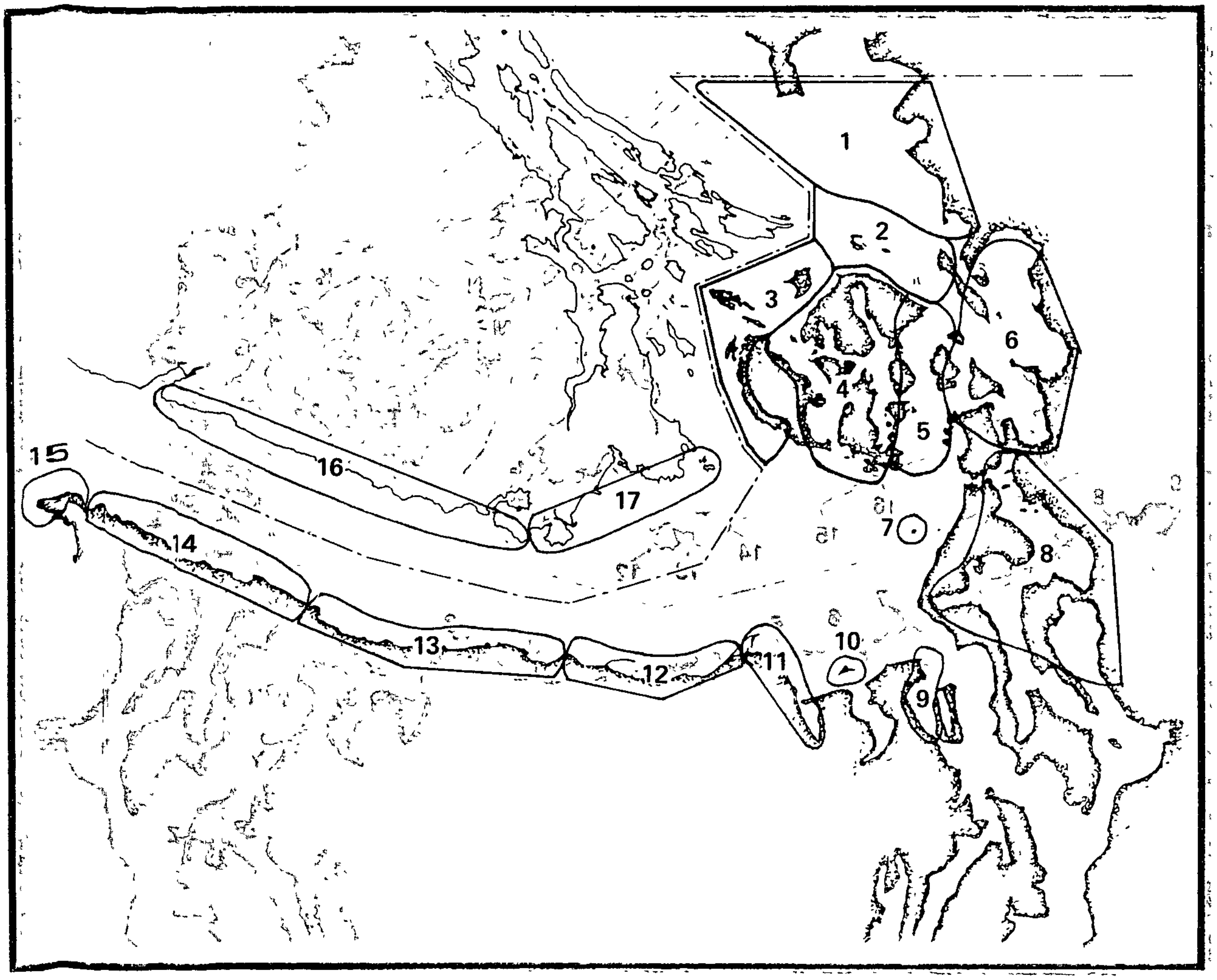


Figure 12. General areas (1-17) in northern Puget Sound and the Strait of Juan de Fuca for which abundance estimates of harbor seals (*Phoca vitulina richardsi*) were made (table 16).

TABLE 16--Summary of aerial survey counts of harbor seals taken from November 1977 to October 1978. Dashed lines (-) indicate the area was not surveyed; zeros (0) mean no animals were present; map reference numbers refer to figure 12. Pup counts are in parenthesis and are not included in the adult totals.

Map Reference Number	General Area	1977 Nov	1977 Dec	1978 Jan	1978 Feb	1978 Mar	1978 Apr	1978 May	1978 June	1978 July	1978 Aug	1978 Sept	1978 Oct
1	Cherry Pt. to Pt. Roberts	-	0	-	-	[illegible]	-	-	0	-	-	0	-
2	Patos I. to Lummi I.	1	86	86	25	114	93	150	46	128(12)	245(20)	229(3)	279
3	Haro Strait	17	49	90	103	178	256	126	42	52(7)	102(8)	69	118
4	San Juan Is.	0	58	29	14	0	60	140	243(6)	247(10)	355(31)	188	348
5	Rosario Strait	0	40	43	41	54	57	44	66	65(2)	197(21)	122(7)	122
6	Bellingham to Padilla Bay	0	12	23	1	15	39	12	27	35	119(15)	169(1)	35
7	Smith-Minor Is.	50	164	165	257	116	74	25	162(20)	196(44)	206(17)	2	155
8	Skagit Bay to Port Susan	-	-	-	-	0	-	0	-	0	10	0	-
9	Point Wilson to Hood Canal Bridge	-	24	6	10	21	9	8	14	3	20(1)	31	49
10	Protection I.	100	183	134	155	164	149	87	71	113(15)	113(19)	128	223
11	Dungeness to Sequim Bay	0	0	81	90	90	81	35	41	45(3)	54(8)	8	66
12	Angeles Pt. to Green Pt.	0	0	0	0	0	0	0	1	2(1)	2	2	3
13	Pillar Pt. to Angeles Pt.	51	1	8	18	9	7	1	2	2	47	37	3
14	Neah Bay to Pillar Pt.	0	0	0	0	0	0	0	0	0	0	0	0
15	Cape Flattery - Tatoosh I.	0	0	0	0	0	0	0	0	0	3	0	0
16	Cervantes Pt. to Sooke Bay	-	0	0	35	0	20	0	2	9	0	6	42
17	Becher Bay to Discovery I	-	26	120	242	243	230	335	190	210(3)	145(3)	83	144
	Monthly Total	219 1/	643	785	991	1,004	1,075	963	907(26)	1,107(97)	1,618(143)	1,074(11)	1,587

1/ Partial survey

Cherry Point to Point Roberts (1)

No hauling sites are known for this area from the literature or the present study. Since this area borders population concentrations immediately to the south, undoubtedly some harbor seals are expected to be foraging here, although to what extent is unknown. Aerial surveys were flown only four times here; no boat surveys were made.

Tidal areas in Lummi Flats produce suitable habitat for harbor seals and they might be expected to occassionally haul out there.

Patos Island to Lummi Island (2)

Important hauling areas are found on Sucia Island, Matia and Puffin Islands, Barnes Island, and on an offshore islet near Pt. Migley, Lummi Island. Harbor seals were observed on Clark Island in winter months and in the fall.

At Sucia Island two areas are utilized. North of the main island is an unnamed island which is part of the San Juan Wilderness Area (map reference number 45, Figure 10). A second location in Echo Bay (map reference L, Figure 11) is utilized irregularly during the winter and spring months. Animals were regularly seen at this site during the breeding season and this was the only site where pups were observed near Sucia Island. Wilson (1978) suggests that pups are commonly born on "nursery sites" away from the non-breeding population. Harbor seals all but abandoned Matia Island during the summer, shifting to Puffin Island which was little used in winter and spring. The possibility that harassment to the Matia Island area caused by increased recreational use of the Marine State Park may be responsible for this movement. A minimum of 20 pups were produced in this area in August. A maximum count of harbor seals in this area was made in October in the study area. This area accounted for 15% of the total August population of 279 animals.

Haro Strait (3)

This area includes six hauling sites from Skipjack Island to Sentinal Island. No concentrations of seals are known along the west side of Henry Island or San Juan Island, though they occur there singly in the water and a few harbor seals occassionally haul out in Andrews Bay (R. Osborne, pers. commun.).

All of the hauling sites are part of the San Juan Wilderness system which affords protection to these animals. The only exception is Sentinal Island where animals would haul out on instead of or in addition to the offshore rocks, only the rocks are part of the refuge. Most of the harbor seals in Haro Strait are found in the islands and reefs north of Sentinal Island. Few pups were observed here during aerial surveys. However, during a small boat survey on 30 September at least 20 weaned pups were observed. The total pup production was probably higher since older pups may have been mistaken for immature animals.

The high count for this area was 256 in April. This area accounted for 6.3% of the maximum population estimate in August.

San Juan Islands (4)

This area includes the interior waters on either side of Haro and Rosario Strait. Nine hauling areas are included here. Most animals were observed south of Lopez Island where disturbance from pleasure craft may be minimal. A group of 50 animals was monitored near Dinner Island by Mr. and Mrs. D. Ward, Bellevue, Washington who kindly provided us with information.

All hauling areas, except Twin Rocks (East Sound, Orcas Island) are protected as part of the San Juan Wilderness area. A high count of 21 pups were seen on the unnamed rocks off Dinner Island (map reference number 74, Figure 10). Nursing was observed away from non-breeding animals at Dinner Island (M. Ward, pers. commun.).

The high count for area 4 was 355 harbor seals in August; an additional 31 pups were also observed. This represents 21.9% of the total population estimate in the study area for that month.

Rosario Strait (5)

Five hauling sites were recorded in Rosario Strait during this study. This includes Williamson Rocks in Burrows Bay although we observed animals there only on 18 August, four to six harbor seals are seen in Burrows Bay throughout the year (D. Lively, pers. commun.). All five hauling sites are part of the Wilderness area.

Bird Rocks and Peapod Rocks are the most important hauling sites in this summary area and animals were observed at these sites on all surveys. Fewer harbor seals were observed in winter and spring than summer and fall. The difference was more than might be expected as a result of tidal influence (P1-05) indicating some seasonal movement through Rosario Strait.

A maximum count of 197 harbor seals was made in Rosario Strait in August, representing 12.2% of the maximum population. A total of 21 pups were observed there in this area in August.

Bellingham Bay to Padilla Bay (6)

This area includes Guemes and Cypress Islands and Fidalgo Bay in addition to the larger bays. Seven hauling areas are located in this area. Of these only Eliza Rock is protected by the wildlife refuge system. Tideflats (Figure 13) in Bellingham, Samish, and Padilla Bays are isolated from most boat traffic and perhaps as a result are the most important areas in terms of total animals hauling out.

Fidalgo Bay was surveyed only once on 13 September 1978 and ten animals were observed hauled out on anchored log booms. This bay will become part of the regular survey track during 1979.

Most of the animals in this area were found in Padilla Bay. The irregularity of occurrence in Samish and Bellingham Bays suggest seals may move into these bays from other areas perhaps following fluctuating food resources.

A high count of 169 animals was taken in this area in September. The August count of 119 represents 7.4% of the total for the study area. Fifteen pups were observed in August, seven of these were from Padilla Bay and six from Samish Bay.

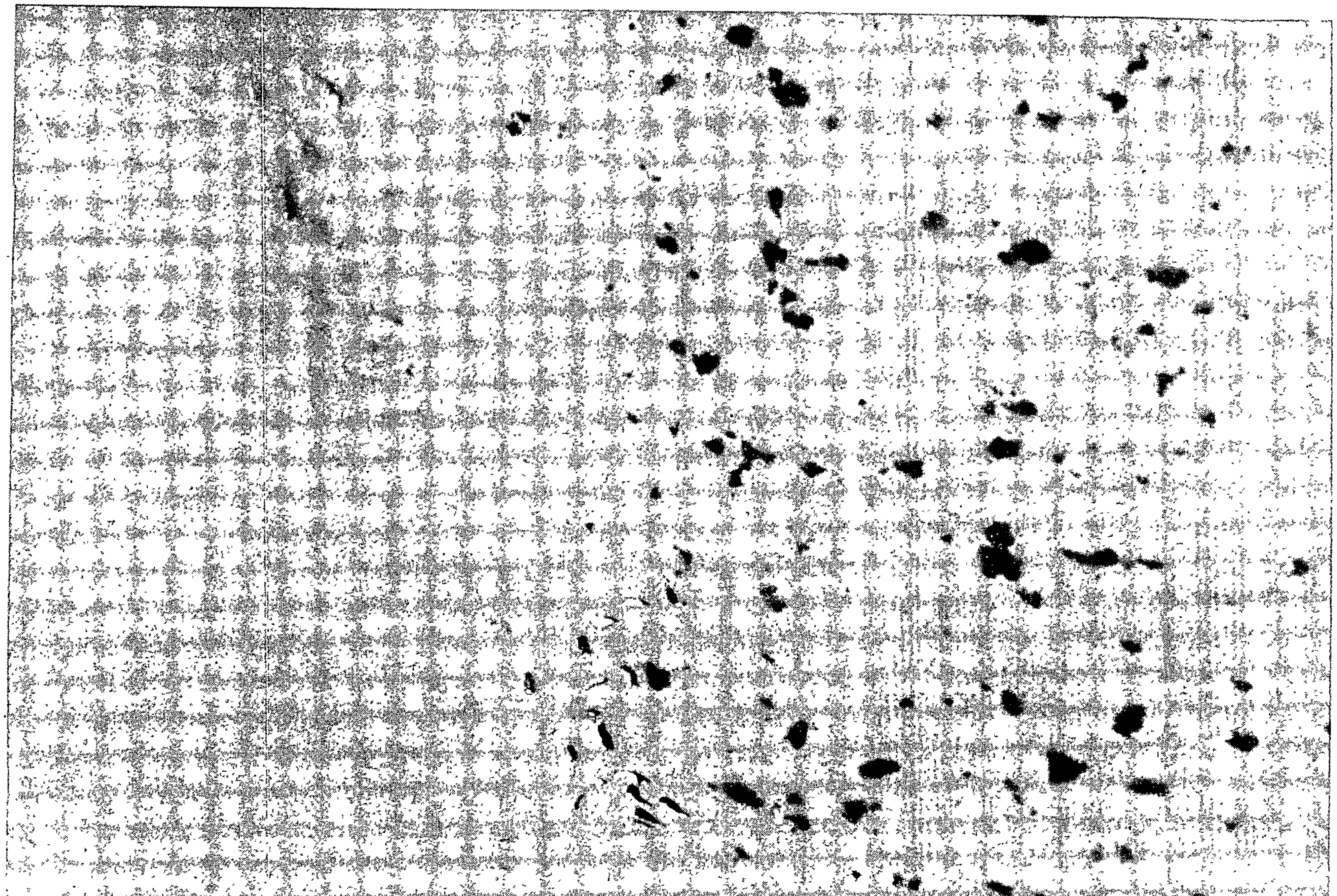


Figure 13. Harbor seals at Padilla Bay.

Smith-Minor Islands (7)

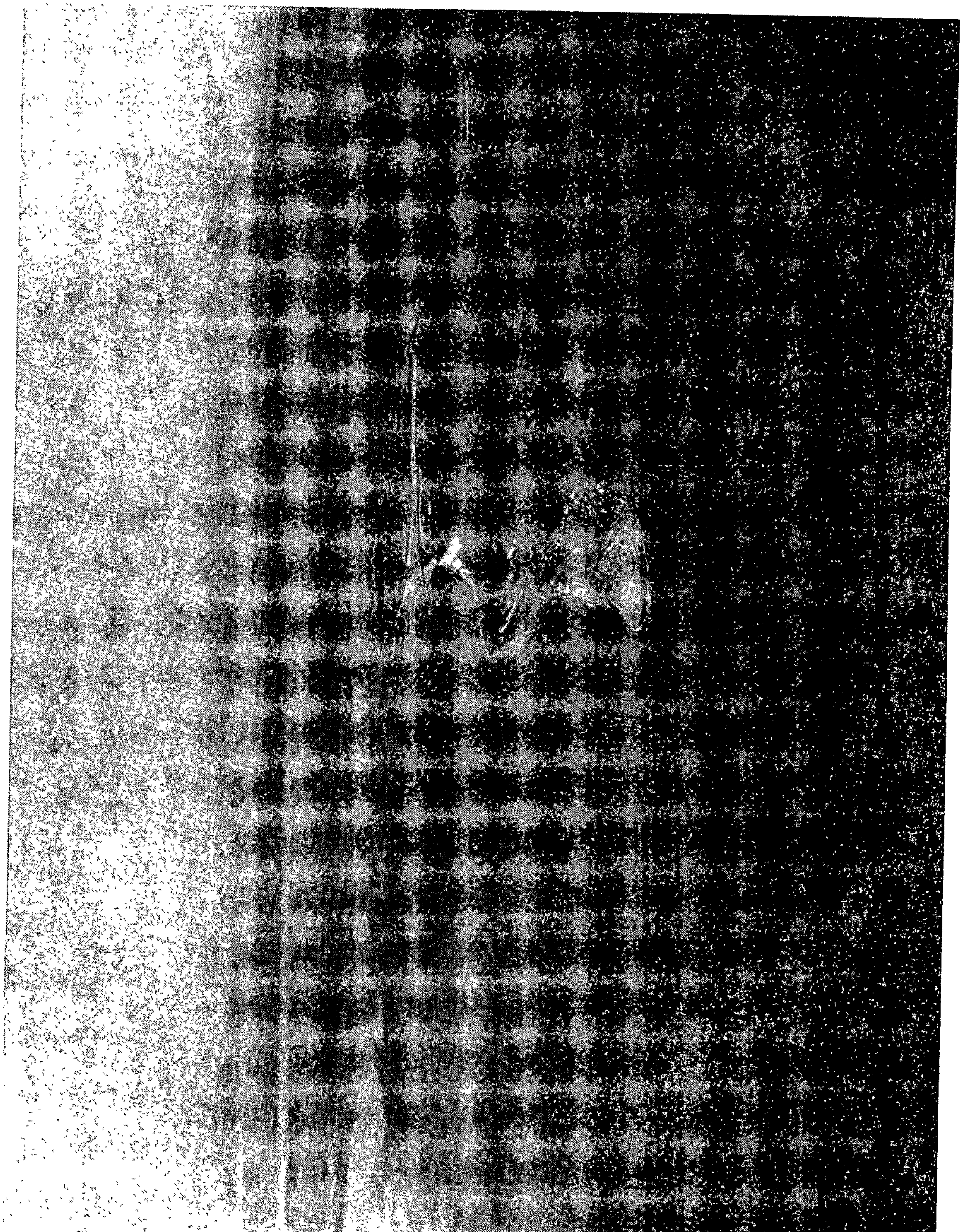
Smith Island and Minor Island are wildlife refuges administered by the Nisqually Wildlife Refuge, Olympia, Washington. Access is strictly controlled. An abandoned Coast Guard lighthouse, now automated, stands on the western side of Smith Island, a light and horn are on Minor Island (Figure 14). Harbor seals haul out on the tidal spit west of the Minor Island light (Figure 15). During the pupping season, females with new pups were most often observed near the light and the animals appeared habituated to the continued blast of the horn.

Newby (1973b) reported 150 harbor seals from this area and Calambokidis et al., (1978) observed 245 animals hauled out in August 1977. The highest count was taken in this study was in February 1978 when 257 adults and immatures were observed. During the month of our largest population estimate for the study area, August, 206 adults and immatures and 17 pups were recorded (total = 233 animals). The highest pup count was made in July, when 44 pups were observed. The first pups were seen here on 27 June 1978; the high count (44) was made one month later on 27 July 1978. The last obvious pups were observed on 29 August 1978, thus the pupping season lasted at least 9 weeks.

The average number of animals seen by season for all surveys (not accounting for tidal or weather influence) is as follows: fall - 117; winter - 133; spring - 93; summer - 123 the differences between any one survey may be attributable to varying environmental conditions, but the data indicates a reasonably stable number of animals throughout the year. Further assessment of this question will be aided by data collected through 1979.

Smith-Minor Islands are the most important single hauling site in the study area in terms of total number of animals and total pup production - 25.8% of the maximum pup count for all summary areas comes from Smith-Minor Islands.

While this area is protected as a wildlife refuge, incidences of harassment were observed to take place. Poor weather hindered survey effort in September 1978 but did allow a survey of Minor Island on 14 September 1978. At 13:35 on that day two people were seen walking the spit at Minor Island. Apparently they had traversed the spit at low tide leaving their boat on Smith Island and had become stranded by the incoming tide. The presence of these



two people accounted for a total lack of harbor seals in the area; only two were observed in the water near Smith Island. During aerial surveys on 23 and 25 May only 25 harbor seals were estimated in the water and none were hauled out. Many small sport fishing boats were observed close to the islands. During a boat survey to the islands on 21 July 1978 a small sport fish boat was seen approaching close enough to hauled out animals to cause them to flee into the water.

Smith-Minor Islands accounted for 12.7% of the harbor seal population estimated for the study area in August.

Skagit Bay to Port Susan (8)

This area comprises the protected waters from Deception Pass southeast to Port Susan and southwest to Rocky Pt., Whidbey Island. Aerial surveys were flown through this area infrequently (March, July, August), usually when local fog on the west side of Whidbey Island forced our approach to northern Puget Sound from the east side.

During a small boat survey from Deception Pass to Goat Island on 26 May 1978 three harbor seals were observed in the water near Hope Island. No animals were seen in the Bay from boat surveys on 27 Mav and 3 to 4 September 1978. During an aerial survey of the southern tide flats in Skagit Bay on 14 August 1978 ten harbor seals were observed hauled out.

There are probably more harbor seals in this area than our low survey effort revealed. Ninety seals were reported in Skagit Bay from yearly observations (1970 to 1972) (Newby 1973b). Calambokidis et al., (1978) reported 14 harbor seals in Skagit Bay on 23 October 1977.

Point Wilson to the Hood Canal Bridge (9)

This area extends from Point Wilson on the Quimper Peninsula south to the Port Gamble Bay including the east side of Marrowstone Island. Three hauling areas were found in this area; rocks off the west side of Marrowstone Island; Colvus Rocks and anchored log booms in the south end of Port Gamble.

Port Gamble was surveyed only twice. During an aerial survey on 12 September 28 harbor seals were hauled out on rafted logs and on 14 October 36 seals were seen. The inclusion of these counts into the area summary produced the highest total estimates for October (49) and September (31). Reports from local residents at Cape George, Washington suggest that some harbor seals can be found in Port Gamble year round.

Harbor seals were observed regularly on Colvus Rocks from December to March. From April to July the only observation made were of two animals on 23 May 1978 and one on 28 June 1978. By 18 August 1978 nine animals were observed, and they have been seen regularly through October. This variable use suggests seasonal movements away from these rocks in the spring and summer. The west side of Marrowstone Island was not surveyed until March, harbor seals were regularly seen at this hauling site.

The count of 20 harbor seals in August represents 1.2% of the total count for that month in the study area.

Protection Island (10)

Located at the head of Discovery Bay, Protection Island represents an important single hauling area, second only to Minor Island for the study area. Harbor seals haul out almost exclusively on Violet Point (southeast spit) (Figure 16). Although once disturbed some animals move to Kanem Pt. on the southwest end of the island and have been observed to haul out there on several occasions.

During the pupping season, females with new pups were observed to haul out on the north side of Violet Point, west of the main group. This area was abandoned by the time of weaning.

Calambokidis et al. (1978) reported a high count of 165 harbor seals on Protection Island in September. During the present study a high count of 223 animals was taken in October of which at least 60% were in molt. In August, the month of the highest count for the study area, 113 harbor seals were observed representing 7.0% of the total. The highest pup count for this island was 19 taken in August. The first pups were observed on 20 July 1978, and pups were seen until 29 August for a pupping period lasting about 6 weeks.

Analysis of population variability throughout the seasons is unclear at the time. A preliminary evaluation of land and aerial observations indicate more animals haul out on Protection Island in fall and winter than spring and summer ($P < .09$). This question will be more fully addressed with additional information collected in 1979.

Protection Island is presently undergoing commercial development. The state of Washington owns a portion of the western end of the island (including Kanem Point) and has declared it a wildlife sanctuary. However, the remainder of the island is subjected to severe human pressure. Disturbances of harbor seals was most evident during the summer weekends when the island is most heavily used by lot owners and small boat traffic in surrounding waters is greatest. A summary of disturbance data was not prepared in time for this report but will be included in the final project report.

Dungeness to Sequim Bay (11)

This summary area extends from Sequim Bay north to and including all of the Dungeness National Wildlife Refuge. During aerial surveys of Dungeness, the coastline south to Kiapot Pt. (entrance to Sequim Bay) was surveyed. These surveys did not penetrate far into Sequim Bay. Of the few small boat surveys to Dungeness, Sequim Bay was examined as time, fuel reserves, and weather allowed. A total of four boats surveys were made in this area (March, April, July and August). Only two hauling sites are known for this general area, Dungeness Refuge and a rarely used site off Kulakala Point.

On only one occasion were harbor seals observed inside Sequim Bay. On 15 March 1978 an estimated 35 seals were seen in the water inside Kiapot Point. Considering the proximity of Sequim Bay to large harbor seal populations at Protection Island and Dungeness Refuge, we expect some animals regularly enter this bay. Conversations with local sport fishermen indicate that it is not uncommon to see single harbor seals inside Sequim Bay.

Calambokidis et al. (1978) reported 36 harbor seals hauled out on the tide flats off Kulakala Point in September 1977. During the present study animals were seen near the point in all seasons, usually in the water. Hauled-out seals were observed on 28 January 1978. Pups were observed only once, on 19 July 1978, when two mother-pup pairs were seen together in the water.

The Dungeness Refuge represents an important sanctuary for harbor seals in this area. Animals were most often observed in the water. The common presence of small pleasure boats in the area may limit the daytime hauling activity here. The highest count was taken from an aerial survey on 28 April 1978 of 81 harbor seals. The expanse of shallow water and shoals limited the effectiveness of boat surveys in the Refuge.

Pups were first seen at Dungeness on 27 July 1978. The largest count was made during a boat survey on 10 August 1978. Twelve pups were counted along with 63 adults and immatures. The last identifiable pups were observed the last week of August.

The high count for Area 11 was 90 harbor seals in February and March. This summary area accounted for 3.3% of the total August count for the study area.

Angeles Point to Green Point (12)

This area stretches from just west of Dungeness to Angeles Point, (west of Port Angeles, Washington). Single harbor seals were seen in the water from June through August from aerial surveys. The observation of a small pup and mother east of Freshwater Bay was the only record of a pup on the Olympic Coast outside of Dungeness.

Because of restrictions to low flying aircraft near Port Angeles, no surveys were made in the immediate vicinity of the town. Harbor seals were reported hauling out near the easternmost pier in Port Angles. Sixteen harbor seals were seen there on 6 April 1978 (J. Brueggeman, pers. commun.) Seals were regularly seen in Port Angeles during bird surveys conducted by another MESA directed study. Observations were made in the summer and fall indicating some harbor seals may be resident there. Exact counts were not avalable as of this writing.

The two harbor seals observed in this area in August represent 0.1% of the total that month.

Pillar Point to Angeles Point (13)

Harbor seals in this area, which includes Freshwater Bay and Crescent Bay, were observed to haul out in three general areas: Low Point, Deep Creek, and Pillar Point. The offshore rocks, exposed at low tide, near Low Point, were the areas most heavily utilized.

Harbor seals were observed here during all seasons, although in greatest abundance from late August through November. Of the seals seen in this area, 74% were observed during those months. It seems probable that after the breeding season, some harbor seals move to this area following schooling fishes which are abundant here in the fall.

The August count of 47 harbor seals represents 2.9% of the total estimate for the study area that month. The low count in October may be attributable to poor survey conditions on 31 October 1978.

Neah Bay to Pillar Point (14)

This summary area extends from Pillar Point to Koitlah Point, (west of Neah Bay). This area was surveyed monthly from November 1977 to October 1978. The only harbor seals observed were a group of ten hauled out on Seal Rock on 28 February 1978. No harbor seals were observed here in August.

Cape Flattery - Tatoosh Island (15)

Cape Flattery and Tatoosh Island were the westernmost limit of the study area. Harbor seals were observed in this area only once. On 29 August 1978, three seals were seen hauled out on rocks offshore from Tatoosh Island. As many as 2,000 harbor seals are found on the outer coast of Washington (Johnson and Jefferies, 1977) and a small number of these occur north of Destruction Island as far as Makkaw Bay (senior author, pers. obs.). Apparently few frequent the Cape Flattery area for any length of time. No pups were seen in this area.

The three harbor seals seen in August represent only 0.2% of the total seals observed in the study area that month.

Cervantes Point to Sooke Bay (16)

This area includes extensive coastline along the southwestern end of Vancouver Island. The only location where harbor seals were observed hauling out was on offshore rocks near Providence Cove and they were seen there only three times, once each in February, March and July. The largest count for this hauling site was 35 on 28 February 1978. In June and July a few single harbor seals in the water were observed off Possession Point, Sherringham Point, and the Jordan River. No pups were observed here. No seals were seen in August.

Becher Bay to Discovery Island (17)

This area from Becher Bay to Discovery Island in British Columbia includes Race Rocks and Chain Islets which are the two most heavily used hauling sites. Other areas where harbor seals were observed were Trial Island and small islets in Becher Bay.

The largest number of animals was observed here in the spring, the fewest in fall and winter. The number of harbor seals at Race Rocks increased in the spring and summer from lower levels in the fall and winter. This corresponds to a decrease in sea lions at Race Rocks in the spring and an increase in fall suggesting that competition for hauling space may limit the harbor seals here in winter.

Chain Islets are a series of tidal rocks and islets off Victoria, B.C. A sizable population of harbor seals resides here year long. A concentration of seals (high count was 144 in July 1978) this close to a major metropolitan area is unique in the study area.

No more than three pups were ever observed in this area. Aerial surveys will tend to underestimate pups since their small size often makes them unobservable. However, if pups were produced here in any number, we would expect to observe more of them. This area may contain a higher percentage of non-breeding animals than elsewhere in the study area or may suffer a higher pup mortality or reproductive dysfunction, perhaps associated with the close proximity to large human populations.

The high count for ths area was taken in March of 243 harbor seals. The August count of 145 animals represents 9.0% of th total high count for that month in the study area.

Ecological Problems

Conflicts between harbor seals and commercial fishery interests over certain fish species (particularly salmonids) is of predominent concern. Results of food habit studies (detailed earlier) indicate that harbor seals are opportunistic feeders and its impact on commercial fish may be less than 5% of the human harvest (Fiscus, 1978). The effect of this take on the fishery is unknown but is under investigation in Alaska and the Columbia River. A recently proposed study by the Washington Department of Game is designed to address this question on the coast. Damage to fishing gear by harbor seals occurs at an unknown level.

Some environmental pollutants, notably PCB's and DDT have been shown to cause reproductive difficulties in many bird and mammal species. PCB contaminants have been implicated in reproductive failure for pinnipeds in the Channel Islands, California (DeLong et al., 1973).

Newby (1971) first reported a high rate of prenatal and neonatal deaths in harbor seals at Gertrude Island in Southern Puget Sound. Arndt (1973) found high levels of PCB and DDT in the tissue of seals collected from Gertrude Island and suggested that these high concentrations may be responsible for the high pup mortality in this area. A recent study of this same population has shown the blubber concentration of these two pollutants remains higher than that for harbor seals in any other area on the west coast (Calambokidis et al., 1978; Anas, 1974).

Pollutant concentrations in the tissue of harbor seals from northern Puget Sound and the outer Washington coast, areas of limited industrial impact, are less than those for the southern Sound (Calambokidis et al., 1978). While some pollutants are potentially damaging to pinnipeds and a problem may exist in Puget Sound harbor seals, studies to date have yet to positively correlate environmental pollutants with low reproductivity for ths species. Considering the recent evidence that has accumulated demonstrating the toxicity of some pollutants to wild and domestic animals it seems likely that a thorough study of Puget Sound harbor seals, on the order of the study performed in California, may produce similar results.

Southern Puget Sound, bounded by major industrial areas from Olympia to Seattle and having limited tidal circulation, will tend to concentrate industrial pollutants more than waters to the north or on the coast. These chemicals enter the food chain at the lowest level and become concentrated within the top consumer. In Southern Puget Sound this includes the resident harbor seal population. Even though the use of PCB's are strictly controlled and DDT has been banned for some years, these pollutants are still retained in the system and may be present for some time to come. An increase in these pollutants or the introduction of new ones into the system could combine to produce further depression of the local harbor seal population in Southern Puget Sound. Seals in other Washington waters do not appear to be severely loaded with chemical pollutants and the danger of increasing loads appears limited in the future.

Another area of concern is the threat of oil contamination, particularly in Northern Puget Sound. The effect of oil pollution on harbor seals has not been well documented (see Section III.B.) although young animals and older, weaker animals would probably be most severely impacted (Geraci and Smith, 1977).

Distribution of harbor seal hauling areas by human activities can lead to abandonment of some areas, a change in hauling behavior, and/or increased pup mortality due to abandonment by mothers (Bishop, 1967; Johnson, 1976; Calamboridis, 1978). A summary of observed disturbances during the course of this study is in preparation. While harbor seals are protected by federal law (i.e., the Marine Mammal Protection Act of 1972) it is not uncommon for animals to be shot. Johnson and Jeffries (1977) included such human activities as gunshot wounds, underwater blasts, and propeller wounds as factors contributing to mortality.

III-A-1-f. Northern Elephant Seal (*Mirounga angustirostris*)

Species Description

The northern elephant seal is the largest pinniped found in the northern hemisphere. This species is sexually dimorphic, adult males attaining a length of 4.8 m and weight of approximately 1800 kg and females are smaller, reaching 2.5 m in length and weight about 900 kg (DeLong, 1977). Adult males are readily identified by a long proboscis which they are capable of inflating. Pelage color is uniform, varying from gray to brown. At the surface of the water, elephant seals rest in an upright position and appear somewhat like a partially submerged "deadhead" with only portions of the head and neck exposed.

This species breeds no further north than the Farallon Islands in central California and south as far as Guadalupe Island, Baja California (Rice, 1977). Adult breeding males enter the rookeries in November and establish territories (LeBouef, 1972). Pregnant females arrive in late December and a single pup is born in about seven days; pups are born from December to February but most in late January (LeBouef et al., 1972). A peak in numbers of animals onshore occurs in February (Gogan, 1977). Pups are suckled for four weeks after which time they are weaned. Shortly thereafter females come into estrus and are bred (LeBouef et al., 1972). Pups molt their black natal pelage shortly after weaning and remain on the rookeries through April. Females leave the rookeries in mid-March and adult males leave by early April (LeBouef, 1972; Odell, 1974).

A certain portion of the elephant seal population is always ashore. The breeding population hauls out in the winter followed in the spring by immatures and adults who haul out to molt (Odell, 1974). This period encompasses the largest concentration of animals on land at any time of year and molting continues through summer. In the fall immatures haul out, leaving the rookeries before the breeding population arrives (Gogan, 1977).

Little published information on the feeding habits of northern elephant seals is available. In a review of the literature, Antonelis and Fiscus (1978) suggest that this species "feeds principally on benthc neritic and demersal prey but does prey to some extent on epipelagic and mesopelagic species." In the MESA study area no stomach content data exists. Cowan and Guiget (1965) report the stomach contents of an elephant seal driven ashore by killer whales at Ucluelet, B.C. (northwest coast of Vancouver Island). Its stomach contained only Pacific hagfish eggs and vertebral column, probably also hagfish. Prey items from specimens examined in other areas include: sardines, ratfish, dogfish, swell shark, skate, anchovy, cusk-eels, catsharks, rockfish, flatfish, Pacific lamprey, and Cephalopods (Townsend, 1912; Huey, 1930; Brown and Norris, 1956; Morejohn and Baltz, 1970; Antonelis and Fiscus, 1978).

Abundance and Distribution

The northern elephant seal population has recovered from a low of about 100 animals in 1890 to about 50,000 today (LeBouef, 1977; DeLong, 1977). Commercial sealing for oil (from blubber) was responsible for its' near extinction and recent protection has allowed the population to increase. Over half the population is found on the breeding rookeries of Baja California, San Miguel Island in the California Channel Islands, is the largest breeding area in U.S. waters (DeLong, 1977). No breeding occurs north of central California. Animals leave the rookeries singly and from sight records appear to remain solitary while at sea (Cowan and Carl, 1945; Pike and MacAskie, 1969; Gogan, 1977; Antonelis and Fiscus, 1978; this study). Evidence from tagging studies show a northward shift in distribution in the spring (Gogan, 1977). The extreme northern extent of the range comes from three recent sightings in the eastern Aleutian Islands (D.W. Withrow and R.D. Everitt, unpublished data). Two records from the northwestern Hawaiian (Leeward) Islands, reported by Antonelis and Fiscus (1978) suggest that some offshore movement occurs.

Observations of elephant seals in north Pacific waters are not uncommon. Gogan (1977) summarized published records which demonstrated a higher frequency of observations in April-May and September-October and a seasonal northward shift in distribution. These peak pelagic sightings correspond to movements on and off the breeding grounds (i.e., after the breeding period and following the spring molt of immature animals).

Cowan and Carl (1945) reported that the Makah Indians regularly hunted for elephant seals off the Strait of Juan de Fuca in the 1800's, demonstrating that these animals have historically occurred in these waters. The Indians hunted for elephant seals only in the spring and thus had no information on its presence in other seasons.

Table 17 summarizes records of northern elephant seals in the inland waters of Washington. Figures 17 and 18 show the distribution of these sightings by season of occurrence. Of the 23 observations, 15 were made in the spring (April-May) and these sightings are distributed throughout the study area. Several observations of elephant seals were made in spring, 1978 in Haro Strait (R. Osborne, pers. commun.) but the details were not available at the time of this report. The southernmost sighting report was near Bainbridge Island in 1977. Elephant seals have not been reported in southern Puget Sound and no records are known north of the San Juan Islands into the Strait of Georgia. Pike and MacAskie (1969) list records from Hectate Strait and Queen Charlotte Sound, none for the eastern side of Vancouver Island.

Scheffer and Kenyon (1963) reported the first elephant seal record in Puget Sound and Craddock (1968) published a second record. Both of these observations came from the same area near Edmonds. Many of the sightings compiled for this report were from sport fishermen in Admiralty Inlet and probably reflect the concentrated effort there, particularly in the fall months when pleasure boating in open waters is reduced and is concentrated in protected areas.

Most of the elephant seals reported were adult males. A molting female was seen for several days in Discovery Bay in April, 1977 indicating both sexes can occur here. The sex of this animal was verified by a tag attached to the rear flipper.

Four animals with green flipper tags have been reported since 1972 in Washington waters. These tags are part of a tagging program using different colors for rookery island identification conducted by Dr. B. J. LeBouef (University of California at Santa Cruz). The green tags were placed on animals at Ano Nuevo Island in central California (just south of San Francisco).

Ecological Problems

The effect of environmental pollutants on elephant seals is virtually unknown. Elephant seal pups contaminated by the Santa Barbara oil spill in 1969 were compared with uncontaminated pups on San Miguel Island (LeBouef, 1971). At the time of the spill these pups were weaned and no difference in mortality between oiled and clean pups was observed. Had the spill occurred earlier, before weaning, more serious damage resulting from ingestion of oil may have occurred (LeBouef, 1971).

TABLE 17--Records of northern elephant seal (*Mirounga augustirostris*) sightings for the inland waters of Washington by month. Records compiled at the Marine Mammal Division, NWAFC, Seattle, WA are described as: (files); records from the Platforms of Opportunity Program are described as: (POP). Dashed line (-) indicates data not available.

Date Mo/Da/Yr	Time Hour	Number Sighted	Location	Comments	Data Source
April					
4/21/63	1630	1	½ m W of Edmonds	First state record; adult male 8 mm movies taken	Scheffer and Kenyon (1963)
4/ -/72	-	1	New Dungeness Light	Green tag #994	(files)
4/ 8/73	-	1	Becher Bay, Vancouver I.	Male stranded alive recovered by Sealand of the Pacific, Ltd.; escaped 5/13/73	J.B. Colby (files)
4/11/75	-	1	Victoria, B.C.	Green tag #2006	M. Bigg (files)
4/22/75	-	1	Pt. Wilson		S. Guill (files)
4/28/75	-	1	Pt. Wilson		S. Guill (files)
4/27/76	1530	1	Admiralty Inlet	Subadult male	Orca Survey (files)
4/27/76	1743	1	off Yeomolt Pt. Bainbridge I.	Subadult male	Orca Survey (files)
4/10/77	-	1	Discovery Bay	Present for 3-4 days; 7' molting female; green tag #3433	A. Barrie (files)
4/19/78	-	1	Dallas Bank		J. Sweat (files)
May					
5/27/70	-	1	Edmonds - Possession Pt.		Seattle PI(29 May 1970)
5/24/72	-	1	Sequim Bay	Green tag 1207 or 1067	MMD (files)
5/ 7/76	1420	1	N. of Slip Pt.	Subadult male	Orca Survey (files)
5/15/76	2015	1	Speiden Channel	Subadult male	Orca Survey (files)
5/30/77	1200	1	Blakely Rk, off Bainbridge I.	12-15' length, sex ?	A. Barrie (files)

TABLE 17 -- Cont.

Date Mo/Da/Yr	Time Hour	Number Sighted	Location	Comments	Data Source
5/ 5/78	1150	1	2 mi. N. of Foulweather Bluff; Whidby I.		R. Murphy (POP)
5/ ?/78	-	1	Violet Pt, Protection I.	Hauled out on spit near harbor seals	M. Pitherick (POP)
Spring 1970	-	1	Cape Flattery	Dead; date unknown green tag #897	MMD (files)
August					
8/27/75	1530	1	Turn Pt., Stuart I.	Adult male	J.E. Mandaville (files)
8/26/77	-	1	1/4 m. W of Smith I.	Observed w/fish in mouth	C. Linden (files)
September					
9/ 2/68	1730	1	1.5 m NW of Edmonds	Adult male; second Washington record	Craddock (1968)
October					
10/ 8/75	1935	1	N. of Kingston Pt.	Adult male	E. Osterhaug (files)
10/26/78	-	1	E. of Pilot Pt.	Adult male	E. Long (POP)

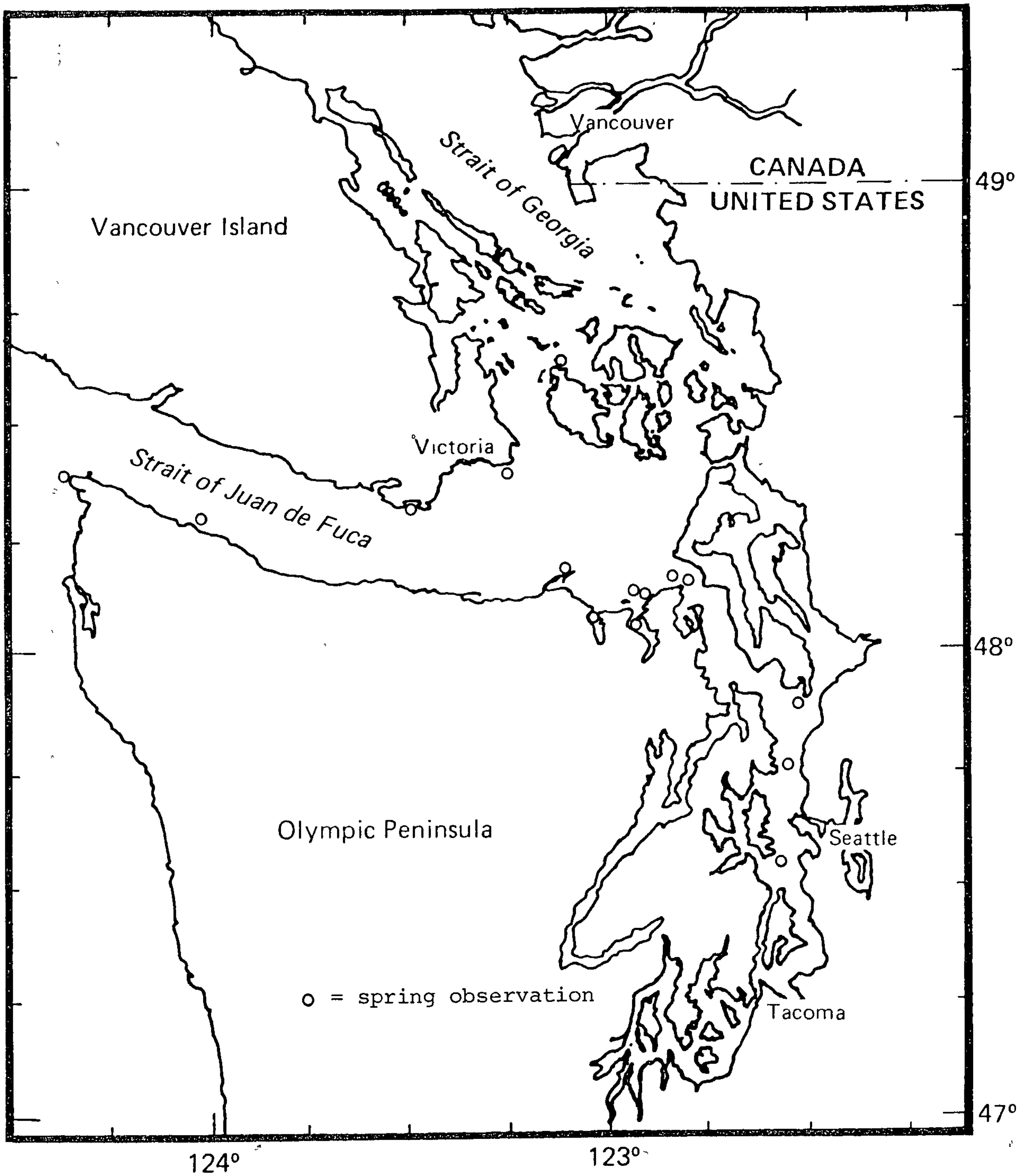


Figure 17. Distribution of elephant seal (Mirounga angustirostris) sightings in spring (March-May) in Puget Sound and the Strait of Juan de Fuca (data from table 17).

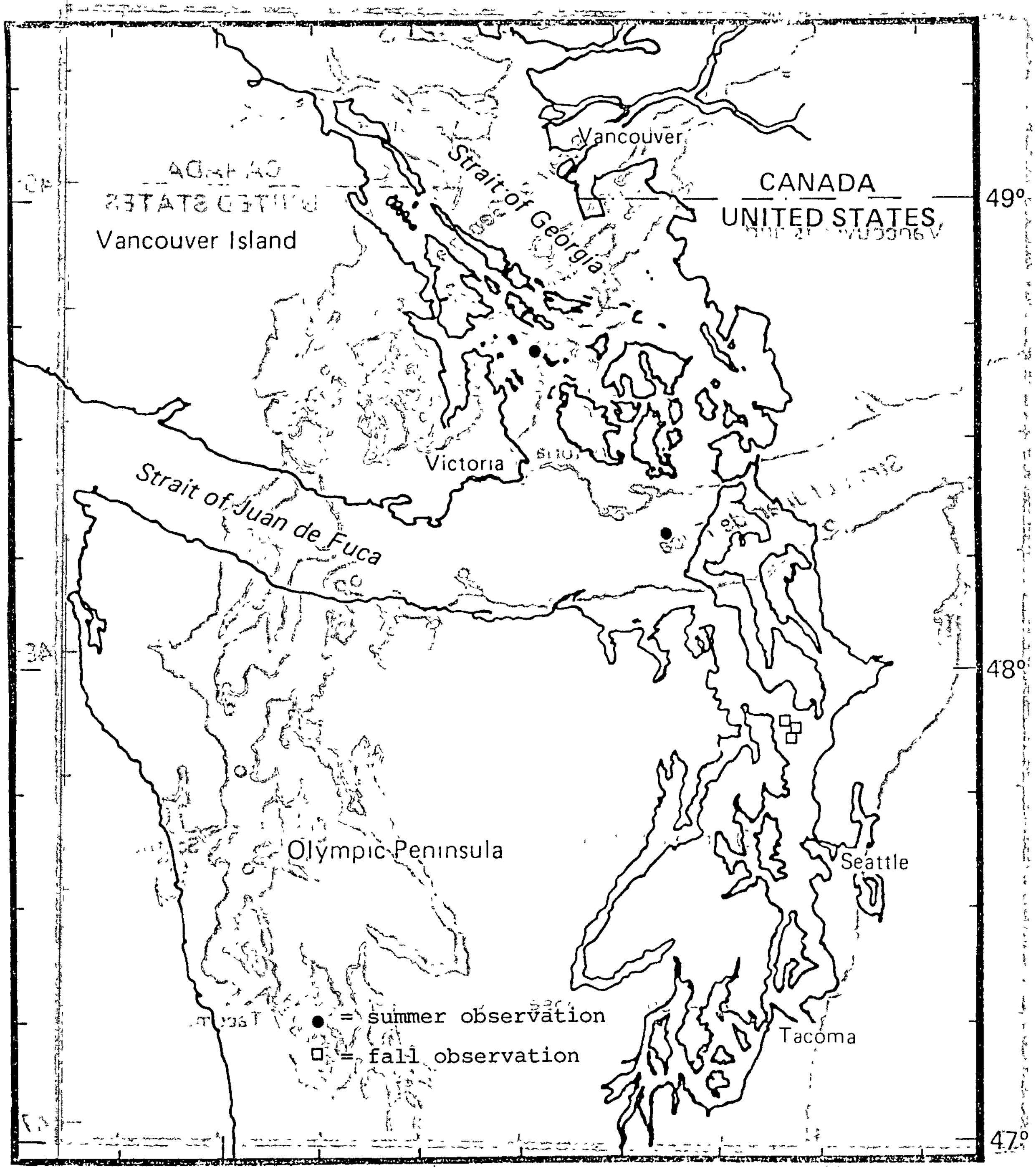


Figure 18.- Distribution of elephant seal (Mirounga angustirostris) sightings in summer (June-August) and fall (September-November) in Puget Sound and the Strait of Juan de Fuca (data from table 17).

III-A-2. Order: Mysticeti

Two families of the order Mysticeti are represented in the study area: Eschrichtiidae and Balaenopteridae. Two of the four species occuring here can be considered common; the gray whale (Eschrichtius robustus) and minke whale (Balaenoptera acutorostrata). Information on all species was collected from the literature, and sighting data from several sources. Several specimen records are presented in the literature for the first time here.

Data collection on both mysticetes and odontocetes is difficult in this area. But for a few exceptions these species do not occur in the inland waters in any great abundance so considerable effort must be expended to obtain sighting data, an expensive process not usually affordable. The Whale Hotline, a NMFS funded public reporting system maintained by the Moclips Cetelogical Society proved to be a valuable source of data. Local pleasure boating activity (the source of most calls) decreases dramatically in the fall and winter which may give a false impression of species abundance due to the decreased effort. Boran and Osborne (1978) in a report on this system to NMFS state ". . . As it stands now, the system does not provide any reliable data on seasonal migration or population sizes of the cetaceans within the study area." (page 1), but the system does provide valuable distribution data. Figure 19 shows the differences in calls received over the year. Response is highest in the summer and decreases rapidly in the fall to its lowest point in the winter. The data in this report reflects this low winter effort and gives a poor picture of species occurring during that season.

III-A-2-a. Gray Whale (Eschrichtius robustus)

Species Description

Historic evidence indicates this stock occurred in the North Atlantic Ocean but is now extinct there. Two stocks occur in the North Pacific, on the western side, the Asia stock is nearly extinct (Bowen, 1974), in the east the stock, once greatly reduced in numbers has now recovered and undergoes an extensive yearly migration that brings it into northwest waters seasonally. Physical maturity for gray whales is reached at a mean age of 4 years and a length of 13.0 m for males, 14.1 m for females (Rice and Wolman,

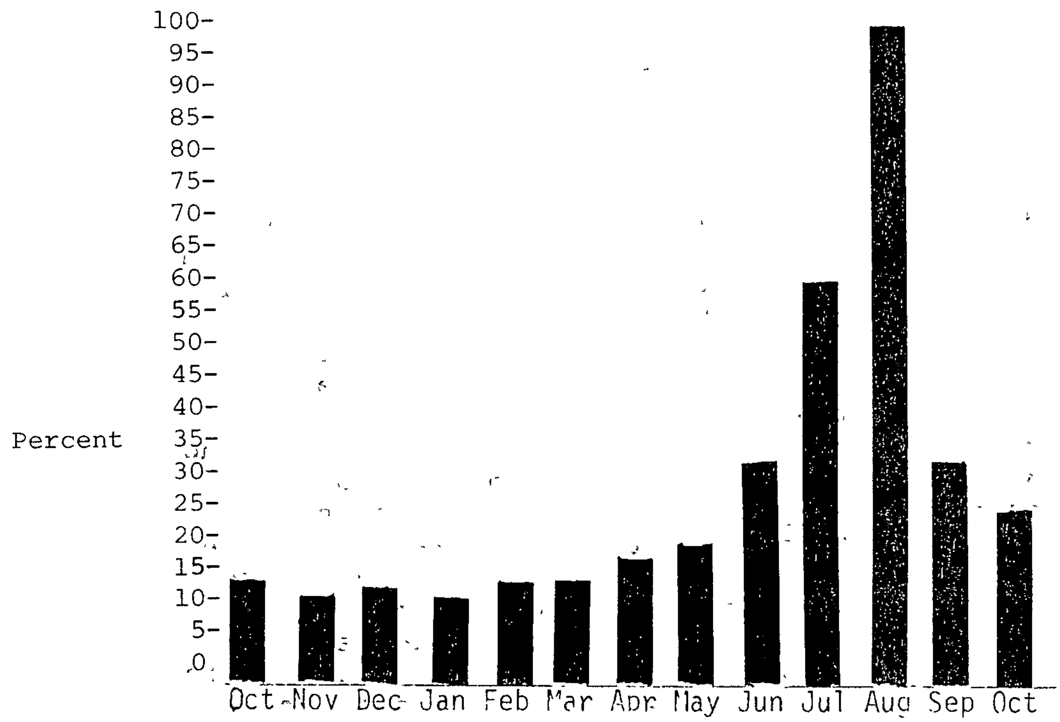


Figure 19. Percent of maximum monthly response (August) for each month from October 1977 to October 1978 of calls received by the public cetacean reporting system (Whale Hotline). Figure source: Boran and Osborne 1978.

1971). Sexual maturity is attained at about 8 years and 11+ m for both sexes. Parturition and breeding occur in the winter, peaking in the month of February (Nishiwaki, 1972). The gestation period is 13 months, females bear calves every 2 or more years.

Feeding takes place during northward migration. Of whales examined during southward movement, almost all had empty stomachs indicating fasting during this time period (Rice and Wolman, 1971). Important food items known include: euphausiids, nektonic fishes, and anchovy. Feeding behavior has been observed during the northern migration route, off Vancouver Island (Hatler and Darling, 1974) and in the Bering Sea (H. Braham unpubl. data). The stomach of a young calf, which died near Edmonds on 21 June 1978, contained dungeness crab zoea (L. Tsunoda pers. commun.). Feeding behavior has been described and it appears these animals feed along the shallow, muddy bottom either by scooping or sweeping over an area straining food through plates of baleen.

Abundance and Distribution

The eastern Pacific stock ranges from the Gulf of California to the Chukchi and Beaufort Seas (Rice, 1977). This stock spends the summer in the Arctic Ocean and Bering Sea although some animals occur infrequently in coastal localities as far south as northern California. Southbound migration from the Chukchi and Bering Seas occurs in November and December and takes this species south to the west coast of Baja California and into portions of the Gulf of California. Both north and south migrations are primarily coastal. The southward migration is composed of three segments of the population (Nishiwaki, 1972); the first group of migrants consist primarily of pregnant females followed by non-pregnant females and mature males, and the last migrants are immature males and nursing females. A few animals are known to winter further north (i.e. off Vancouver Island, B.C.) which are presumed to be non-breeding animals (Hatler and Darling, 1974). Most births take place in shallow lagoons in the southern (winter) range, notably Scammons Lagoon, Guerrero Negro Lagoon and San Ignacia Lagoon. Females with calves remain in these areas longer than other segments of the population (Rice and Wolman, 1971). The northward migration from the southern range begins in late February and lasts to April. Animals follow the coast to British Columbia where some may cross the Gulf of Alaska although at least a portion of the population remains coastal (Fiscus et al., 1976). Migration into the Bering Sea appears to be coastal along Unimak Island and the Alaskan Peninsula (H. Braham and D. Rugh, unpubl. data). North from the Alaska Peninsula their movements are less clear though large numbers of animals have been observed feeding near St. Lawrence Island before proceeding into the Chukchi Sea (Senior author, pers. obs.).

Gray whales were afforded international protection in 1947 and its numbers have increased steadily since. Rice and Wolman (1971) gave a population estimate of 11,000 animals based on counts from shore observation points. Henderson (1972) placed the original population at about 15,000 animals. Preliminary estimates of stock size from shore counts at Cape Sarichef, Alaska in 1977 and 1978 indicate the population may now number 15,000 (D. Rugh, unpubl. data.).

This species is abundant in Washington waters during migration periods. They appear in coastal waters, during northward migration between February and April and in December and January during the southern migration (Pike and MacAskie, 1969). Fiscus and Niggol (1965) reported over 200 gray whales offshore between Destruction and James Islands in April 1957 and Wahl (1977) reported sightings in May. Gray whales generally cross the Strait of Juan de Fuca between Cape Flattery and Pachena Pt., Vancouver Island (Hatler and Darling, 1974).

Northward migrants pause often to rest or feed in British Columbia waters, while in the winter the fasting southbound whales do not (Pike and MacAskie, 1969), which may account for the spring take of this species by local natives historically (Scheffer and Slipp, 1948) during the time when the whales would be most vulnerable.

Scheffer and Slipp (1948) postulated that this nearshore species would probably occur infrequently in inland waters. They suspected that a report of a whale near Pt. Defiance in 1938 was probably a gray whale. The scarcity of records in Puget Sound indicate that few animals venture very far into Washington inside waters.

Table 18 summarizes observations of gray whales in inland Washington waters. Peak occurrence of this specie is from March - May and again from August to September (Boran and Osborne, 1978). At least one report has been received for every month of the year, which may indicate that some individuals remain in these waters for extended periods. Observations are concentrated in Admiralty Inlet and the

TABLE 18--Recent observations of gray whales (Eschrichtius robustus) for the inland waters of Washington. Sightings are presented by month. Records compiled at the Marine Mammal Division, NWAFC, Seattle, Washington are described as files; records from the Platforms of Opportunity Program are described as POP; records reported to the Whale Hotline (NMFS funded) are described as H.L.; records from Orca Survey are described as O.S. Dashed lines indicate data not available.

Date	Time	No.	Location	Comments	Source
January					
1/7/77	-	1	Green Pt.		H.L.
1/2/78	1340	1	Elliot Bay, Pier 69		H.L.
1/20/78	PM	1	Rich Passage, Bainbridge I.		H.L.
1/20/78	PM	1	Sinclair Inlet		H.L.
1/24/78	1600	1	Tacoma Narrows		H.L.
February					
2/2/78	-	2	Port Gamble		H.L.
March					
3/30/76	-	1	Clam Bay, Rich Passage	Tentative I.D.	POP
3/1/78	1040	2	Port Gamble		H.L.
3/2/78	-	2	"		H.L.
3/3/78	-	2	"		H.L.
3/4/78	-	2	"		H.L.
3/5/78	-	2	"		H.L.
3/9/78	1530	1	Wing Pt., Bainbridge I.		H.L.
3/10/78	1230	1	Pt. Defiance		H.L.
3/25/78	0900	1	Off Edmonds		H.L.
April					
4/24/77	PM	2	Budd Inlet		H.L.
4/26/77	-	2	Eld Inlet	Tentative I.D.	H.L.
4/30/77	-	1-2	Budd Inlet		H.L.
4/2/78	-	1	Green Pt.		H.L.
4/9/78	0630	1	Hammersley Inlet		H.L.
4/9/78	1230	5	5 mi n. Clallam Bay		H.L.
4/9/78	-	1	Colvus Passage, Vashon I.		H.L.
4/14/78	-	1	Port Angeles		J. Brueggeman(files)

TABLE 18.--Cont.

Date	Time	No.	Location	Comments	Source
May					
5/14/77	-	1	Hammersley Inlet		H.L.
5/15/77	-	1	Hammersley Inlet		H.L.
5/23/78	2145	1	Elliot Bay		H.L.
5/24/78	0600	1	Green Pt.		H.L.
5/24/78	1400	1	Bush Pt.		H.L.
5/24/78	1530	1	Alki Pt.		H.L.
5/26/78	0800	2	Commencement Bay		H.L.
June					
6/15/77	-	1	Hammersley Inlet		O.S.
6/1/78	-	2	Pt. No Point		H.L.
6/1/78	1800	1	Possession Pt.		H.L.
6/24/78	0830	1	Chuckanut Bay		H.L.
6/24/78	0835	1	"		H.L.
6/24/78	0900	1	"		H.L.
6/28/78	0930	1	Viti Rk, Lummi I.	Tentative I.D.	H.L.
July					
7/11/76	1200	1	Partridge Pt, Whidbey I.		H.L.
7/1/78	1010	1	Sinclair Inlet		H.L.
7/2/78	1240	1	Pt. No Point		H.L.
August					
8/14/76	2100	1	Bush Pt.	Tentative I.D.	H.L.
8/24/76	1600	1	Victoria	"	H.L.
8/29/76	1100	1	Elliot Bay	"	H.L.
8/29/76	1400	1	Robinson Pt.	"	H.L.
8/31/76	1200	1	Carr Inlet	"	H.L.
8/29/78	1413	1	Seal Rock	Resting at surface	This study

TABLE 18.--Cont.

Date	Time	No.	Location	Comments	Source
September					
9/2/76	1045	2	Dalco Passage		H.L.
9/3/76	1000	1	Dana Passage		H.L.
9/3/76	1130	1	Budd Inlet		H.L.
9/3/76	1315	1	Hunter Point		H.L.
9/5/76	AM	1	Olele Pt., Oak Bay		H.L.
9/6/76	0609	1	S. Fox I.		H.L.
9/12/76	0730	1	Three Tree Pt.		H.L.
9/9/77	-	1	Rich Passage		O.S.
9/9/77	-	1	Sinclair Inlet		O.S.
9/10/77	-	1	Sinclair Inlet		O.S.
October					
10/12/76	1535	1	Poverty Bay		H.L.
November					
11/8/77	-	1	Ediz Hook		O.S.
December					
12/4/76	-	1	Gooseberry Pt, Lummi Pt		H.L.

Strait of Juan de Fuca (Figures 20 to 22). In September 1976 and again in April 1977 several sightings were reported from Southern Puget Sound indicating a straggler is capable of penetrating any of the waters of Puget Sound. Few sightings were made in the San Juan Island area. A gray whale was sighted in Chukanut Bay (near Bellingham) three separate times on 24 June 1978. The few records from the western Strait of Juan de Fuca probably represent reduced effort of whale watchers, although we suspect this area has the largest number of gray whales passing through.

At least 20 individual gray whales can be accounted for (allowing for duplicate sightings) in the inland waters in recent years. This count is undoubtedly low and does not reflect the movement of animals in the western Strait of Juan de Fuca.

There are two recent specimen records for the inside waters. On 19 June 1978 a dead gray whale floating in Possession Sound was reported. This animal, an 8.1 m female calf, was towed to a beach near Edmonds where it was necropsied by J. Rodzilsky and other personnel of the Burke Museum, University of Washington, Seattle, Washington and personnel of the MMD. The skeleton will be retained in the Museum's collection. A second whale, entangled in a gillnet off Neah Bay, Washington on 14 September 1978 (MMD-78-003), was a young 8.37 m male (Table 19). Also entangled were several species of marine birds and one harbor seal pup. The whale was examined by Dr. R. Stroud (Oregon State University, Corvallis, OR.) and personnel of the MMD.

Ecological Problems

This species is protected internationally from commercial exploitation through a subsistance harvest is allowed for Siberian and Alaskan natives.

A developing tourist industry in southern California and Mexico are subjecting migrating animals to unknown levels of harassment from sightseeing and whale watching cruises. Movements of these tour vessels on the calving grounds are now restricted by the Mexican Government. As commercial development in these lagoon areas increase so does the potential for detrimental harrassment. Commercial barging has been shown to change distribution and habitat use in lagoons and bays (Gard, 1974). Some harrasment by small boat operators undoubtedly occurs when large whales are sighted in Washington.

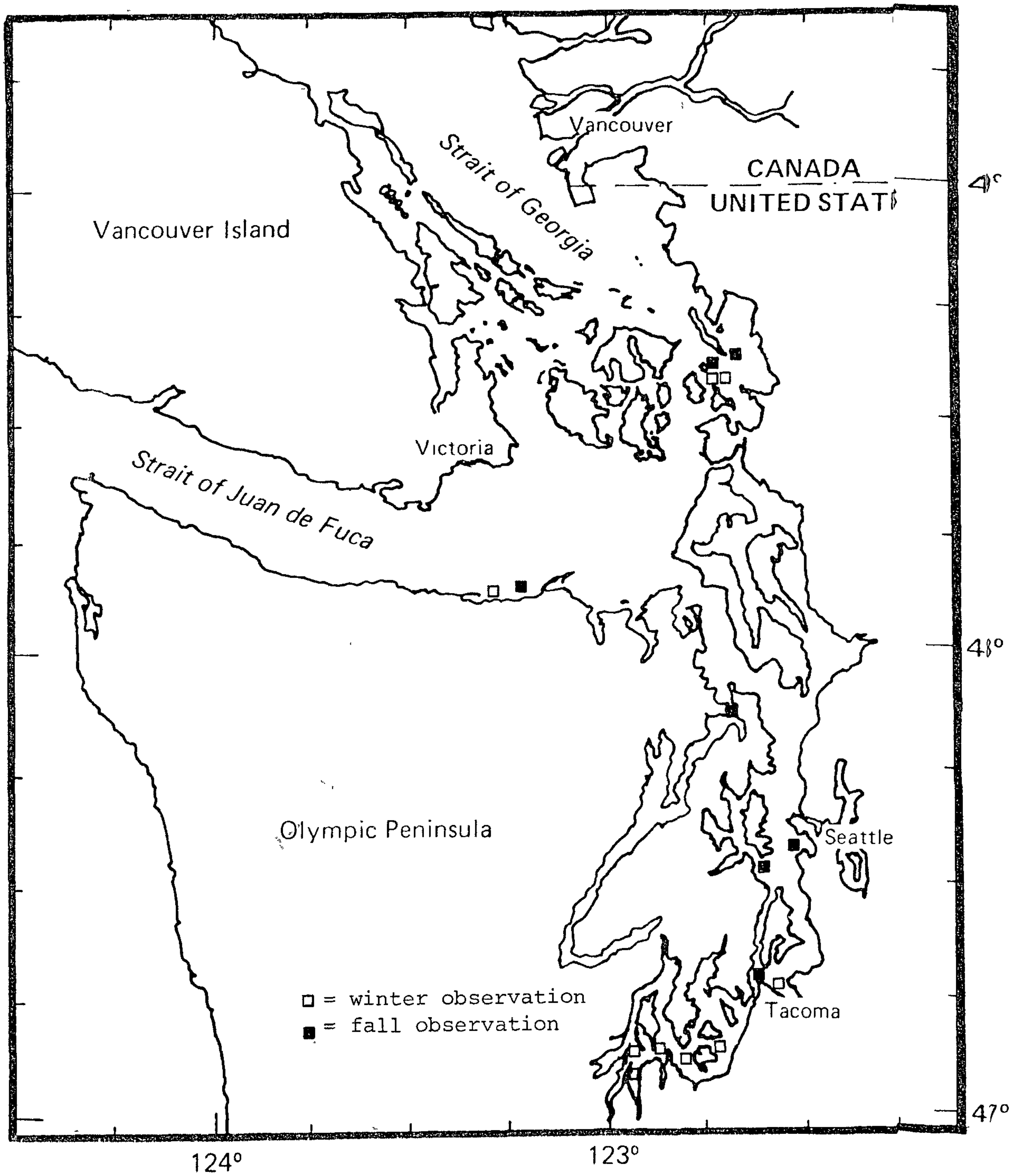


Figure 20. Distribution of gray whale (Eschrichtius robustus) sightings in fall (September-November) and winter (December-February) in Puget Sound and the Strait of Juan de Fuca (data from table 18).

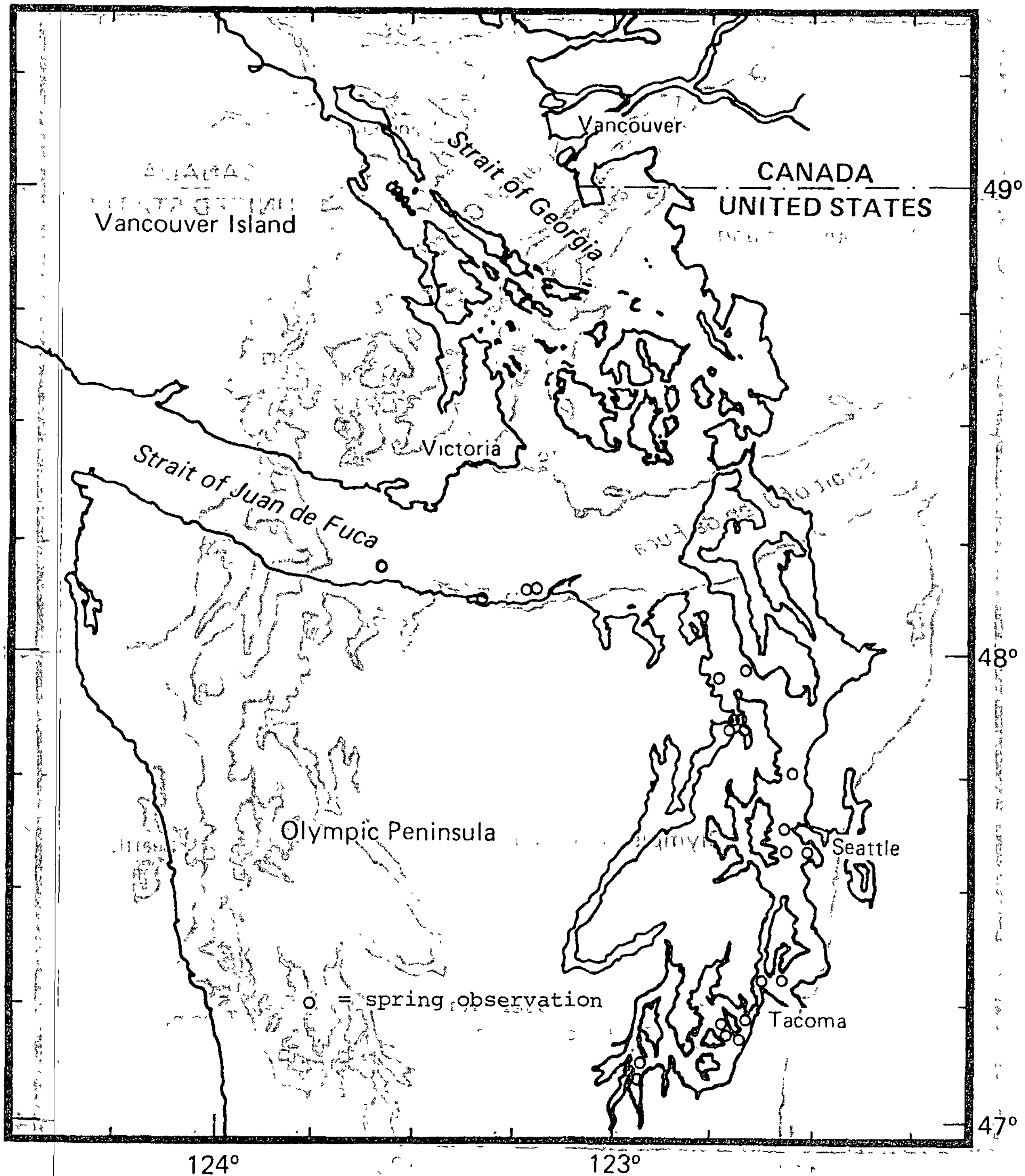


Figure 21. Distribution of gray whale (Eschrichtius robustus) sightings in spring (March-May) in Puget Sound and the Strait of Juan de Fuca (data from table 18).

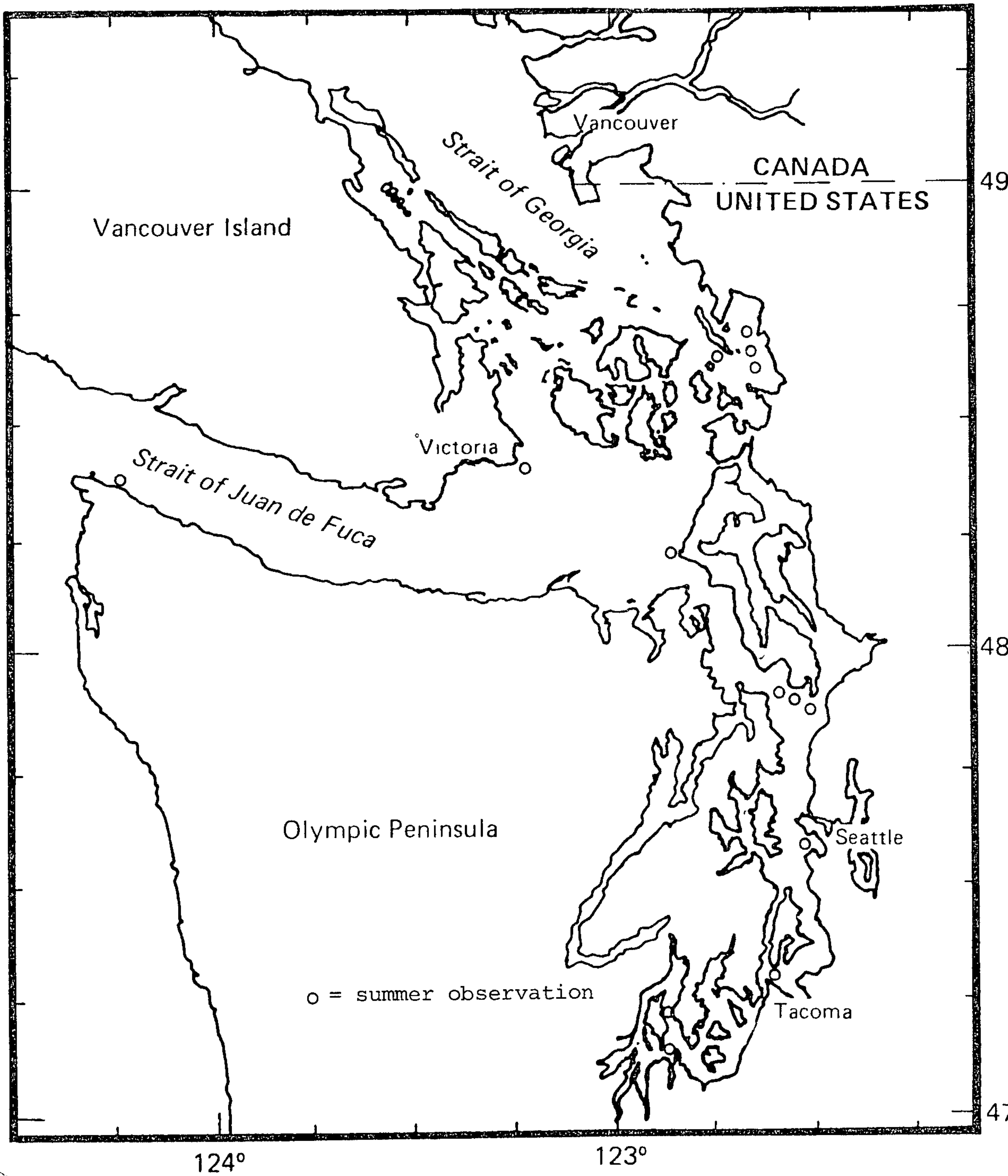


Figure 22. Distribution of gray whale (Eschrichtius robustus) sightings in the summer (June-August) in Puget Sound and the Strait of Juan de Fuca (data from table 18).

TABLE 19.--Measurements in m of a male gray whale (*Eschrichtius robustus*) drowned in a gill net and examined at Neah Bay, Washington on 14 September 1978. (MMD-78-003).

Measurement	Length (m)
Snout to notch of flukes	7.37
Snout to insertion of flipper	2.03
Snout to ear	1.70
Snout to center of blowhole	.96
Snout to eye	1.37
Snout to gape	1.25
Eye to ear	.38
Eye to angle of gape	.13
Snout to umbilicus	3.89
Snout to genital aperture	4.50
Snout to anus	5.23
Snout to throat creases	1.47
Blubber thickness (mid-lateral)	.07
Blubber thickness (mid-ventral)	.06
Throat crease length (max.)	1.27
Throat crease length (min.)	.69
Girth (max.)	4.17
Length, genital slit	.51
Anal opening	.05
Anterior length of flipper	1.32
Axillary length of flipper	.99
Maximum width of flipper	.51
Span of flukes	1.80
Width of flukes	.25

The effect of oil pollution on this species is unknown. Stranded animals were examined after the Santa Barbara oil leakage in 1969. No mortality could be attributed to the spill and most strandings appeared to have occurred prior to the spill (Brownell, 1971).

III-2-A-b. Minke Whale (Balaenoptera acutorostrata)

Species Description

The minke whale (Balaenoptera acutorostrata), referred to in the literature by other common names including, little piked whale and sharp-nosed finner, is the smallest member of the family Balaenopteridae. Geographically isolated populations are recognized as three subspecies: B. a. bonaerensis is found in the southern hemisphere; B. a. acutorostrata in the North Atlantic; and B. a. davidsoni in the North Pacific (Rice, 1977). The latter subspecies is the only one that occurs in Washington waters.

Minke whales rarely exceed 10 m or weigh more than 10,000 kg. In the North Pacific, breeding occurs from February to April and calves are born from January through May, peaking in March (Nishiwaki, 1972). The gestation period is 10 to 11 months. Sexual maturity is attained at length of 6 to 7 m for males and 7.3 m for females.

Because of its small size, the minke whale is of little importance to commercial whaling, however as the stocks of larger whales decrease or are protected, whaling emphasis could shift to this species. Historical records from local whaling stations indicate that this species was taken rarely in Washington (Scheffer and Slipp, 1948; Pike and MacAskie, 1969). Consequently local feeding habit data is scarce, stomach contents examined from specimens taken in other areas, indicates that this species exploits a variety of prey items including: euphausiids, small fishes, copepods, and squid (Scattergood, 1949, Omura and Sakuira, 1956 and Nemota, 1959).

Killer whales (Orcinus orca) are known to prey on this species. In 1976 in the Gulf of Alaska a pod of killer whales was observed to attack and kill a single minke whale (Fiscus et al., 1976). Hancock (1965) describes the attack and killing of a minke whale by killer whales in Barkley Sound, B.C. in May 1964. Predation by other animals (other than man) are not known.

Distribution and Abundance

B. a. davidsoni is distributed throughout the North Pacific. In the eastern North Pacific it ranges north into the polar pack ice and south to Baja California during the summer. This distribution shifts south in winter, extending to just north of the equator. Migration through Japanese waters occurs during the spring and summer months (northward) and fall and winter months (southward) (Nishiwaki, 1972).

Rice (1974) states that this species may be near carrying capacity in the North Pacific, though not enough data was available to quantify the abundance. Nishiwaki (1972) suggested this stock was composed of about 10,000 animals.

Local historical records summarized by Scheffer and Slipp (1948) consisted of reports of dead or collected animals. These records occurred on the coast, in Admiralty Inlet, and from several locations in Puget Sound. Of the five records for British Columbia compiled by Pike and MacAskie (1969) none were from inland waters. Two of the records reported by Scheffer and Slipp (1948) were of whales in freshwater tributaries. One near McAlister Creek (Nisquallly Valley) in 1929 and the second, killed by local residents in the Snohomish River in 1938. These occurrences in freshwater are undoubtedly rare since none have been reported in the past 40 years.

A recent stranding in Puget Sound was of a 4.91 m male near Long Branch, Washington in the Southern Sound on 15 April 1964 (Table 20). The stranded animal was reported by Mrs. D.F. Johnson and was examined by G. Baines and R. Peterson on 29 April 1964. Photographs and field notes are on file at the MMD. This record represents the southernmost stranding of this species in the Sound.

Distribution of minke whale in the study area by season is depicted in Figures 23 to 25, taken from observation summaries (Table 21). The paucity of sightings in fall-winter imply that there is some movement out of these waters in those seasons, although sighting effort is greatly reduced during these months. Records from areas of heavy boat use (i.e. Admiralty Inlet and the San Juan Islands) indicate that some animals remain in the area year round. Sightings in the spring and summer are common and this species is regularly found near productive banks (e.g. Partridge Bank, Hein Bank, and Middle Bank), where the

TABLE 20.--Measurements in m of a minke whale (Balaenoptera acutorostrata) that stranded near Long Branch, WA)approx. location: Lat 47°10'N long 122°50'W) on 15 April 1964.

Measurement	Length (m)
Snout to notch of flukes	4.91
Snout to insertion of flipper	1.41
Snout to center of blowhole	.55
Snout to center of eye	.78
Snout to gape	.80
Notch of flukes to genital aperture	1.35
Notch of flukes to anus	1.30
Anterior length of flipper	.64
Maximum width of flipper	.14
Span of flukes	1.28

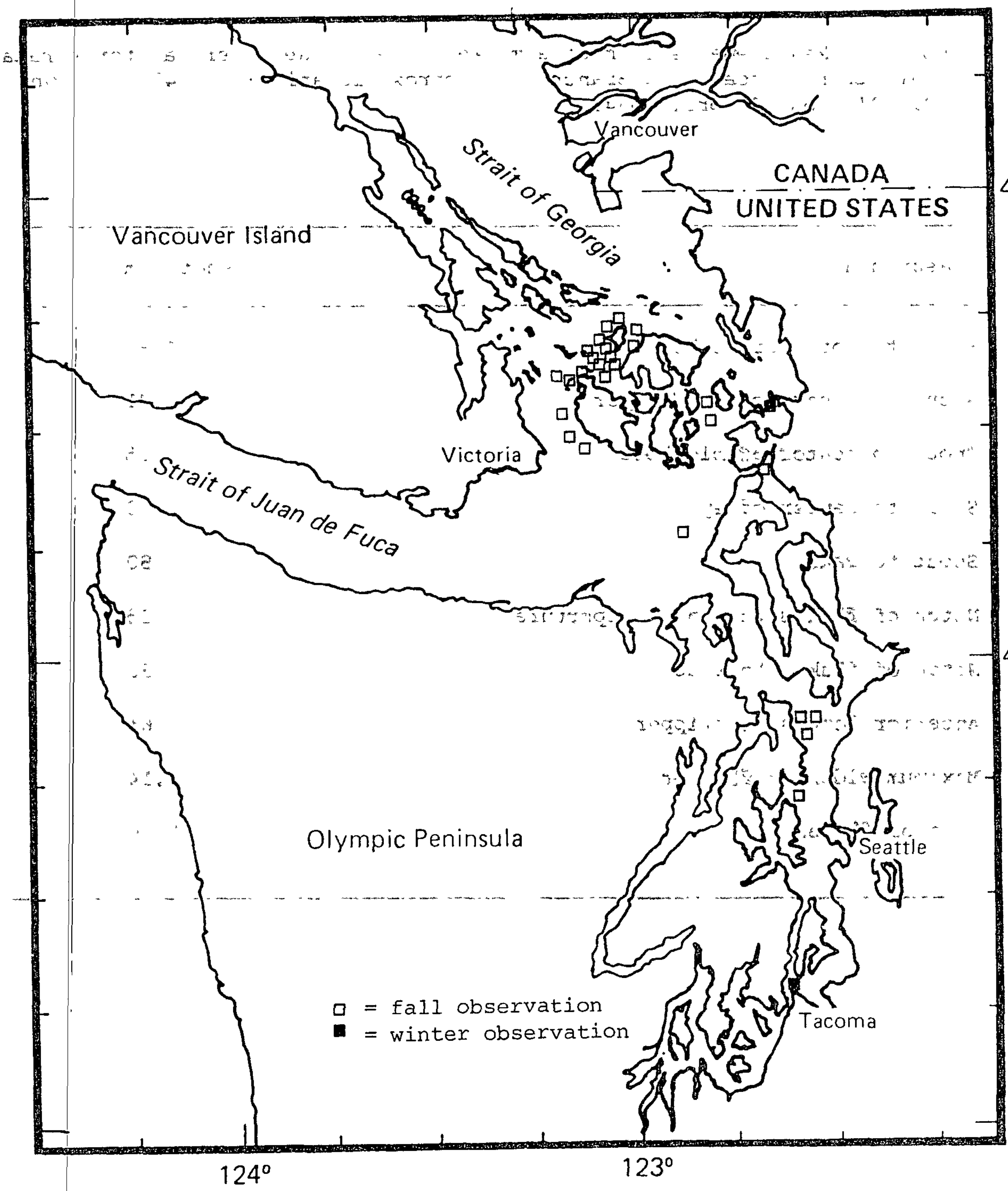


Figure 23. Distribution of minke whale (Balaenoptera acutorostrata) sightings in fall (September-November) and winter (December-February) in Puget Sound and the Strait of Juan de Fuca (data from table 21).

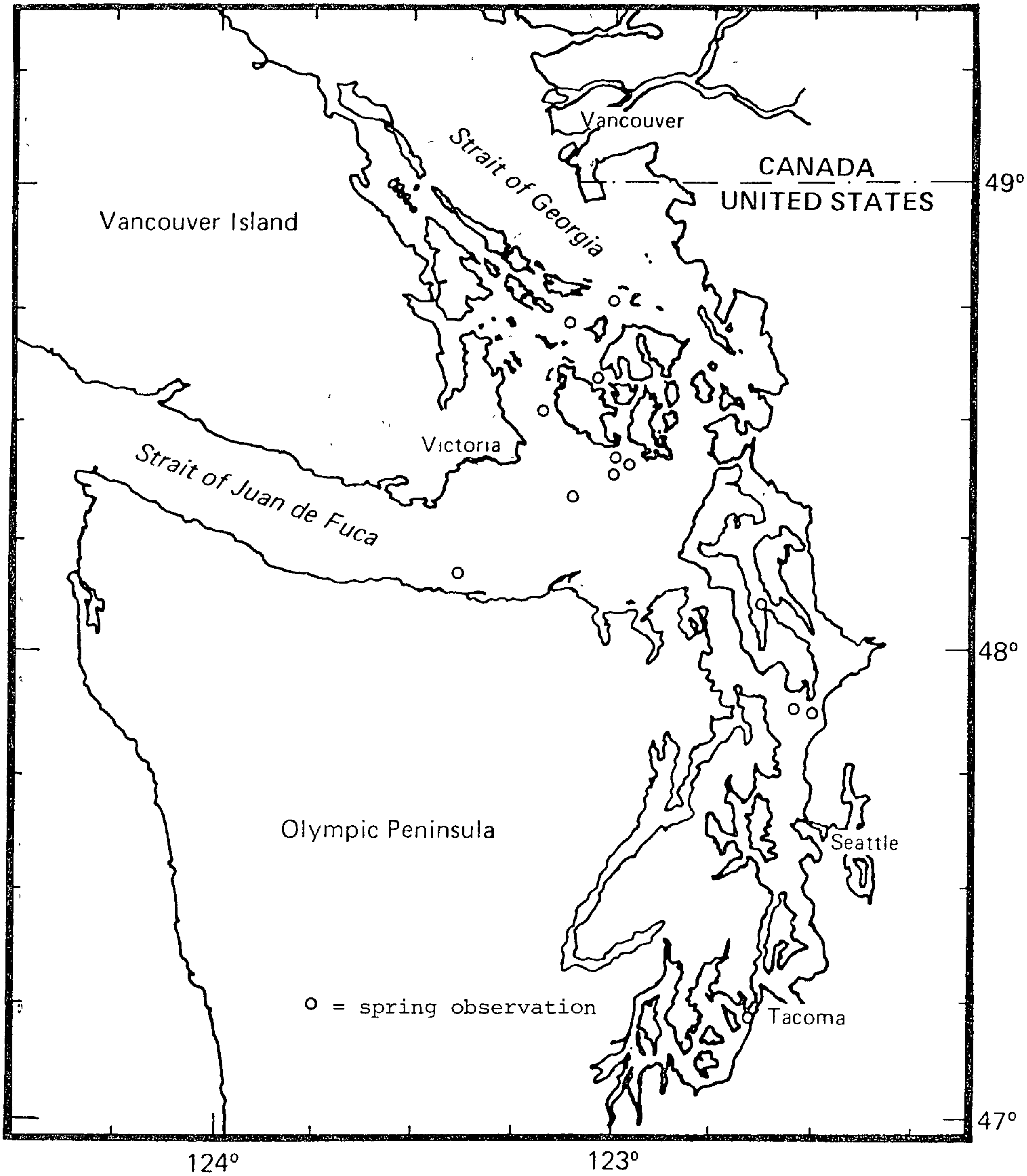


Figure 24. Distribution of minke whale (Balaenoptera acutorostrata) sightings in spring in Puget Sound and the Strait of Juan de Fuca (data from table 21).

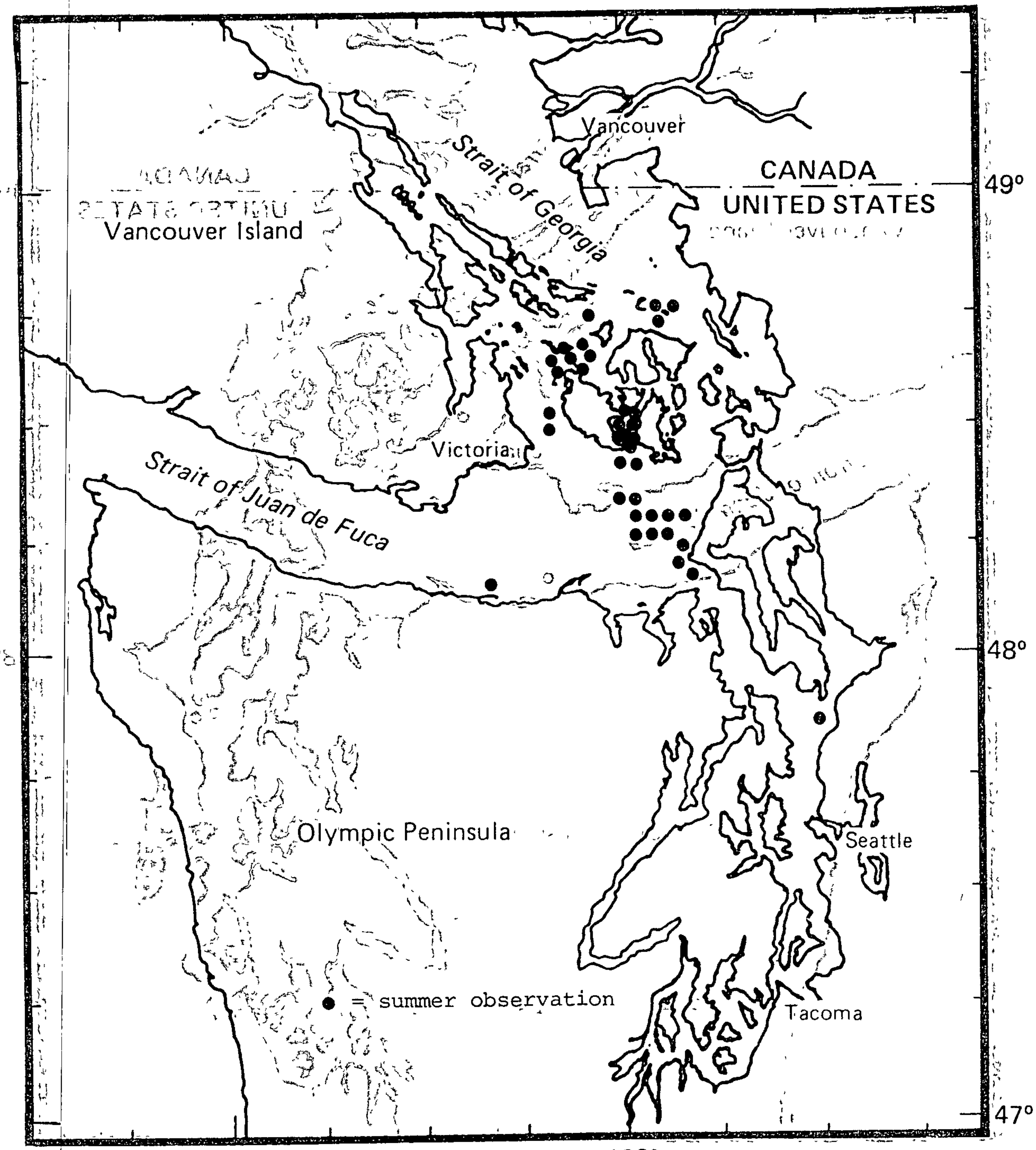


Figure 25. Distribution of minke whale (Balaenoptera acutorostrata) sightings in summer (June-August) in Puget Sound and the Strait of Juan de Fuca (data from table 21).

TABLE 21.-Recent observations of minke whales (Balaenoptera acutorostrata) for the inland waters of Washington. Sightings are presented by month. Records compiled at the Marine Mammal Division, NWAFC, Seattle, Washington, are described as files; records from the Platforms of Opportunity Program are described as POP; records reported to the Whale Hotline (NMFS funded) are described as H.L.; records from Orca Survey (Moclips Cetological Society) are described as O.S. Dashed lines indicate data not available.

Date	Time	No.	Location	Comments	Source
January					
1/27/78	1035	1	Gig Harbor		H.L.
March					
3/29/78	0748	1	Andrews Bay		H.L.
April					
4/22/76	1427	1	Hein Bank		O.S.
4/29/76	1830	2	Salmon Bank		O.S.
4/10/78	1400	1	Tacoma Narrows		H.L.
4/14/78	1600	1	Shaw I., San Juan Channel		H.L.
4/15/78	1400	1	N. Camano Is.		H.L.
4/22/78	1730	1	Sandy Pt., Waldron I.		H.L.
4/30/78	0930	1	Cattle Pass		H.L.
4/30/78	1300	1	Cattle Pass		H.L.
May					
5/1/76	1610	1	Cattle Pass		O.S.
5/7/78	1400	1	Boundary Pass		H.L.
5/31/78	1300	1-2	Possession Pt.		H.L.
5/31/78	2000	1-2	Sachet Hd., Whidbey I.		H.L.
June					
6/2/76	1505	1	Partridge Bank		O.S.
6/2/76	1520	1	Partridge Bank		O.S.
6/14/76	1115	1	Hein Bank		O.S.
6/17/78	1200	2	Hein Bank		H.L.

TABLE 21.--Cont.

Date	Time	No.	Location	Comments	Source
July					
7/6/65	-	1	W. San Juan I.	Hunted unsuccessfully	Fiscus & Kajimura (1965)
7/7/65	-	2	San Juan Channel	"	"
7/7/65	-	3	" " " .Shaw I.	"	"
7/8/65	-	1	" " "	"	"
7/8/65	-	2	" " "	"	"
7/9/65	-	2	" " " , Turn I.	"	"
7/9/65	-	1	N. San Juan Channel	"	"
7/9/65	-	1	Speiden Channel	"	"
7/9/65	-	1	Griffin Bay to Cattle Pt.	"	"
7/10/65	-	2	San Juan Channel	"	"
7/11/65	-	2	Partridge Pt.	"	"
7/12/65	-	1	San Juan Channel	"	"
7/14/65	-	3	" " "	"	"
7/2/76	1005	2	S.W.Smith I.		O.S.
7/2/76	1507	1	Haro St.		O.S.
7/25/76	1500	2	S. Haro St.	Tentative I.D.	H.L.
7/28/76	1105	2	Cattle Pt.		O.S.
7/29/76	0925	1	Speiden Channel	Tentative I.D.	H.L.
7/30/76	0600	1	off Friday Harbor	Tentative I.D.	H.L.
7/4/78	1430	1	Ebbey Landing		H.L.
7/15/78	1400	1-2	Skipjack I.		H.L.
7/15/78	1630	1	E. Smith I.		H.L.
7/17/78	-	1	Limestone Pt. SJI		H.L.
7/19/78	0912	1	Partridge Bank		This study
7/19/78	0955	1	Speiden Channel		This study
7/19/78	1130	2	Possession Pt		H.L.
7/19/78	AM	1	Speiden I.		H.L.
7/19/78	PM	1	Partridge Bank		H.L.

TABLE 21.--Cont.

Date	Time	No.	Location	Comments	Source
August					
8/5/76	1835	1	Speiden Channel	Tentative I.D.	H.L.
8/9/76	2100	1	W. Jones I.	Tentative I.D.	H.L.
8/10/76	1120	1	Salmon Bank		O.S.
8/14/76	1600	1	E. Sucia I.	Tentative I.D.	H.L.
8/14/76	1820	1	W. Matia I.		O.S.
8/17/76	1040	2	W. Smith I.		O.S.
8/24/76	1730	1	W. Shaw I.	Tentative I.D.	H.L.
8/24/76	2030	1	N. Barnes I.	Tentative I.D.	H.L.
8/29/76	1200	1	Speiden Channel	Tentative I.D.	H.L.
8/3/77	1359	1	Partridge Bank		MMD (files)
September					
9/2/76	1547	1	President's Channel		O.S.
9/5/76	1840	1	Speiden Channel		O.S.
9/5/76	1900	1	Kellet Bluff		O.S.
9/6/76	0700	1	Hansville		H.L.
9/6/76	1430	1	Waldron I.		O.S.
9/9/76	1217	1	N. James I.	Tentative I.D.	H.L.
9/10/76	0655	1	off Bremerton	Tentative I.D.	H.L.
9/10/76	0912	1	Middle Pt., Rich Passage	Tentative I.D.	H.L.
9/10/76	1100	1	James I.		O.S.
9/10/76	1130	1	E. Middle Pt.	Tentative I.D.	H.L.
9/11/76	1411	2	Battleship Rk.		O.S.
9/13/76	1345	1	E. Deception Pass	Tentative I.D.	H.L.
9/14/76	1600	1	Speiden Channel	Tentative I.D.	H.L.
9/16/76	1330	1	Speiden Channel	Tentative I.D.	H.L.
9/17/76	1700	2	W. Speiden I.		O.S.
9/17/76	1950	1	N. Speiden I.	Tentative I.D.	H.L.
9/20/76	1300	2	N. Speiden I.	Tentative I.D.	H.L.

TABLE 21.--Cont.

Date	Time	No.	Location	Comments	Source
<u>September</u>					
9/20/76	1540	1	Hansville	Tentative I.D.	H.L.
9/21/76	1745	1	Limestone Pt., S.J.I.		O.S.
9/24/76	1300	1	W. Smith I.		O.S.
9/25/76	1648	1	N. Henry I.		O.S.
9/27/76	1300	2	Speiden Channel	Tentative I.D.	H.L.
9/29/76	1500	1	S. Waldron I.	Tentative I.D.	H.L.
9/30/76	1250	1	N. Speiden I.	Tentative I.D.	H.L.
9/10/77	1340	1	Griffin Bay		MMD(files)
9/10/77	1354	2-3	off Lime Kiln		MMD(files)
<u>October</u>					
10/2/76	1345	1	Pt. No Point	Tentative I.D.	H.L.
10/4/76	1825	1	N.E. Speiden I.		O.S.
10/5/76	0900	1	Hansville	Tentative I.D.	H.L.
10/8/76	1845	1	Pt. No Point	"	"
10/16/76	1715	1	Pt. No Point	"	"
10/20/76	1310	1	S.W. Jones I.	Tentative I.D.	H.L.
<u>December</u>					
12/20/76	1425	1	W. Hat I.	Tentative I.D.	H.L.

abundance of small fishes and other potential prey items are greatest. The northern part of Haro Strait is also important, sightings are made there regularly throughout the year. Sighting reports of this species by the public are greatest in April-September (Boran and Osborne, 1978).

Minke whales appear to remain in more protected waters than other Balaenoptera. Observations in the Strait of Juan de Fuca are rare, although their presence in that area is known from a subsistence native take in the vicinity of Cape Flattery. Wahl (1977) reported a sighting offshore from Westport, Washington. Coastal records have also been compiled in POP data files.

Rice (1974) describes this species as abundant in the Puget Sound area though offers no estimates. Examination of the data suggests that at least 15-20 animals may be present in summer, assuming duplicate sightings, although this figure may underestimate the acutal population size.

Ecological Problems

This species is taken in the nearshore fishery off Japan, and in the past, other nearshore fisheries, but is not taken in any substantial amount by the high seas whaling fleets. Aboriginal whaling on the west coast of North America for this species has not occurred in modern times.

III-A-2-c. Fin Whale (*Balaenoptera physalus*)

Species Description

Two forms of this species are recognized, in the southern hemisphere *B. p. quoyi* occurs and a smaller form *B. p. physalus* is recognized in the northern hemisphere (Rice, 1977). This species is one of the largest whales, second only to the blue whale (*Balaenoptera musculus*) and may reach 23.2 m in length. This species is usually sighted in small pods, data from Fiscus et al. (1976) for the North Pacific and Gulf of Alaska show average group size of fin whales to be 1.67, ranging from 1 to 4 individuals (n=48). Sexual maturity occurs from 6 to 12 years of age, which corresponds to a body length of 17.7 m. Mating and calving occur in the winter and females give birth every 2 or 3 years. The gestation period lasts about 1 year.

Primary prey items for fin whales are euphausiids, although anchovies are taken in some areas of the North Pacific. Seasonal movements correlate with seasonal abundance of food resources (Nemoto and Kasuya, 1965).

Distribution and Abundance

B. physalus occurs in all oceans of the world, but is rarest in tropical and polar areas (Rice, 1977). In the eastern North Pacific, this species summers from California northward into the Chukchi Sea.

Presently the North Pacific stock of fin whales is considered below maximum sustainable yield level and has been protected from commercial harvest since 1976 (MMPA 1978). The original stock size has been estimated at 44,000; the current level is approximately 17,000 (Osburn and Wada, 1975). The number of animals of legal (harvestable) size may approximate 9,000 (Rice, 1974).

Fin whales occur in Hectate Strait and Queen Charlotte Sound, occasionally appearing in the Strait of Georgia (Pike and MacAskie, 1969). Fin whales were important in the catch of both British Columbia and Washington whaling stations (Scheffer and Slipp, 1948). Eaton (1975) determined this species to be potentially threatened with extinction in Washington waters.

While primarily an offshore oceanic species, a few records from the inland waters of Washington are known. A probable fin whale appeared in Puget Sound and was harpooned near Pt. Defiance in 1915 (Scheffer and Slipp, 1948). The whale was estimated to be 20.3 m in length and was not captured. A second record, in August, 1930 was of a single animal first seen near Shelton (Scheffer and Slipp, 1948). The whale was eventually killed after several days of pursuit by local residents. It was a male estimated at 17.2 m to 18.8 m in length. A few strandings of fin whales are known from the coast, but these two reports constitute the only confirmed occurrences of fin whales in inland Washington waters, no recent record are known. The heavy commercial harvest of this species has reduced the probability of traditionally rare occurrences. Any new sightings might be expected from the Strait of Juan de Fuca which is most accessible to this oceanic species.

Ecological Problems

Other than the harvest by whaling nations which is regulated by the International Whaling Commission, none are known.

III-A-2-d. Humpback Whale (*Megaptera novaeangliae*)

Species Desciption

The humpback whale (*Megaptera novaeangliae*) is geographically isolated into three separate populations, though no subspecies are recognized. These stocks are located in the North Pacific Ocean, North Atlantic Ocean, and southern hemisphere. Mature animals reach lengths up to 15.6 m and sexual maturity is attained at 6 to 12 years (Wolman, 1978). In the North Pacific breeding and calving occurs in the winter months and is centered in the Hawaiian Islands and off Baja California. Gestation lasts for a year terminating in birth of a single calf; births occur in successive years.

Megaptera are often observed engaged in spectacular behavioral displays including breaching and tail lobbing, the functions of which are unknown. One behavioral trait that is partially understood, is bubblenet feeding which is used to restrict movement of prey. Humpbacks feed primarily on euphausiids,but do occasionally take smaller fishes. During bubblenet feeding a series of air bubbles are released enclosing a school of fish, the whale then can lunge through the prey for maximum feeding efficiency (Wolman, 1978).

Abundance and Distribution

Humpback whales are distributed nearly worldwide, but do not extend into polar ice areas (Rice, 1977). In the North Pacific seasonal migrations take place from productive feeding grounds in high latitudes in summer to tropical waters in winter. Temporal separation by age and sex occurs during migration. Humpback migration pathways are little known, animals wintering in the Hawaiian Islands are thought to move into the Aleutian Islands in summer, while animals wintering off Mexico probably move northward along the coast to summer in Southeast Alaska and the Gulf of Alaska. These migrants reach Vancouver Island in May or June (Wolman, 1978). The catch of this species by local whaling stations began in the spring and increased through summer before a rapid decrease in take, implying that some of these migrant animals lingered in the area before departing southward in the fall (Scheffer and Slipp, 1948). During the first half of this century humpbacks were the most common of the larger whales in the inland waters and regular reports of these animals in Southern Puget Sound were made (Scheffer and Slipp, 1948).

The original population size of the North pacific stocks numbered about 15,000 animals and intensive whaling reduced this population to its present level of about 850 (MMPA 1978). The other two geographic stocks suffered similar exploitations. Complete protection was given humpback whales in 1964, though no significant population increase has been noted. The humpback is now one of the rarest whales, second only to the two right whales *Balaena glacialis* and *Balaena mysticetus*.

The humpback was the most important commercial whale locally early in this century and as the stock diminished, it contributed less to the harvest (Scheffer and Slipp, 1948; Pike and MacAskie, 1969). Commercial extinction of this species led to the demise of whaling in Washington. Since the 1940's, records of humbacks in the inland waters of Washington are rare. Two recent sighting records (Table 22; Figure 26) came from nearly the same area, though separated by two years. On May 7, 1976, two humpback whales were observed from the Seattle-Winslow ferry, both animals were breaching. Photographs were sent to Lt. R.W. Mercer (NOAA Corps) who verified the identification and made the sightings available. Four humpbacks near the Fauntleroy district, Seattle, Washington, were reported in September 1978. These records confirm that this species still inhabits its former range, though the rarity of records reflect the reduced population. No sighting of humpback whales was made during the present study. Although humpback whales at one time were common in the inland waters they can now be considered rare.

Ecological Problems

As shoreline development continues in the breeding range, impact from resultant harassment may hinder the recovery of this stock.

TABLE 22.--Recent observations of humpback whales (*Megaptera novaeangliae*) for the inland waters of Washington. Sightings are presented by month. Records compiled at the Marine Mammal Division, NWAFC, Seattle, Washington are described as files; records from the Platforms of Opportunity Program are described as POP; records reported to the whale hotline (NMFS funded) are described as H.L. Dashed lines indicate data not available.

Date	Time	No.	Location	Comments	Source
May					
5/7/76	1403	2	Restoration Pt., Bainbridge I.	Observed from ferry, photos verified I.D.	POP
September					
9/7/78	1000	4	off Fauntleroy	Movoing north	H.L.

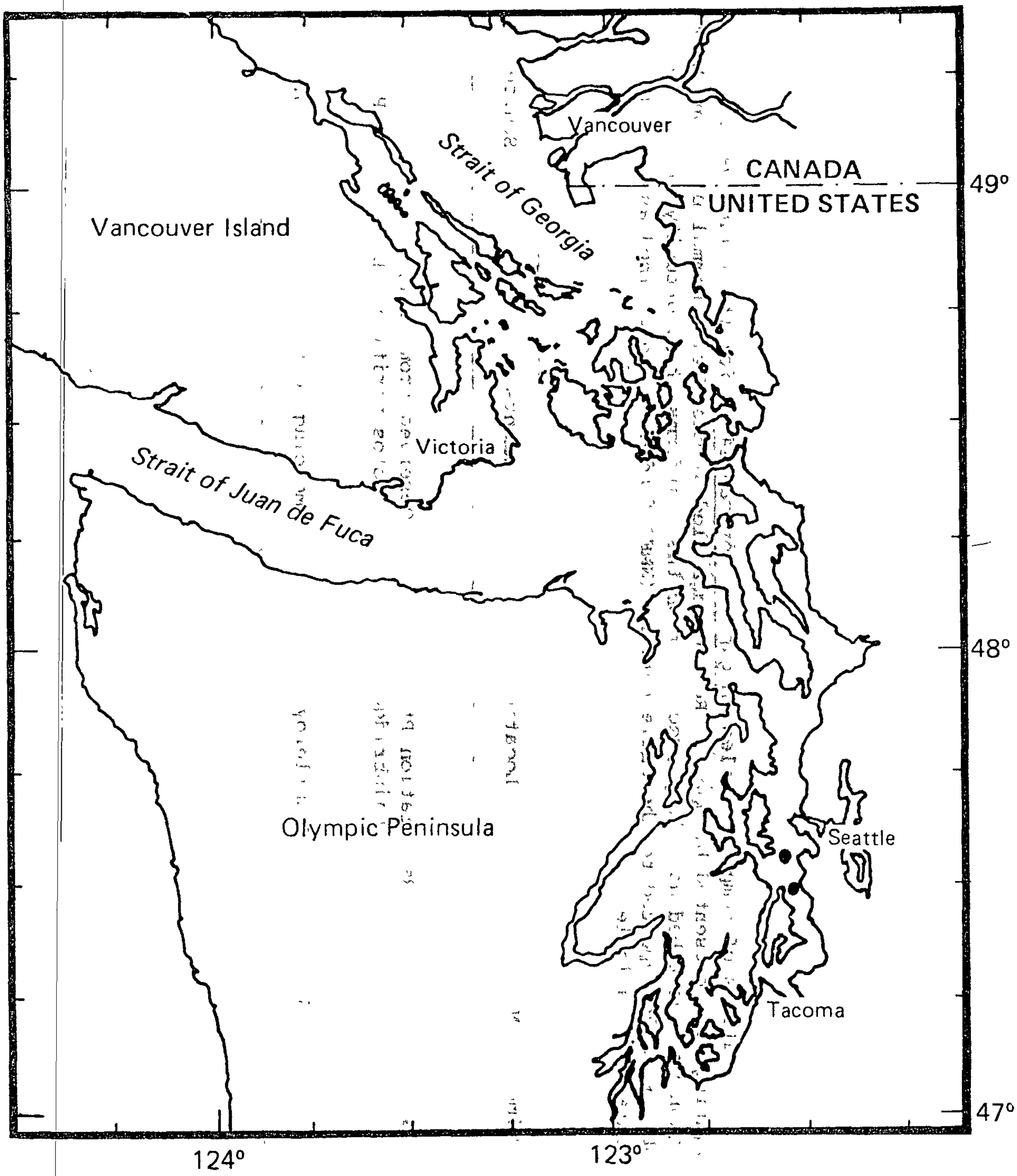


Figure 26. Location of two humpback whale (Megaptera novaeangliae) sightings in Puget Sound (see table 22).

III-A-3. Order: Odontoceti

Three families of the Odontoceti: Delphinidae, Physeteridae, and Ziphiidae are known to occur in the study area. Most of the current indormation on the members of thse families comes from sighting data collected by various research groups and organizations. Several new specimen records are reported.

III-A-3-a. Whitehead Grampus (Grampus Griseus)

Species Description

The whitehead grampus (Risso's dolphin) (Grampus griseus) is little known in the North Pacific Ocean. Information available is restricted to rare pelagic observations and data obtained from a few strandings. This species may attain a length of 4.0 m and its skin is characteristically marked by numerous white scratches which may be caused by other individuals of the species.

Of the few stomachs available for examination only cephalopods have been reported (Guiguet and Pike, 1965; Stroud, 1968). One stomach of an animal stranded in British Columbia contained only eelgrass, which suggested to the author that cetaceans may ingest some vegetables when sick (Hatler, 1971).

Abundance and Distribution

G. griseus is distributed through all temperate and tropical seas (Rice, 1977). The first specimen from North America since the late 19th Century was a male found in 1963 near San Mateo, California (Orr, 1966). Based on pelagic observations of this species, Fiscus and Niggol (1965) extended its range in the eastern North Pacific to northern California. Since then other sightings have been reported further north. On 20 April 1972, Fiscus sighted one of the largest pods ever reported, numbering about 200 animals, 44 miles west of Cape Alava, Washington. The first specimen record for this species north of California was from an animal shot near Stuart Island, British Columbia in May 1964 (Guiguet and Pike, 1965). Sighting records of this species from a fixed weathership (lat. 50°N long 145°W) in 1958-1960 confirmed this range extension (Guiguet and Pike, 1965; Pike and MacAskie, 1969). The first record for Washington State occurred on 20 April 1967 when a young male *Grampus* was found at Mukkaw Bay just south of Cape Flattery on the outer coast (Stroud, 1968). A third specimen from this area was reported stranded on the west side of Vancouver Island on 17 April 1970 (Hatler, 1971).

Since previous records of the species come entirely from coastal waters, the report of a recent stranding in the inland waters of Washington is of considerable interest. On March 10, 1975 a 3.28 m female *Grampus* stranded southwest of Port Townsend in Port Discovery. A pod of killer whales (*Orcinus orca*) were in the area at the time and appeared to turn the animal into the beach when it attempted to swim into open water. A successful rescue attempt was made by personnel of the Seattle Marine Aquarium and the animal was transported to a pool at the aquarium the next day. On 12 March 1975 the animal died. Measurements of this specimen (MMD specimen No. 1975-1) are presented in Table 23, skeletal parts are stored in the collection of the MMD. This animal represents the second stranding record for Washington and the first for inland waters, which was undoubtedly an accidental occurrence for this area.

Table 23.--Measurements in m of a female Risso's Dolphin (*Grampus griseus*) stranded in Port Discovery, Washington, 10 March 1975. (Specimen No. MMD-1975-1).

Measurement	Length m
Snout to notch of flukes	3.27
Snout to insertion of flipper	.62
Snout to center of blowhole	.30
Snout to center of eye	.32
Notch of flukes to umbilicus	1.85
Anterior length of flipper	.71
Maximum width of flipper	.20
Height of dorsal fin	.47
Span of flukes	.87
Width of flukes	.25
Blubber thickness[1]	.028

[1] Mid lateral, opposite dorsal fin.

Ecological Problems

Unknown.

III-A-3-b. Pacific Whiteside dolphin (Lagenorhychus obliquidens)

Species Description

The Pacific Whiteside dolphin (Lagenorhychus obliquidens) is an oceanic species common off the coast of North America (Pike, 1956). This species attains an adult length up to 2.3 m and can weigh 180 kg. Birth and breeding occur from spring to summer, and the gestation period is approximately 10 to 12 months (Nishiwaki, 1972). Lagenorhyncus are gregarious and sightings of large schools are not uncommon. A pod of 1000+ was observed off the coast of British Columbia in 1959 (Pike, 1960). Large groups (200-250) are common in inside waters in the winter, smaller groups are seen during summer (Pike and MacAskie, 1969).

This species preys primarily upon cephalopods though stomach contents have been reported that contain anchovy and hake (Fiscus and Niggol, 1965).

Abundance and Distribution

Lagenorhynchus obliquidens ranges in the waters off North America from the Gulf of Alaska to Baja California and off the Asian coast (Rice, 1977). They are most commonly found beyond the 100 fm depth curve but inside the 1,000 fm curve (Fiscus and Niggol, 1965). Reports from inside waters in British Columbia and Washington are not uncommon. The species is found year round in coastal California waters, some seasonality is apparent in the northern areas. No estimate of abundance is available for the population off the North American coast, though it is considered one of the most abundant dolphins off California (MMPA 1978). The population in Japanese waters has been estimated at 30,000 - 50,000 (Nishiwaki, 1972).

Strandings of Pacific whiteside dolphins are not uncommon in Washington. Most records come from coastal areas (Scheffer and Slipp, 1948; Scheffer, 1950; Cowan and Guiget, 1952). A recent stranding of this species at the LaPush River was reported on 3 May 1978 (Boran and Osborene, 1978). A female was collected in the Strait of Juan de Fuca in 1936, which may be the only modern specimen record from inland waters (Scheffer and Slipp, 1948).

Observations of Lagenorhynchus in Washington coastal waters are common. Fiscus and Niggol (1965) report records as far north as Pt. Grenville. Recent records from British Columbia and northern Washington were summarized by Pike and MacAskie (1969). They suggested that this species moves inshore into protected waters in winter months and in the summer move to offshore areas. Group sizes were larger in the winter than summer. Cowan and Guiguit (1965) also report inshore movements in winter in waters north and south (Strait of Juan de Fuca) of Vancouver Island. The only recent record we have from Puget Sound come from an observation of 7 animals north of Foulweather Bluff in Admiralty Inlet on 5 September 1975. This suggests that Lagenorhynchus rarely enter these waters and restrict themselves to the Straits. No observations of Lagenorhynchus were made during the present study.

Ecological Problems

Unknown.

III-A-3-c. Saddleback Dolphin (Delphinus delphis)

Species Description

The saddleback dolphin (Delphinus delphis), also known as the whitebelly or common dolphin, demonstrates geographical variations in several characteristics (Rice, 1977) and may be separated into other distinct species in the future. Adult males in the North Pacific attain lengths of 2.6 m, females are slightly smaller. Two mating seasons occur in the North Pacific, January to April and August to November. Estrus occurs after parturition, two calving periods (January to April; August to November) are thus closely correlated with the mating season. Large aggregations beyond the 100 fathom line are often seen in tropical waters where this species occur most frequently offshore (Leatherwood and Reeves, 1978).

Some feeding habits has been documented and in the North Pacific primary prey items include anchovy, cephalopods and lantern fish.

Abundance and Distribution

Dephinus delphis is widely distributed in warm temperature and tropical waters including the Black Sea (Rice, 1977). In the eastern North Pacific the northern limit of the range occurs off northern California. This species is present off southern California throughout the year but is most abundant in August through January (Evans, 1975). A population estimate for the eastern tropical Pacific in 1976 was 1.4 million (MMPA 1978).

No offshore sightings are known for Washington or British Columbia but its occurrence here is established by two specimens. A photograph taken of a stranded animal on the Washington coast in February 1942 is the only record for Washington (Scheffer and Slipp, 1948). The only record for inland waters is from a dead animal on the beach at Victoria, B.C., on April 8, 1953 (Guiguet, 1954). The stomach of this animal was filled with herring.

No new specimens or sightings have been verified in Washington in the past 25 years. This species can be considered of rare or accidental occurrence in the study area.

Ecological Problems

Delphinus is taken incidentally in the eastern tropical Pacific tuna purse-seine fishery. The take steadily increased from 4,000 in 1971 to 22,000 in 1973, but is still considered not great enough to adversely impact the population in that area (MMPA 1978).

An increase in the anchovy or squid fishery, major prey items of *Delphinus*, has potential to affect this population.

III-A-3-d. False Killer Whale (*Pseudorca crassidens*)

Species Description

The false killer whale (*Pseudorca crassidens*) its common name from a resemblance to the killer whale (*Orcinus orca*), however, this species lacks a tall dorsal fin and is completely black. Males are slightly larger than females, attaining a length of 6.1 m and females grow to 4.9 m (Scheffer, 1978). These animals are extremely gregarious and it is not uncommon to see groups of several hundred. The breeding period appears to be protracted over the year. Food habits are poorly known, but Pseudorca is thought to prey on squid and large fish.

Abundance and Distribution

Pseudorca is an oceanic species distributed through all temperate and tropical seas (Rice, 1977). This species rarely occurs north of Baja California, though some records are known in central California. Current abundance is unknown but this species is uncommon in most of its range (MMPA, 1978).

The only record north of California comes from a specimen that was shot and killed in southern Puget Sound in May, 1937 (Scheffer and Slipp, 1948). This animal (sex unknown) was about 5.4 m long and weighed 900 kg. It was described as being in poor physical condition and had suffered previous rifle and shotgun injuries. The occurrence of this single animal, so far north of its usual range, can be considered accidental.

Ecological Problems

This species occasionally interferes with the long line tuna fishery in the Gulf of Mexico (Scheffer, 1978). Mass strandings of Pseudorca occur occassionally, the cause of which is unknown.

III-A-3-e. Shortfin Pilot Whale (Globicephala macrorhynchus)

Species Description

Taxonomy of the genus Globicephala is unsettled. In the North Pacific Globicephala sieboldii is conspecific with Glopicephala macrorhynchus. The correct classification of these two forms and their relationship with the Atlantic form Globicephala melaena is currently under investigation. For the purposes of this report we will refer to shortfin pilot whales as G. macrorhynchus. These animals are known by other common names such as pothead and blackfish, names that refer to their large bulbous heads and coloration. The male can attain a length of 6.9 m while the female is slightly smaller, no more than 5.3 m long (Reilly, 1978). Little is known of the breeding biology of this species. The Atlantic species has been more extensively studied and may exhibit similar behavior. In _G. malaena_, females mature at 6 to 7 years of age, males at 12 and the peak calving period is the summer, though well-developed fetuses have been found in other seasons. Gestation may last as long as 16 months and cows give birth every three years. A social hierarchy occurs, with dominant males controlling a harem part of the year. Some species segregation by age and sex may occur.

Food habits of this species is not well described, though squid is a primary food item. In southern California the abundance and distribution of this species correlates with the presence of spawning squid (Reilly, 1978).

Abundance and Distribution

Globicephala macrorhynchus occurs in tropical and warm waters of the Atlantic, Indian, and Pacific Oceans (Rice, 1977). In the North Pacific it occurs off Japan and along the western coast of North America north to the Gulf of Alaska. The northern most record comes from a specimen taken near Kanatak on the Alaska Peninsula in 1937 (Orr, 1951). Three juveniles caught in a gillnet about 400 miles west of Dixon Entrance (British Columbia) represent the northernmost Canadian records (Pike and MacAskie, 1969). The largest numbers of this species occur in the eastern North Pacific in winter off California while fewer are observed in summer months (MMPA 1978).

In Washington the stranding of a 3.4 m animal near Queets, is the first state record (Scheffer and Slipp, 1948). Four sight records have been reported off northern Washington in 1957 and 1958 (Fiscus and Niggol, 1965). The only specimen record for the inland waters of Washington is from an animal captured by the Seattle Marine Aquarium in Pleasant Harbor, Hood Canal on 24 March 1968. This animal, a 3.05 m male, died in captivity six days later on 30 March 1968. Scientists from the MMD, examined and measured the carcase (Table 24).

In the three seasons that the public cetacean reporting system or "Whale Hotline" has been in operation, pilot

TABLE 24.--Measurements (in m) of a male shortfin pilot whale (Globicephala macrohynchus) captured in Pleasant Harbor, Hood Canal which died in captivity 30 March 1968. (Data from files at the Marine Mammal Division, Seattle, WA. Specimen #1968-106).

Measurement	Length
Snout to notch of flukes	3.05
Snout to tip of dorsal fin	1.50
Snout to insertion of flipper	0.54
Snout to ear	0.43
Snout to center of blowhole	0.31
SNout to center of eye	0.32
Snout to gape	0.25
Notch of flukes to genital aperture	1.30
Notch of flukes to anus	1.02
Girth behind flippers	1.64
Maximum girth	1.70
Anterior length of flippers	0.55
Axillary length of flipper	0.43
Maximum width of flipper	0.16
Length of base of dorsal fin	0.52
Height of dorsal fin	0.20
Span of flukes	0.70
Width of flukes	0.19

whales were reported only in 1978 (Table 25). Between 25-30 April 1978, 5 reports were made in southern Puget Sound of between 4 and 13 individuals. These observations were listed as tentative, but the descriptions were clear enough that members of Moclips Cetological Society, who received the reports, felt they were accurate identifications. Periodic observations continued in May and July indicating that either the original group was moving into other areas of Puget Sound or that new individuals were arriving. No reports occurred North of Middle Bank (Figure 27) for any season. These records for inland waters occurred only in the spring and summer.

The rarity of reports indicates that pilot whales occur accidentally in Washington inland waters. These occurrences could be in response to an unusual incursion of oceanic water or to a unique local variation in a food resource. This species can occur in the Strait of Juan de Fuca and any of the protected waters. No records are known north of Haro Strait or the Strait of Georgia.

Ecological Problems

This species is known to strand in large numbers periodically. The reasons for this phenomenon are unclear and are currently under investigation. *Globicephala* is taken in the Japanese small whale fishery, though the impact of this harvest on the population is not known.

III-A-3-f. Killer Whale (*Orcinus orca*)

Species Description

The killer whale (*Orcinus orca*) is one of the most frequently observed and reported marine mammal of Washington waters, thanks largely to the efforts of the Moclips Cetological Society's (Friday Harbor, Wa.) public education program, certain aspects of which are supported by the MMD. This group, through the use of newspaper advertisements, postcards, posters, and pamphlets, has encouraged the boating public to report whale sightings to a toll free number as part of a data collection system known as Orca Survey. Much of the recent information on *O. orca* reported here is used courtesy of this group. Observation of this species made during aerial surveys as part of this study

TABLE 25.--Recent observations of the shortfin pilot whale (Globicephala macrorhynchus) for the inland waters of Washington. Sightings are presented by month. Records compiled at the Marine Mammal Division, NWAFC, Seattle, Washington are described as files; records reported to the Whale Hotline (NMFS funded) are described as H.L. Dashed lines indicate data not available.

Date	Time	No.	Location	Comments	Source
April					
4/25/78	1400	7-13	Harstene I.	Tentative I.D.	H.L.
4/29/78	1444	--	Case Inlet	"	"
4/30/78	1100	5-10	Harstene I.	"	"
4/30/78	1330	4	Budd Inlet	"	"
4/30/78	1435	4	Harstene I.	"	"
4/30/78	1440	1	Holmes Hd., Whidbey I.	Tentative I.D.	H.L.
May					
5/4/78	1200	2	Case Inlet	Tentative I.D.	H.L.
5/13/78	AM	10	Middle Bank		H.L.
July					
7/22/78	1430	1	Eagle Pt., S.J.I.		H.L.
7/26/78	AM	1	Sequim Bay		H.L.

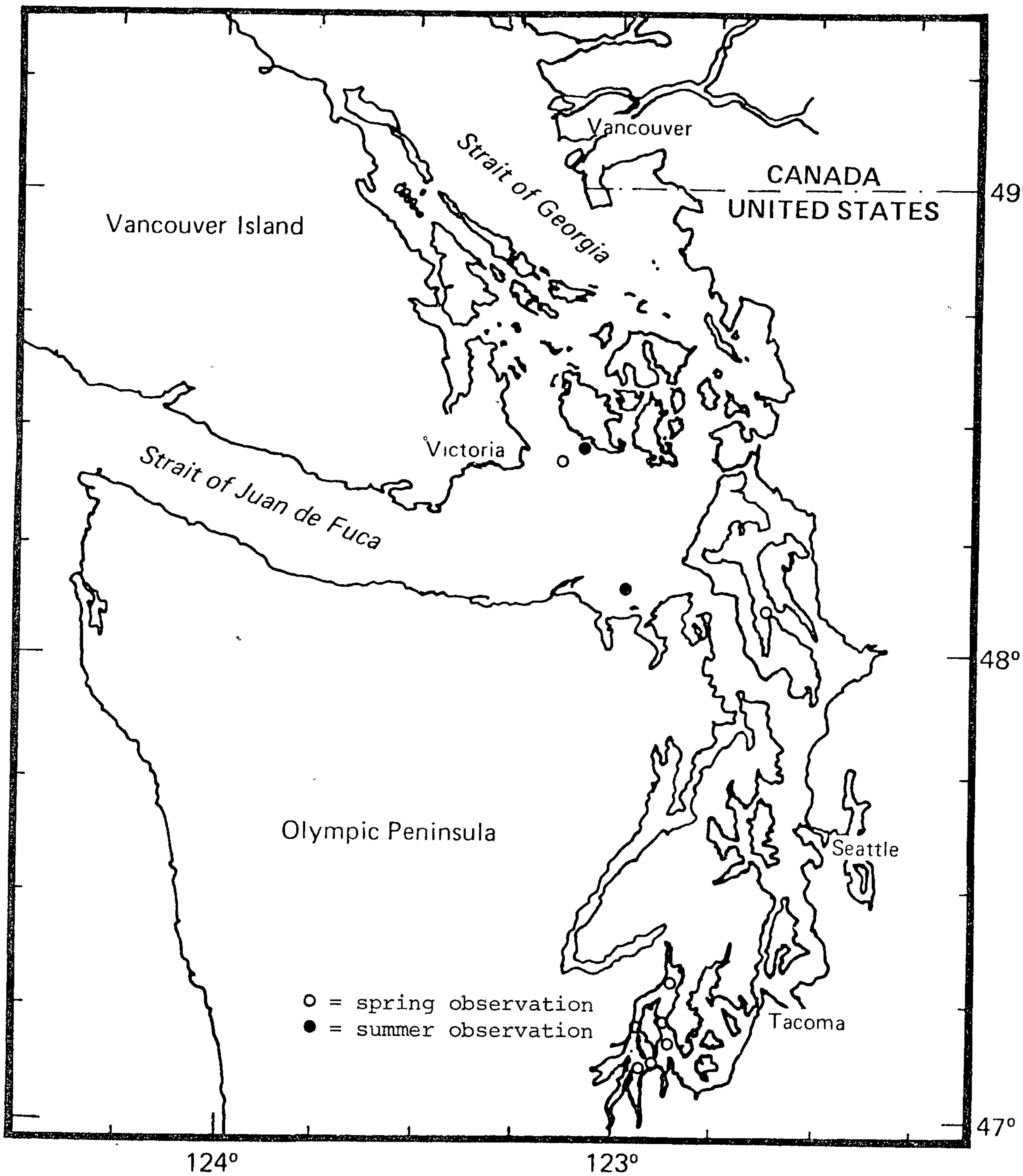


Figure 27. Distribution of pilot whale (Globicephala macrorhynchus) sightings in spring (March-May) and summer (June-August) in Puget Sound and the Strait of Juan de Fuca (data from table 25).

were relayed to Orca Survey and were incorporated into their recent report to the MMD (Boran and Osborne, 1978).

Local research on this species originated with government agencies in the United States and Canada in response to increased public interst in the capture and removal of animals for display. A method of identifying individual members of a family group or pod by use of photographs was developed by Canadian biologists (Bigg et al., 1976). Pods were identified by letter and individuals of each pod by number. This was the system adopted by Orca Survey and used in subsequent years (Balcomb and Goebel, 1976).

O. orca, the largest member of the family Delphinidae, are easily recognized by a large dorsal fin, which may reach one quarter of the body length in males, by light gray or white patches behind the fin, and by a white eye patch (Nishiwaki, 1972). In a study of specimens collected in Japanese coastal waters, adult males were 6.3 to 6.8 m long, and females were smaller, about 6.1 m (Nishiwaki, 1972).

Breeding apparently occurs year-round, though a peak in calving may occur in spring through summer (Scheffer and Slipp, 1948; Nishiwaki, 1972). Nishiwaki and Hander (1958) speculated that gestation in this species may last from 12 to 16 months. Balcomb (1978) observed an adult female (J-10) with a small calf, which he designated J-18 on 8 December 1977. Balcomb states that this female was observed to "...boisterously engage in sexual activity with an adult male, J-6..." some 15 months prior to this birth. In the same pod three calves have been born over the past three years. It is assumed that the pod contains 8 mature females; thus the birth rate for this period was 12.5% (Balcomb, 1978). Balcomb and Goebel (1976) suggested that the interval between births for a female is four years, which include a year or more of pregnancy, two years of nursing, and a year of resting.

Age determination in this species has been attempted by counting the cementum layers in the teeth. Scheffer (1978) reports a 25 year old animal aged by using this technique. A local whale (L-8) stranded and was collected by the British Columbia Provincial Museum, Victoria, B.C. Its teeth suggested an age of 18 years (Balcomb, 1978). This method of age determination can only be confirmed with known age animals.

Balcomb (1976) reports difficulty in quantifying behavioral data at the present time, though he lists a few general observations. Sexual activity seems to be most apparent in the fall. It is not uncommon to observe several pods coming together and extensive interplay of family members, which may be an important behavioral adaptation to ensure gene flow between pods. Pods are observed in constant movement, averaging three or four knots, becoming shortly waylaid near an abundant food resource and then moving on.

An early summary of prey items for this species was presented by Scheffer and Slipp (1948) to include four main types: marine mammals, sea birds, fishes and cephalopods. Information from a study of 364 O. orca stomachs taken by Japanese whalers over a ten year period showed this species to feed on, in order of occurrence: fishes, squid and octopus, striped dolphins and porpoises, whales, and seals, salmon were found in only 1.6% of the stomachs (Nishiwaki and Hander, 1958). Rice (1968) in an account of stomach contents from ten whales from the eastern North Pacific found that eight of the ten contained marine mammal remains, three stomachs contained fish, and one stomach contained cephalopod remnants. Fiscus and Niggol (1965) examined a stomach that contained remains of several elephant seals, one California sea lion, and one cetacean. A recent report of O. orca attacking and killing a minke whale and presumably eating it has been reported from the Gulf of Alaska (Fiscus et al., 1976). A similar incident is known from the northwest coast of Vancouver Island (Hancock, 1965).

While marine mammals may constitute important prey items in most parts of this species' range, they may not contribute significantly in Washington waters. Rice (1968) speculates that in the Puget Sound region, where the O. orca population is large, there may not be enough other marine mammal species available to them, and in such a case they may rely more heavily on species of schooling fishes for their prey.

Abundance and Distribution

Rice (1977) describes this species as present in all the oceans of the world, though primarily in coastal and cooler waters. In the eastern North Pacific O. orca is abundant off the Aleutian Islands, Pribilof Islands and southeastern Alaska, which are areas of high productivity (Leatherwood and Dahlheim, 1978). O. orca is also abundant in coastal waters of British Columbia and Washington

(Scheffer and Slipp, 1948; Pike and MacAskie, 1969). The distribution of these whales appears to be related to occurrences of prey items in inland Washington waters (Bigg et al., 1976, Balcomb, 1978) and there is some speculation that this seasonal distribution is due to the presence of salmon and/or other schooling fishes.

Sight records in Washington waters are extensive. Balcomb and Goebel (1976) list reports from the public and their own survey work in appendices, as does Balcomb (1978). This data is on file at the MMD. Boran and Osborne (1978) reported 397 sightings of killer whales over a one year period (October 1977 to October 1978).

Four pods are known to frequent the Puget Sound area and are designated J, K, L, and O (Bigg et al., 1976; Balcomb and Goebel, 1976). As many as seven other pods are transient in the area, arriving and departing from the area unpredictably, but these seem to be restricted to Canadian waters (Bigg et al., 1976). The general movements of two pods (J and L) for which a large number of sightings exist are depicted in Figure 28 and 29. The data from other local pods is not extensive enough at this time to generate similar figures. In these figures the relative width of a line represents roughly the relative number of occurrences in any one area, dashed lines represented hypothetical movements based on unconfirmed reports. Movements north of the study area are not depicted. Observations of this species are fewest in the winter months which may not necessarily indicate low abundance at that time, but rather reflects decreased effort. The data suggest that sightings of killer whales may be greatest in late summer and early fall (Pike and MacAskie, 1969).

Major water ways are utilized by this species more often than deadend channels and bays. Thus, the Strait of Juan de Fuca and Georgia, Haro, and Rosario Straits appear to be important routes in and out of the study area, which are most heavily utilized in the summer and fall.

The distribution and abundance of these local animals as identified and described by Bigg et al. (1976) and Balcomb and Goebel (1976), discussed by pod follows:

<u>J Pod</u>. This group is the most frequently observed pod and it is considered a resident of the inland waters of Washington and British Columbia. J Pod has been sighted in Washington waters during all months of the year, through most reports are from summer and fall. The most recent count of J Pod

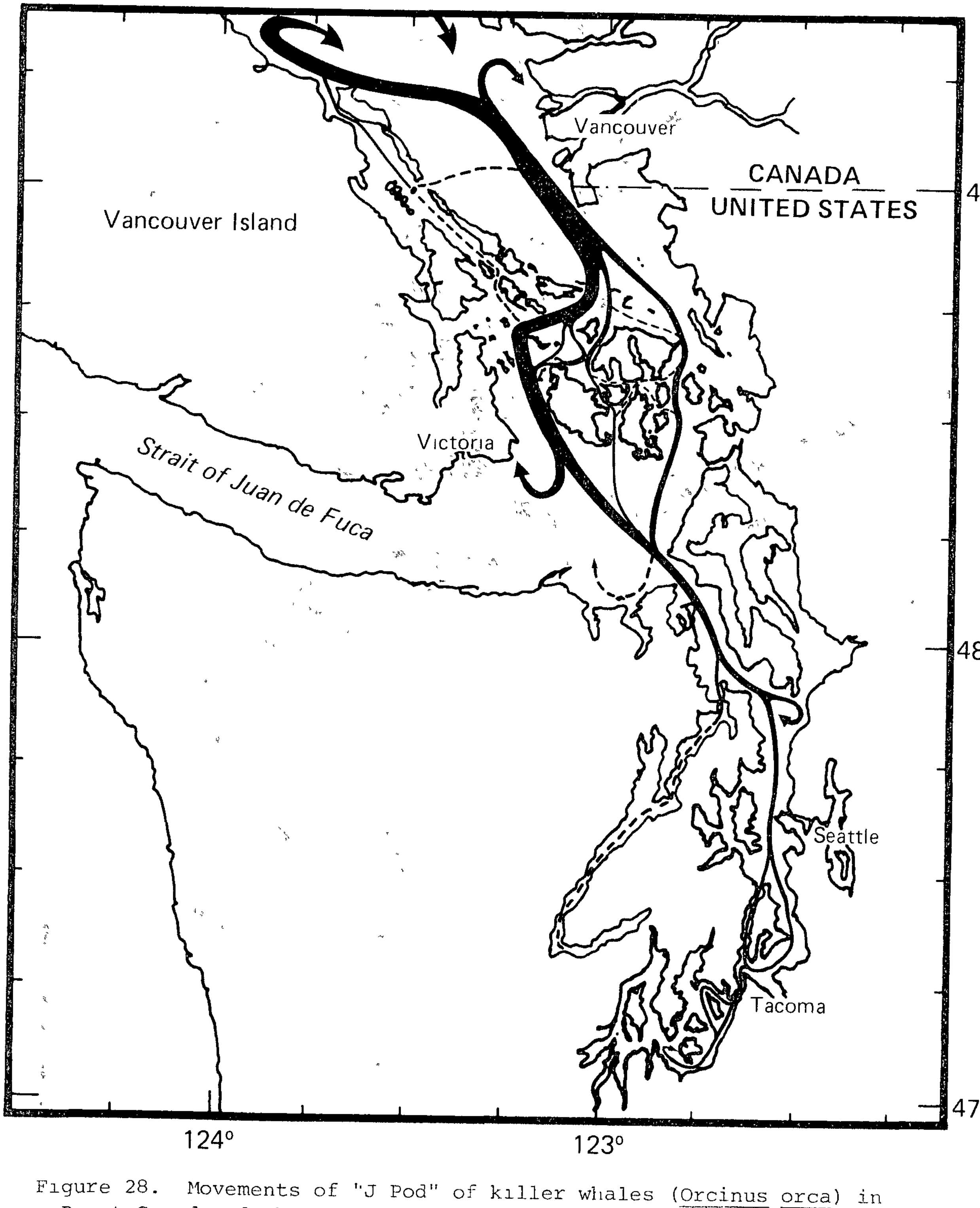


Figure 28. Movements of "J Pod" of killer whales (Orcinus orca) in Puget Sound and the Strait of Juan de Fuca in 1976-1977. The width of a line represents the relative number of occurences in any one area, dashed lines represents hypothetical movements based on unconfirmed reports. (chart courtesy of K. Balcomb, Moclips Cetological Society)

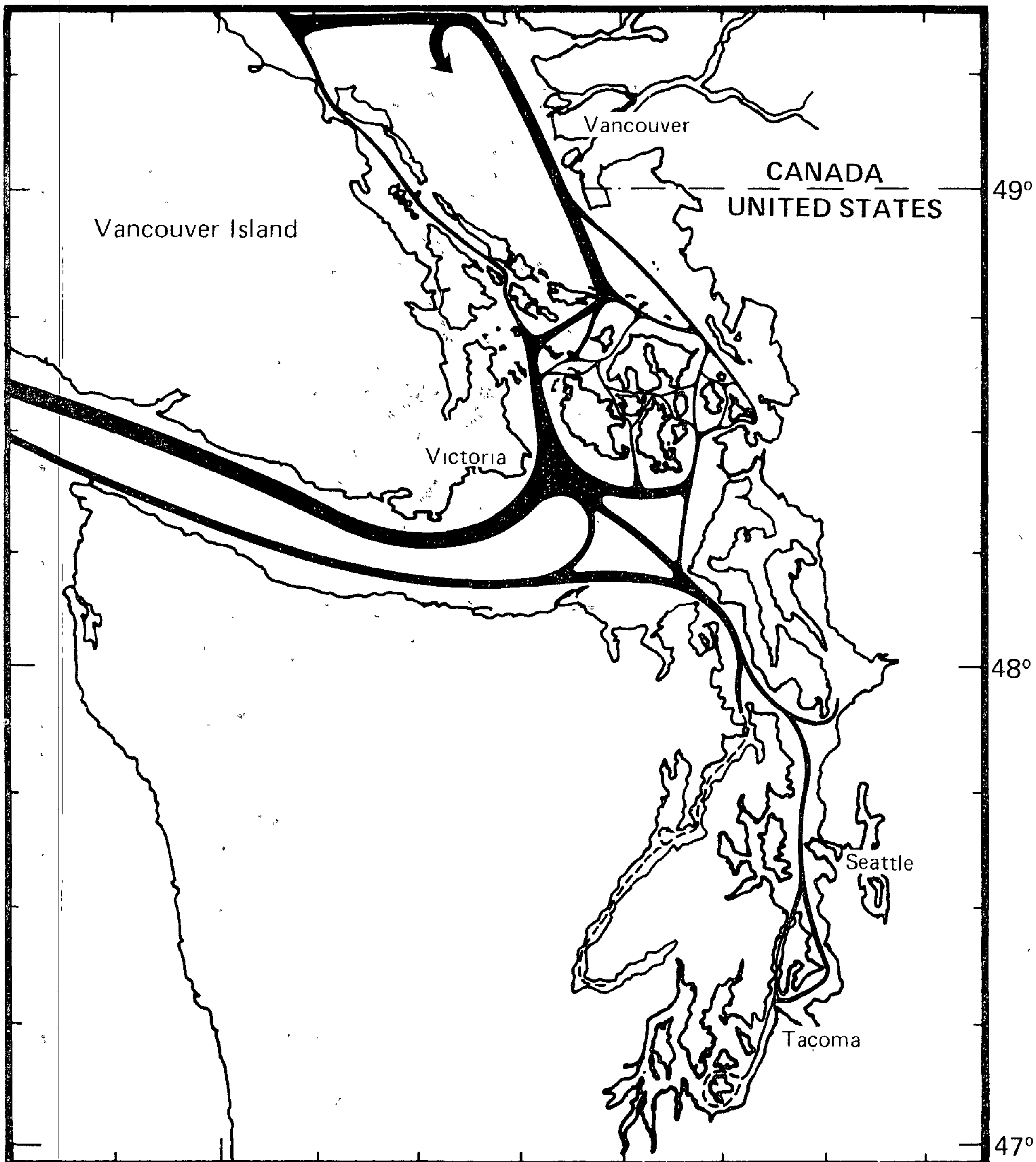


Figure 29. Movements of "L Pod" of killer whales (Orcinus orca) in Puget Sound and the Strait of Juan de Fuca in 1976-1977. The width of a line represents the relative number of occurrences in any one area, dashed lines represent hypothetical movements based on unconfirmed reports. (chart courtesy of K. Balcomb, Moclips Cetological Society).

was 18 whales which included three calves born since 1976 (Balcomb, 1978). This group has apparently adapted to small boat activity and tolerates them in close proximity. The pod appears to remain exclusively in the Strait of Georgia, Puget Sound and the eastern Strait of Juan de Fuca, a range of over 200 nm.

K Pod. This pod is more frequently reported from Canadian waters but does enter Washington waters at any time of the year. Most recent sightings of this pod have been when in the company of other pods. The pod appears to spend a considerable time in offshore waters. The most recent population estimate is 12 animals.

L Pod. This group is to be the largest pod that enters Puget Sound. Because it is so large some difficulty has been experienced in identifying all individuals, though an estimate of 40-45 animals is considered most likely. This pod which enters and leaves Puget Sound via the Strait of Juan de Fuca, appears to be resident in coastal waters probably spending most of the time on the west coast of Vancouver Island although it frequently enters Puget Sound. L Pod is less tolerant of human disturbance than the other pods indicating that those animals that are most often exposed to disturbance (e.g. J and K Pods) are more apt to become used to it.

O Pod. This small group of four whales has been observed for two consecutive years in the Bellingham Bay area in August, and its appearance there may relate to the August run of Chinook salmon in the Nooksack River (Balcomb, 1978).

J, K, and L pods represent 70 to 75 whales that appear in Puget Sound during the year. Observations of all the pods together (5 times in 1977) indicate that regular meetings occur. The addition of the four whales from O Pod brings the total to nearly 80 resident killer whales in Puget Sound. While they are reported for all areas of the Sound, they are most common in northern Puget Sound and the Strait of Juan de Fuca (Scheffer and Slipp, 1948; Eaton, 1975; Balcomb, 1978).

Ecological Problems

A live capture fishery for these whales in local waters was quite active from 1962 to 1976. By 1973, 263 *O. orca* had been captured in west coast waters, of which 50 were kept for display purposes, 12 died during capture, and 201 escaped or were released (Bigg and Wolman, 1975). The last capture attempts occurred in March of 1976, when a group of six whales was captured near Olympia. Public disaproval was such that the animals eventually were all released. Two of the animals (designated S-1 and S-2) were fitted with radio transmitters and were tracked northward for nine days at the rate of 75 miles a day before contact was lost (Erickson, 1976). No capture plans in this area are presently considered.

Effect of environmental pollutants on this species is not known. It has been shown by tissue analysis of a recently stranded whale near Victoria B.C. that certain contaminants do deposit in tissue of local killer whales (Calambokidis et al., 1978).

Besides unknown impact that *O. orca* may have on commercial fish stocks locally, some damage to fishing gear has been reported (Scheffer and Slipp, 1948). Balcomb (1978) considers the possibility that the animal stranded at Victoria, B.C., in September 1977 may have prior to its death and stranding become entangled and drowned in leadline of a gillnet.

It appears that killer whales are able to adapt to human activity in their environment. Animals that come into contact with humans often appear to be more tolerant than those that rarely encounter disturbances.

III-A-3-g. Harbor Porpoise (Phocoena phocoena)

Species Description

One of the smaller porpoise's, the harbor porpoise (*Phocoena phocoena*) reaches a length of about 1.8 m and weighs up to 54 kg (Nishiwaki, 1972). Males are slightly larger than females. Breeding and calving periods occur in the late spring and summer and females mature sexually in 3 to 4 years. This species is shy, seldom approaching vessels as do other porpoises and dolphins. They are difficult to observe since they seldom jump clear of the water, usually only the dorsal fin is seen when they surface and blows are seldom observed.

Important prey items for harbor porpoise are probably small fishes and squid (Scheffer and Slipp, 1948). A male harbor porpoise stranded near Port Townsend was examined in May, 1950 (Wilke and Kenyon, 1952); the stomach contained several Pacific herring. Thirty seven capelin were found in the stomach of a harbor porpoise stranded on Twin Harbor Beach on the Washington coast near Grayland in 1952 (Scheffer, 1953), it had choked to death on a Pacific shad which had lodged in its throat. A similar death was reported from the same location in 1948 (Scheffer and Slipp, 1948).

Predators of this species probably include sharks, killer whales (*Orcinus orca*) and man. Scheffer and Slipp (1948) report Washington natives commonly taking this species for food, although no modern take has been recorded.

Abundance and Distribution

The harbor porpoise has a circumpolar distribution in the northern hemisphere. In the North Pacific it ranges in coastal waters from Japan and Baja California north to the Arctic Ocean (Rice, 1977). Harbor porpoise are rarely seen in tropical waters (Nishiwaki, 1972). *P. phocoena* is an inshore species, found in coastal waters, estuaries, harbors, and bays. This species is abundant in the coastal waters of the Gulf of Alaska though no estimate of abundance is known (Fiscus et al., 1976). The annual take of this species in the North Atlantic is estimated at over 2,500; no comparable harvest occurs in the North Pacific (MMPA 1978).

Phocoena is a year round resident of the waters of British Columbia (Cowan and Guiguet, 1965; Pike and MacAskie, 1969) and this species is regularly sighted in the coastal waters of Washington (Eaton, 1975; Wahl, 1977). Scheffer and Slipp (1948) termed this species the most regularly sighted cetacean in Washington occurring every month of the year and particularly abundant in southern Puget Sound. Scheffer and Slipp presented 28 specimen records from all areas of the state.

During the present study this species was regularly sighted in the San Juan Islands during all months of the year (Figures 30 to 32). The large number of sightings from the San Juan Island area probably reflect the degree of pleasure boat use since most sightings were reported to the public sighting system (Whale Hotline) (Table 26). No sight records were received west of Port Angeles, perhaps partially because of less effort there but it also may be that Phocoena is less abundant in this area as compared to the more protected waters inland. We have no recent observations south of Seattle. Scheffer and Slipp (1948) state "In southern Puget Sound the harbor porpoise occurs at all seasons, rarely singly, usually in groups of 2 to 5, occasionally 10 to 12." Certainly if this species was still as common in southern Puget Sound, we would expect at the very least a few observations from that area where we now have none. It seems likely that the loss of inshore habitat to commercial development has played an important role in the disappearance of this species from the southern sound. The effect, if any, of industrial pollutants on Phocoena in this area is unknown.

From the records available, Rosario and Haro Straits appear to be important areas for this species throughout the year. We also have reports of animals from Guemes Channel (near Anacortes). A population estimate for the study area is difficult to obtain with this sketchy information, but as many as 100 individuals can be accounted for from recent observations, though some may have been counted twice and certainly many go unreported.

Two specimens of Phocoena from the inland waters of Washington are reported here for the first time. One measuring 1.6 m in length (sex?) was stranded in Birch Bay on 11 August 1964, other measurements are not available, the skull is in the collection at the MMD. Cherry Point, the site of a major oil refining installation is located at Birch Bay. A second specimen (MMD-1971-1) stranded near Poulsbo, Washington, and was examined by staff scientists on 5 January 1971 (Table 27). The stomach of this animal was empty.

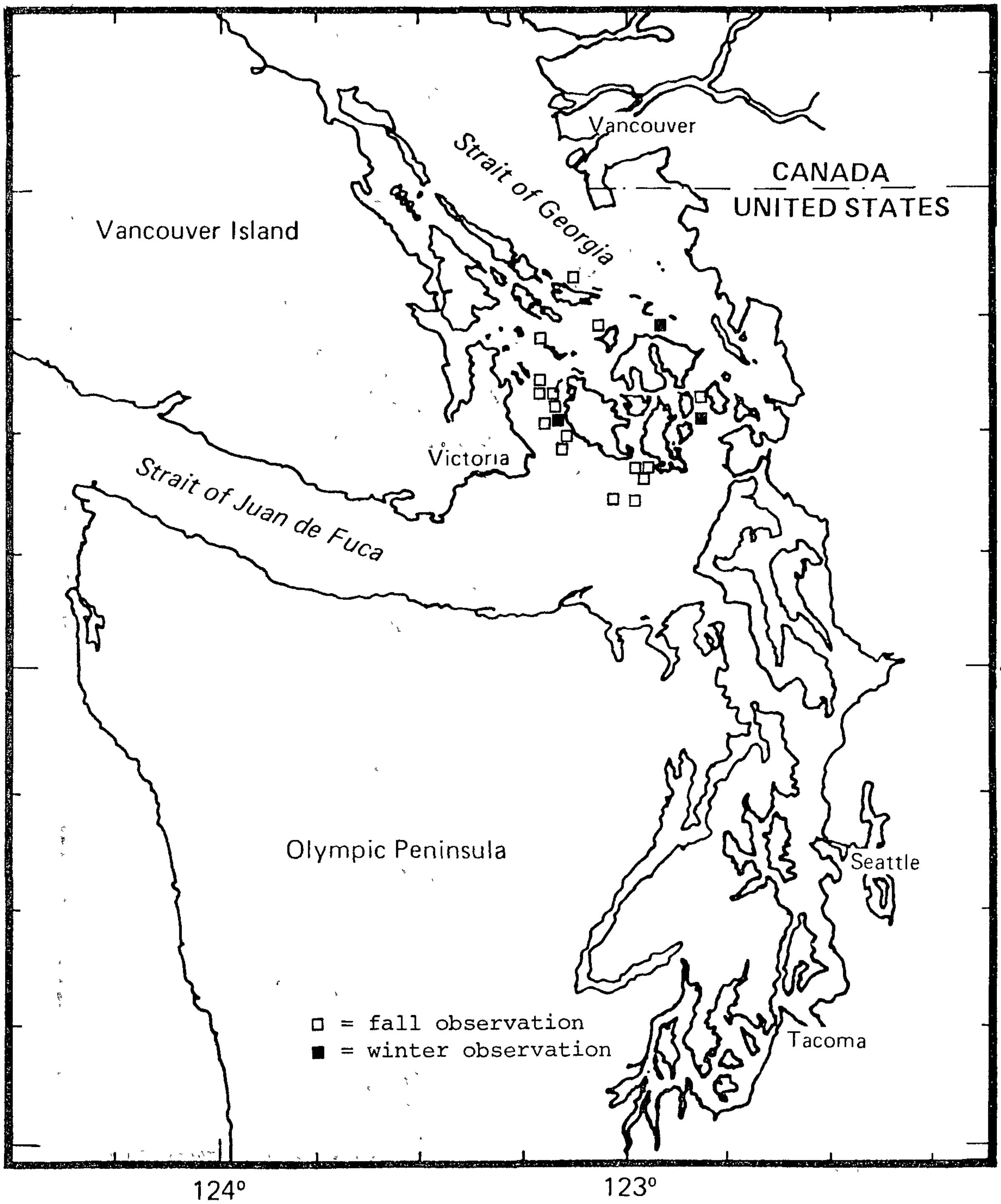


Figure 30. Distribution of harbor porpoise (Phocoena phocoena) sightings in fall (September-November) and winter (December-February) in Puget Sound and the Strait of Juan de Fuca (data from table 26).

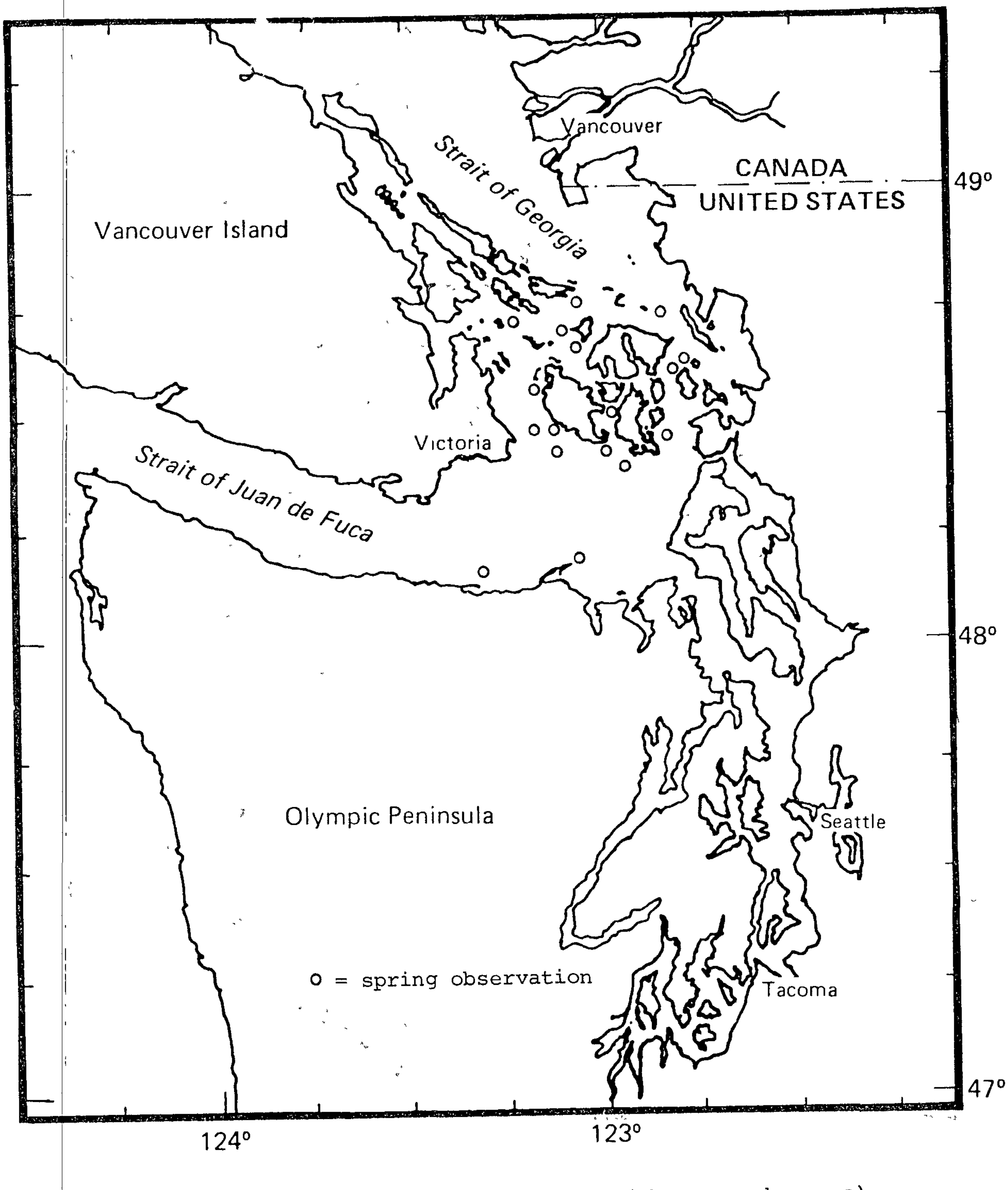


Figure 31. Distribution of harbor porpoise (Phocoena phocoena) sightings in spring (March-May) in Puget Sound and the Strait of Juan de Fuca (data from table 26).

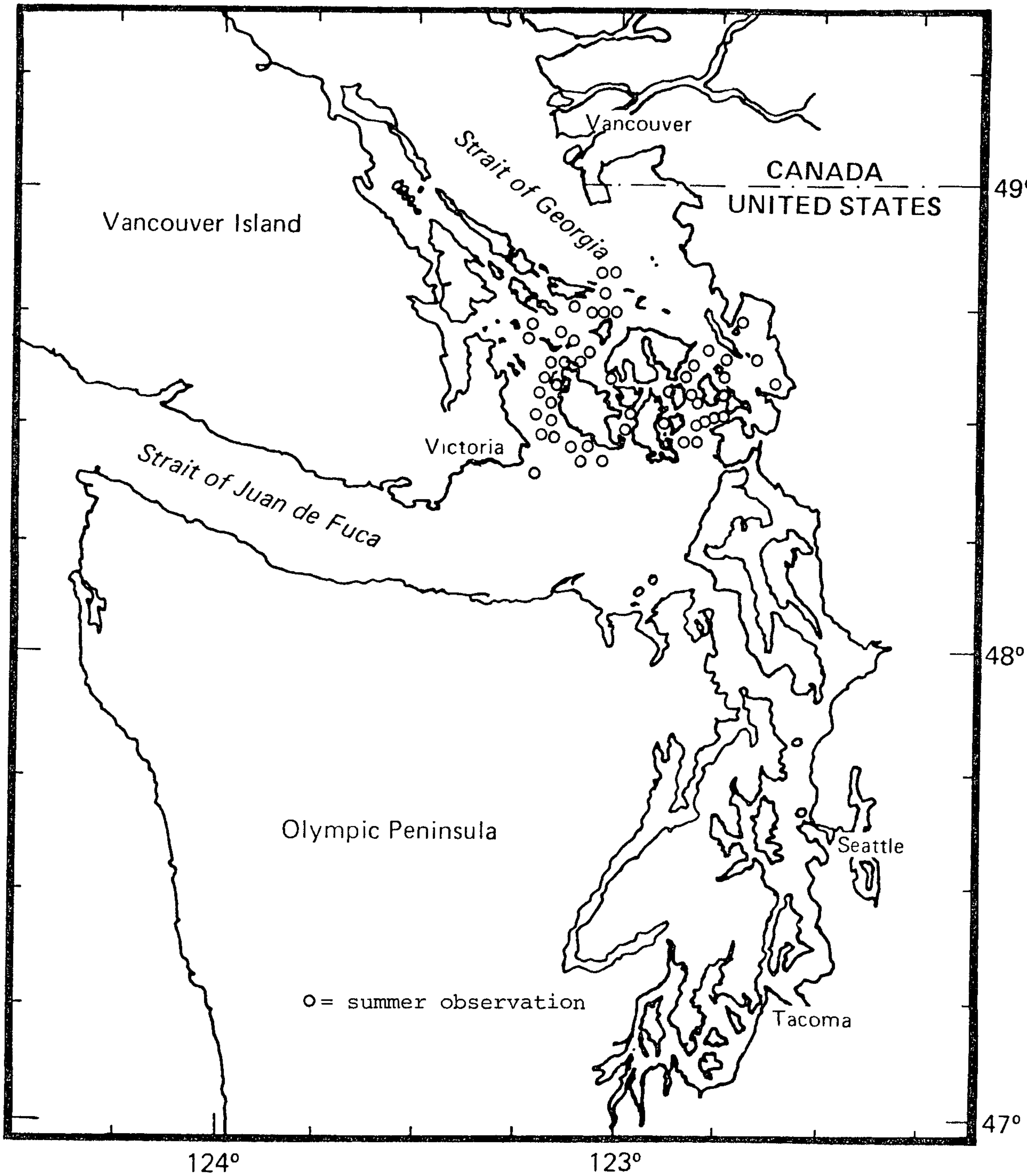


Figure 32. Distribution of harbor porpoise (Phocoena phocoena) sightings in summer (June-August) in Puget Sound and the Strait of Juan de Fuca (data from table 26).

TABLE. 26--Recent observations for harbor porpoise (Phocoena phocoena) for the inland waters of Washington. Records compiled at the Marine Mammal Division, NWAFC, Seattle, Washington are described as files; records from the Platforms of Opportunity Program are described as POP; records reported to the Whale Hotline (NMFS funded) are described as H.L.: records from ORCA Survey (Moclips Cetological Society) are described as O.S. Dashed lines indicate data not available.

Date	Time	No.	Location	Comments	Source
January					
1/26/78	1052	8	S.W. Matia I.	feeding, tide rips	This study
February					
2/26/78	1500	10	Bellevue Pt., S.J.I.		H.L.
April					
4/3/76	1015	7	Peapod Rks		O.S.
4/25/76	1207	20	Sandy Pt., Waldron I.		O.S.
4/28/76	1809	1	Dungeness Spit		O.S.
4/2/77	-	2	Gooch I., B.C.		O.S.
4/3/78	1830	1	Andrews Bay, S.J.I.		H.L.
4/23/78	1810	3-5	Sandy Pt., Waldron I.		H.L.
4/29/78	1630	7-15	Limekiln Pt. San Juan Is., Haro St.		H.L.
4/30/78	1000	4-5	Limekiln Pt. San Juan Is., Haro St.		H.L.
May					
5/1/76	1635	1	San Juan Channel		O.S.
5/5/76	1411	1	Sister Rks., Clark I.		O.S.
5/6/76	1608	4	Peapod Rks		O.S.
5/7/76	1053	2	Off Pt. Angeles		O.S.
5/15/76	1926	4	McCracken Pt.		O.S.
5/23/76	1320	5	Boiling Reef		O.S.
5/7/78	1030	1	Cattle Pass		H.L.
5/19/78	1240	1	Bird Rocks, Rosaio St.		H.L.
5/29/78	1300	3	Middle Bank		H.L.
5/29/78	1530	2	Iceberg Pt.		H.L.
June					
6/7/76	1440	2	Presidents Channel		O.S.
6/7/76	1607	2	Peapod Rks.		O.S.
6/7/76	1645	1	Rosario Pt.		O.S.
6/18/76	1710	1	Battleship Rk.		O.S.
6/22/76	1231	1	Speiden Channel		O.S.
6/27/76	1706	2	Patos I.		O.S.
6/27/76	1725	1	Boiling Reef, Saturna I.		H.L.

TABLE 26.--Cont.

Date	Time	No.	Location	Comments	Source
June					
6/2/78	1500	2	Rosario St.		H.L.
6/4/78	0930	2	Andrews Bay		H.L.
6/11/78	1650	1	Andrews Bay		H.L.
6/30/78	2000	2	Andrews Bay		H.L.
July					
7/3/65	-	3	Waldron I.		Fiscus & Kajimura (1965)
7/6/65	-	1	Pt. Francis		"
7/6/65	-	4	Bellingham Channel		"
7/6/65	-	2	Bird Rocks		"
7/6/65	-	2	Boulder I.		"
7/7/65	-	1	San Juan Channel		"
7/8/65	-	1	Speiden Channel		"
7/8/65	-	1	N.E. Speiden I.		"
7/9/65	-	1	San Juan Channel		"
7/9/65	-	1	E. Speiden I.		"
7/9/65	-	1	W. Speiden I.		"
7/9/65	-	2	Pile Pt., S.J.I.		"
7/9/65	-	2	Griffin Bay	Hunted for 1 hour	"
7/10/65	-	1	Rosario St.		"
7/10/65	-	1	Cypress I.		"
7/10/65	-	2	Bellingham Channel		"
7/10/65	-	1	Eliza I.		"
7/11/65	-	4	Clark Pt., Guemes I.		"
7/11/65	-	8	Rosario St.		"
7/12/65	-	1	Pt. Hammond, Waldron I.		"
7/13/65	-	2	Boundry Bay		"
7/14/76	1504	1	Skipjack I.		O.S.
7/14/76	1605	1	Waldron I.		O.S.

TABLE 26.--Cont.

Date	Time	No.	Location	Comments	Source
July					
7/1/78	1500	3-5	Bird Rks		H.L.
7/16/78	1530	3	S. Peapod Rks.	Tentative I.D.	H.L.
7/21/78	2020	1	Partridge Bank		This study
7/21/78	1510	2	Pile Pt., San Juan Is., Haro St.		H.L.
7/22/78	1700	3	Devil's Head	Tentative I.D.	H.L.
7/23/78	0944	3-4	N. Protection I.		This study
7/27/78	-	1	Shilshole Bay, Puget Sound		H.L.
7/27/78	1806	7	Patos Is., Boundary Pass, SJI		H.L.
7/29/78	1825	2-4	Samish Bay		H.L.
August					
8/1/76	1405	1	Mid-Channel		O.S.
8/31/76	1650	1	Turn Pt., Stuart I.		O.S.
8/6/77	-	2	Discovery I.		H.L.
8/14/77	-	2	Rosario St.		H.L.
8/17/77	-	2	False Bay, Haro St.		H.L.
8/3/78	0745	5	Turn Pt., Stuart Is., Haro St.		H.L.
8/3/78	0830	4	Apple Tree Cove, Puget Sound		H.L.
8/7/78	2020	8-10	Andrews Bay, San Juan Is., Haro St.		H.L.
8/8/78	0900	5	Andrews Bay, San Juan Is., Haro St.		H.L.
8/8/78	1930	5	Pile Pt., San Juan Is., Haro St.		H.L.
8/30/78	1745	4-6	False Bay, San Juan Is., Haro St.		H.L.
8/31/78	1725	4-5	Limekiln Pt., San Juan Is, Haro St.		

TABLE 26.--Cont.

Date	Time	No.	Location	Comments	Source
September					
9/2/76	1253	1	S.San Juan I.		O.S.
9/15/76	1209	2	N.E. Waldron I.		O.S.
9/19/76	1300	2	Hein Bank		O.S.
9/20/76	1215	1-2	Monarch Hd., Saturna I.		O.S.
9/5/77	-	5	Turn Pt., Stuart I.		H.L.
9/6/77	-	2	James I.		H.L.
9/10/77	1310	1	Cattle Pt.		MMD(files)
9/12/77	-	2	Cattle Pt.		H.L.
9/6/78	1608	2-3	Deadman's Cove, San Juan Is., Haro St.		H.L.
9/11/78	1835	2	Deadman's Cove, San Juan Is., Haro St.		H.L.
9/13/78	1832	3	Deadman's Cove, San Juan Is., Haro St.		H.L.
9/24/78	1914	2-3	Deadman's Cove, San Juan Is., Haro St.		H.L.
October					
10/5/76	1245	2	Middle Bank		O.S.
10/3/78	1925	3	Limekiln Pt., San Juan Is., Haro St.		H.L.
10/5/78	0915	3-4	Andrews Bay, San Juan Is., Haro St.		H.L.
10/5/78	1730	2-3	Andrews Bay, San Juan Is., Haro St.		H.L.
December					
12/8/77	0936	1	Bird Rocks		This study

TABLE 27.--Measurements (in m) of a male harbor porpoise (*Phocoena phocoena*) stranded near Poulsbo, WA on 5 January 1971 (MMD-1971-1).

Measurement	Length (cm)
Snout to notch of flukes	1.50
Snout to tip of dorsal fin	.81
Snout to gape	0.10
Girth behind flippers	0.88
Maximum girth	0.97
Notch of flukes to umbilicus	0.96
Notch of flukes to genital aperture	0.74
Notch of flukes to anus	0.49
Anterior length of flipper	0.23
Axillary length of flipper	0.19
Maximum width of flipper	0.08
Length of dorsal fin at base	0.25
Height of dorsal fin	0.11
Span of flukes	0.38
Width of flukes	0.11

Ecological Problems

Harbor propoise are occasionally caught in drift and salmon gillnets and drown. Mortality in the gill net fishery was reported by Scheffer and Slipp (1948) although the numbers of porpoise caught was not reported. Incidental take in the gillnet salmon fishery continues.

Geraci and Smith (1977) state the harbor porpoise is most susceptible to human disturbances, including oil spills and industrial pollutants. The impact of oil spills on this species in conjunction with commercial gillnet fisheries may eliminate or greatly reduce it numbers in the study area.

III-A-3-h. Dall Porpoise (Phocoenoides dallii)

Species Description

The Dall porpoise (*Phocoenoides dallii*) is a medium sized porpoise that attains a length of approximately 2.2 m and may weigh 150 kg at maturity. A color phase known as "True's porpoise" is restricted to Japanese waters and was formerly considered distinct from *P. dallii* (Rice, 1977). Breeding and calving occur in the spring and summer months. The Dall porpoise is an agressive, fast swimmer, and when breaking the surface of the water to breath produce a characteristic spray or "roostertail", by which this species can be positively identified. On 18 May 1978 a group of five *P. dallii* played in the bow of our small (16') outboard boat in the vicinity of Partridge Bank. They discontinued apparent feeding behavior as we passed close by, approached the small wake produced by our boat, and followed for several minutes until we had left the area. After we had passed they resumed the slow rolling movements characteristic of feeding activities.

A Dall porpoise collected in the Stait of Juan de Fuca in 1937 was reported to contain squid beaks and fish (Scheffer and Slipp, 1948). Pike and MacAskie (1968) reported the stomach contents of five animals collected in Washington and British Columbia: two stomachs contained squid, one contained herring, and two were empty. Of five animals collected off northern California, four stomachs contained squid remains and one was empty (Fiscus and Niggol, 1965). Throughout its' range, squid and small schooling fishes are important prey items (Nishiwaki, 1972).

Abundance and Distribution

Dall Porpoise occur in the offshore water of the North Pacific from Japan and southern California north to the Bering Sea (Rice, 1977). The animals are regularly sighted offshore but do enter exposed seaways and straits (Pike and MacAskie, 1969). Inshore movements may occur in late winter and spring, southerly movements are noted in winter, and a northerly movement occurs in summer (Nishiwaki, 1972).

Dall porpoise appear to be more abundant offshore than in inshore waters at most times of the year and appear most often in spring and summer in the inside waters, occurrences inside decrease in the fall and winter (Pike and MacAskie, 1969; Boran and Osborne, 1978). This species is frequently seen in the large and open straits and sounds of British Columbia, but they are seldon seen in the more protected waters (e.g. the Strait of Georgia) (Pike and MacAskie, 1969). Fiscus and Niggol (1965) observed a few animals within 50 km offshore the Washington coast in April 1959. Wahl (1977) reported offshore encounters more frequently in the summer than early spring. Pike and MacAskie (1969) report more sightings from the summer than any other season in British Columbia. Movements into the inside waters of Washington may begin in the late spring with an offshre movement in fall, although a few animals may remain in inside waters year round.

Nishiwaki (1972) estimated the population of P. dallii in the western North Pacific at 20,000 to 30,000. Cowan and Guiquet (1965) describe this species as the most abundant porpoise north of Vancouver Island. Fiscus (1978) considers this species and the Pacific whiteside dolphin the most abundant small cetaceans found off Washington.

Results of the present study indicate that P. dallii are common in the eastern Strait of Juan de Fuca in the spring and summer (Figures 33 to 35; Table 28). The only record during the present study for the western strait is from an observation made near Tatoosh Island during an aerial survey in November 1977. We expect this area to contain animals that do not penetrate further east and the lack of sightings may be a result of the low survey effort there. Dall Porpoise are seen in both Haro and Rosario Straits in all seasons but winter, there are no records north of Patos Island. They occur in Admiralty Inlet but rarely penetrate further south into Puget Sound than the vicinity of Seattle. Several reports of what were probably

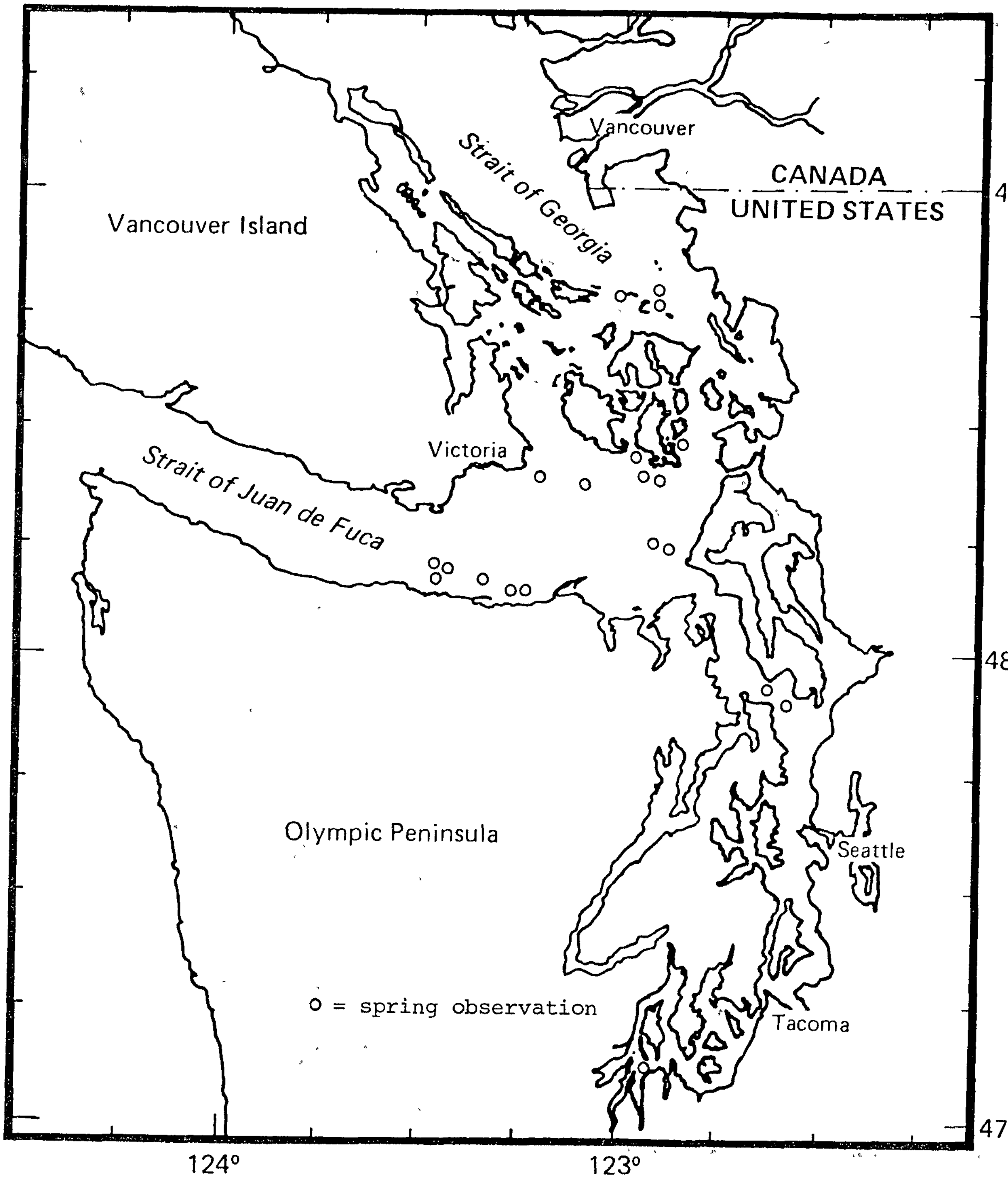


Figure 33. Distribution of Dall porpoise (Phocoenoides dalli) sightings in spring (March-May) in Puget Sound and the Strait of Juan de Fuca (data from table 28).

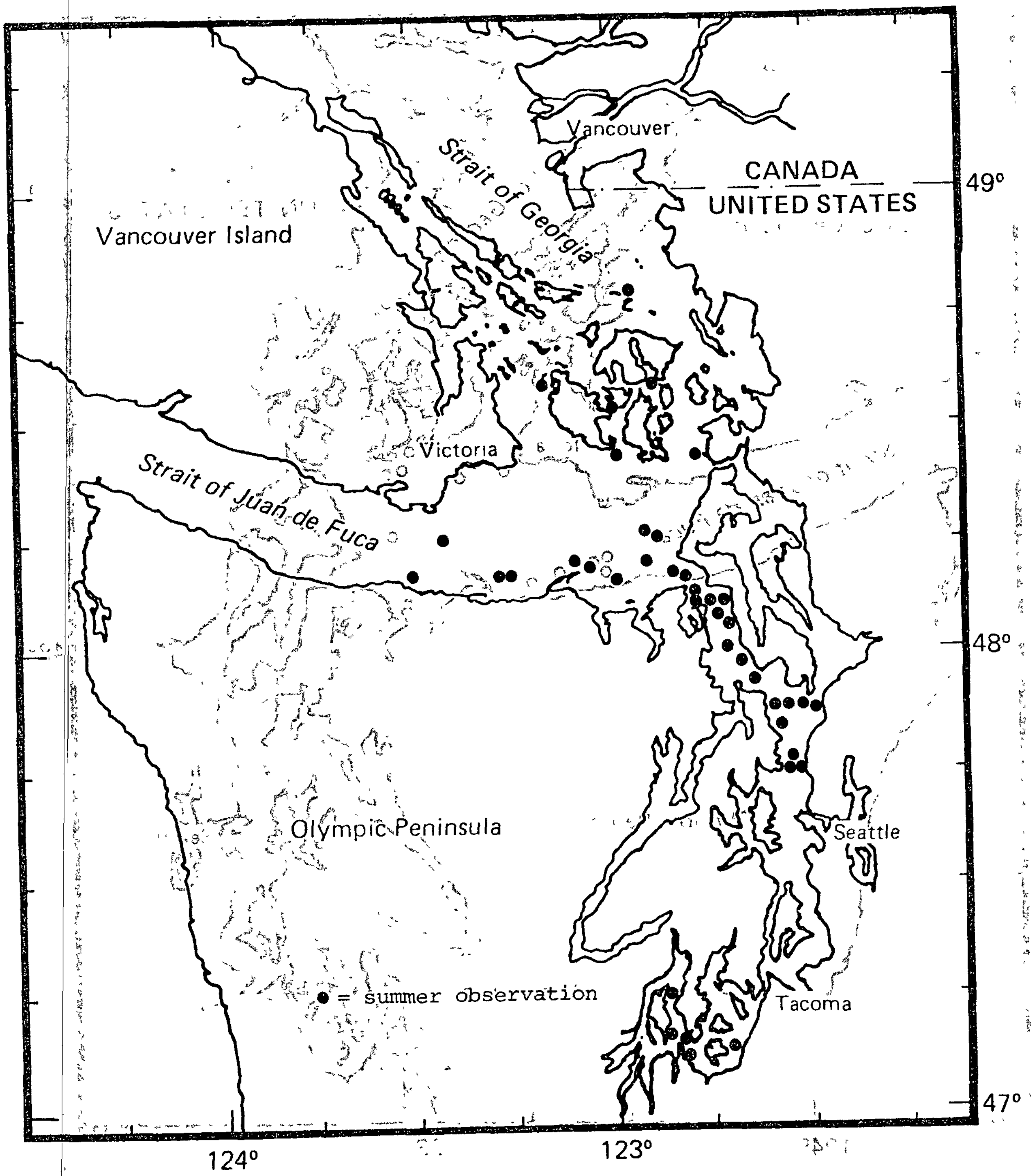


Figure 34. Distribution of Dall porpoise (Phocoenoides dalli) sightings in the summer (June-August) in Puget Sound and the Strait of Juan de Fuca (data from table 28).

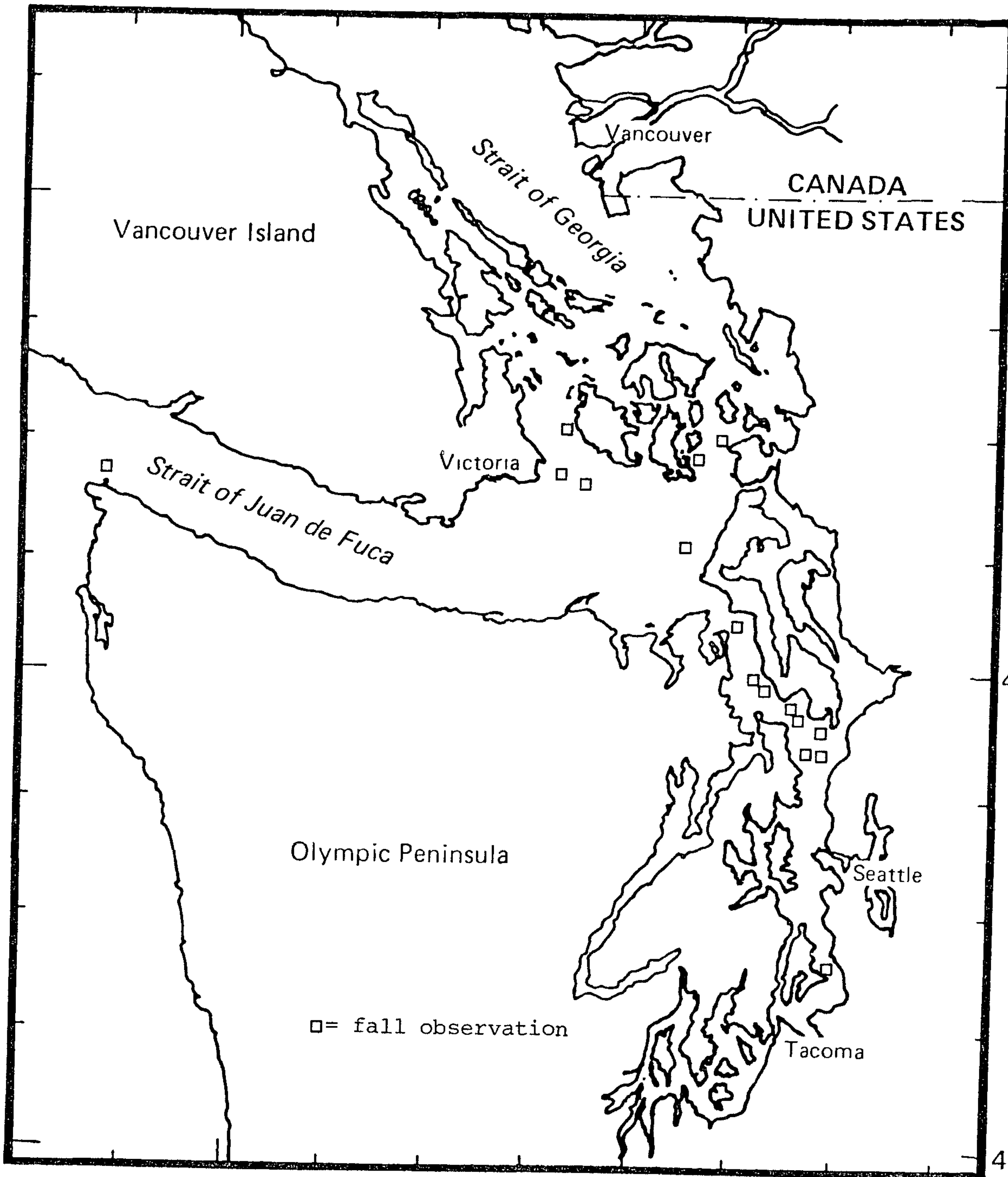


Figure 35. Distribution of Dall porpoise (Phocoenoides dalli) sightings in fall (September-November) in Puget Sound and the Strait of Juan de Fuca (data from table 28).

TABLE 28.--Recent observations of Dall porpoise (Phocoenoides dalli) for the inland waters of Washington. Sightings are presented by month. Records compiled at the Marine Mammal Division, NWAFC, Seattle, Washington are described as files; records from the Platforms of Opportunity Program are described as POP; records reported to the Whale Hotline (NMFS funded) are described as H.L.; records from Orca Survey (Moclips Cetological Society) are described as O.S. Dashed lines indicate data not available.

Date	Time	No.	Location	Comments	Source
March					
3/17/77	0930	5	Budd Inlet		H.L.
April					
4/5/76	1330	6-10	S.E. of Chain Is.		O.S.
4/5/76	1420	20	5 mi N of Pt. Angeles		O.S.
4/8/76	0730	15	E of Ediz Hook		O.S.
4/8/76	1015	10	E of Pt. Angeles		O.S.
4/21/76	1500	5	E of Saturna I.		O.S.
4/26/76	1910	3-4	Hall I. (near Lopez I.)		O.S.
4/27/76	1425	2	Iceberg Pt.	Bow ride	O.S.
4/27/76	1440	8	Iceberg Pt.	Bow ride	O.S.
4/29/76	1105	4	Juan de Fuca		O.S.
4/29/76	1755	5	Salmon Bank		O.S.
4/14/78	–	13	off "A" Buoy - Juan de Fuca		H.L.
4/23/78	–	2	1/2 mi N Sucia I		H.L.
4/25/78	1020	4	Partridge Bank		This study
May					
5/12/76	1900	8	1/2 mi E of Sucia I.		H.L.
5/18/78	1320	5	Partridge Bank		This study
5/20/78	1445	2-4	Thatcher Pass		H.L.
5/26/78	2100	2	Pt. No Point		H.L.
5/29/78	AM	3	Middle Bank		H.L.
5/31/78	0800	3-6	Sachet Hd., Whidbey I.		H.L.
June					
6/1/78	1030	2	Steilacoom		H.L.
6/3/78	1530	2	Johnson Pt.		H.L.
6/4/78	0600	5	Johnson Pt.		H.L.
6/4/78	0830	2	Andrews Bay		O.S.

TABLE 28.--Cont.

Date	Time	No.	Location	Comments	Source
June					
6/4/78	2000	4-5	San Juan Channel		H.L.
6/6/78	-	5	Marrowstone I.		H.L.
6/11/78	1836	1	Johnson Pt.		H.L.
6/17/78	2000	6-7	Possession Pt.		H.L.
6/20/78	1500	4	Pt. Wilson		H.L.
6/23/78	1045	2-4	Marrowstone I.		H.L.
July					
7/7/76	1030	2	W. Smith I.	Tentative I.D.	H.L.
7/18/76	1000	6	Lagoon Pt., Whidbey I.	Tentative I.D.	H.L.
7/20/76	1700	2	E. Patos I.	Tentative I.D.	H.L.
7/23/76	1530	6-8	N.W. Smith I.		H.L.
7/29/76	1300	2	Admiralty Inlet		H.L.
7/31/76	0900	5	Pt. Jefferson		H.L.
7/6/77	-	6	Carl Bay		O.S.
7/29/77	-	15	-		O.S.
7/6/78	1430	6-7	Admiralty Inlet		H.L.
7/9/78	1400	3-4	Pt. No Point		H.L.
7/13/78	0700	10-20	Possession Pt.		H.L.
7/17/78	1500	6	Admiralty Pt.		H.L.
7/18/78	1800	2	off Mukilteo		H.L.
7/19/78	1237	2	S. Race Rocks		This study
7/19/78	1335	6	S. Useless Bay		This study
7/21/78	0745	1	Mitchell Bay, S.J.I.		H.L.
7/22/78	0800	3	off Edmonds		H.L.
7/25/78	2000	8-15	Case Inlet		H.L.
7/27/78	1036	1	N.E. Dungeness Refuge		This study

TABLE 28.--Cont.

Date	Time	No.	Location	Comments	Source
August					
8/7/76	1508	3	Pt. No Point	Tentative I.D.	H.L.
8/11/76	1400	4	off Richmond Beach	Tentative I.D.	H.L.
8/17/76	1015	4	Cattle Pt. S.J.I.	Tentative I.D.	O.S.
8/18/76	1600	2	Pt. No Point	Tentative I.D.	O.S.
8/28/76	1610	1	Partridge Bank		O.S.
8/29/76	1550	3-5	Dungeness Spit		O.S.
8/29/76	1630	1	3 mi NE Pt. Angeles		O.S.
8/29/76	1645	2	4 mi NE Pt. Angeles		O.S.
8/29/76	1655	2	off Crescent Bay		O.S.
8/16/77	-	10-12	Protection I.		O.S.
8/17/77	-	1	Burrows Bay		O.S.
8/25/77	-	10-12	Admiralty INlet (Skunk Bay)		O.S.
8/18/78	1113	2	Harney Channel		This study
8/23/78	2045	5-6	Admiralty Inlet (Bush Pt)		R.L.DeLong(files)
September					
9/7/76	1945	1	Discovery I.		O.S.
9/16/76	1144	1-2	W. San Juan I.		O.S.
9/19/76	1515	2	Middle Bank		O.S.
9/29/76	1600	3-6	Double Bluff, Whidbey I.		O.S.
9/1/77	-	1	Smith I.		O.S.
9/4/77	-	5	Admiralty Inlet		O.S.
9/5/77	-	6-7	Pt. No Point		O.S.
9/5/77	-	4	Langley Pt. Fidalgo I.		O.S.
9/10/77	-	3	Thatcher Pass		O.S.
9/23/77	-	6-10	Possession Head		O.S.
9/6/	1000	6-8	Bush Pt.		W.B. McAlister(files)
9/10/78	1700	6-8	2 mi off Pt. No Point	Bow ride	MMD(files)

TABLE 28.--Cont.

Date	Time	No.	Location	Comments	Source
October					
10/15/76	1605	3-4	Bush Pt., Whidbey I.		O.S.
10/13/76	-	6	Double Bluff, Whidbey I.		POP
10/12/78	1130	2	Vashon I.		H.L.
November					
11/30/78	1357	2	N. Cape Flattery		This study

the same group of animals, were received from Case Inlet in the southern Sound in June 1978. No records are known from the protected waters of Hood Canal and to the east of Whidbey Island.

The complete absence of any reports of this species in th winter from the Strait of Juan de Fuca and Puget Sound suggest it does not occur in the area at that time. An evaluation of sighting data for this species accounting for duplicate observations suggested that the maximum number of animals in the Strait of Juan de Fuca and Puget Sound is from 25 to 30 (Boran and Osborne, 1978). Of the 77 recent sight records compiled in this study a few single animals were reported but most sightings were of groups of 2 to 20 individuals, and the average group size was 5 animals. Pike and MacAskie (1969) report group size in British Columbia waters from 5 to 14, with a group size of 6 the average. They also reported the largest groups (30 to 100) occurring inshore. We have no records of any group larger than 20.

Considering the regular occurrence of this species locally, surprisingly few specimens have been reported in the literature. Scheffer and Slipp (1948) report on two species and Pike an MacAskie (1969) examined five new specimens and report on several others. A recent specimen was drowned in a commercial seine net south of Iceberg Pt., Lopez Island on 18 July 1978. This was a 1.95 m lactating female which was collected and frozen whole by personnel of th Marine Mammal Division (LMT 001-78). Complete measurements and necropsy are scheduled pending investigation of the incident and release of the specimen by NMFS enforcement.

Ecological Problems

Dall porpoise are taken incidentally in the Japanese high seas gillnet fishery in the western North Pacific. Kasuya (1974) reports that the take may exceed 20,000 animals annually. A National Marine Fisheries Service research project is currently assessing the incidental take in this fishery. Some adverse interaction between the species and commercial fisheries occurs locally as indicated by the specimen caught near Lopez Island and another porpoise that was caught in a seine net near Lip Lip Pt., Marrowstone Island on 4 October 1978. This animal appeared unharmed and was released (L. Tsunoda pers. commun.).

III-A-3-i. Pygmy Sperm Whale (*Kogia brěviceps*)

Species Description

The pygmy sperm whale (*Kogia breviceps*) is a species known only from scattered stranding records and a few observations at sea. These animals measure up to 3.4 m and sexes are indistinguishable based on size (Rice, 1978). The blowhole is centrally located on the top of the head in contrast to a close relative, the sperm whale (*Physeter macropcephalus*) which has an assymetric arrangement. *Kogia* also has a series of light markings behind the eye which superficially look like gill slits. Food habits are known from a few stranded specimens and include primarily squids and cuttlefish. The stomach contents of a recent specimen stranded locally contained cephalopods representing at least seven groups and 78 individuals (Table 29). Breeding behavior is unknown, though some evidence indicates calves may be born every other year.

Abundance and Distribution

Kogia breviceps has a worldwide distribution in tropical and warm waters. In the eastern North Pacific Ocean its northern limit is Washington; the southern limits of its range are less well known. Abundance of this species is unknown though it is considered rare (MMPA 1978).

In Washington, the pygmy sperm whale probably occurs primarily offshore. The first and only confirmed coastal record comes from a specimen stranded just south of Grayland, Washington in May 1942 (Scheffer and Slipp, 1948). These authors also speculate from evidence obtained from Makah Indians that one other *Kogia* may have stranded near Cape Flattery.

Recently a freshly dead carcass of this species washed ashore 13 km north of Oak Harbor on Whidbey Island on 5 October 1977, attesting to the rare occurrence of *Kogia* in inland waters. This is the first record for protected Washington waters. The animal, a 2.79 m male, was collected by personnel of the Burke Museum, University of Washington, Seattle. Skeletal parts were retianed in the collection of that museum.

TABLE 29.--Stomach contents of a Pygmy sperm whale (*Kogia beviceps*) stranded 5 October 1977 on Whidbey Island. Stomach content identification by C. H. Fiscus, MMD, NWAFC, Seattle, WA.

Food item	No. Individuals represented
First Chamber	
Octopoteuthis sp	1
Second Chamber	
Histioteuthis sp	8
Octopoteuthis sp	22
Gonatidae (probably *Gonatopsis borealis*)	18
Onychoteuthis borealijaponicus	6
Chranchidae	1
Gonatus sp	14
Unidentified beaks	4
Third Chamber	
Octopoteuthis sp	2
Histioteuthis sp	1
Unidentified beak	1

Ecological Problems

Unknown.

III-A-3-j. Goosebeak Whale (*Ziphius cavirostris*)

Species Description

The goosebeak whale (Cuvier's beaked whale) (*Ziphius cavirostris*) is a moderately sized beaked whale with maximum body lengths in both sexes to 7.0 m, though males tend to be slightly smaller than females (Rice, 1978). Adults have a white head and nape (particulary well-developed in old males), bodies are well scarred and are tan or light brown in color. Sexual maturity occurs at 5.5 m. Other than a few squid remains found in the stomachs of stranded specimens no feeding habit information is known. Predation in the wild is unknown, although the account of a *Ziphius* apparently being attacked by sharks has been reported from a newspaper article, though the article incorrectly identified the whale (Mitchell, 1968).

Abundance and Distribution

The status of *Ziphius* is unknown although it is the most frequently observed ziphiid. Records of strandings are more common for this species than other beaked whales and suggest that it may be fairly abundant (Mitchell, 1968). This species is found in all temperate and tropical seas (Rice, 1977).

Two records of *Ziphius* are known for inland waters but no records exist for Washington. One record comes from a skull unearthed during clearing operations near Victoria, B.C. (Cowan and Guiguet, 1952). The second comes from the decomposed carcass of a male that washed ashore one mile south of the Jordan River on the southwest coast of Vancouver Island in January, 1954 (Pike and MacAskie, 1969). This animal was an estimated 4.9 m in length.

Both of these records come from shores exposed to oceanic influences in the Strait of Juan de Fuca. If live animals occur in this area, they would probably not penetrate beyond the straits.

Ecological Problems

Unknown.

II-A-3-k. North Pacific giant bottlenose whale (Berardius bairdii)

Species Description

The North Pacific giant bottlenose whale (giant bottlenose whale; Baird's beaked whale) (Berardius bairdii) is a poorly known species of the norther Pacific Ocean. It is the largest of the beaked whales, males reach a maximum length of 11.9 m and females are slightly larger reaching 12.8 m. They usually travel in pods of 10 to 20 individuals predominantly comprised of males (Pike and MacAskie, 1969) suggesting some geographical segregation of sexes. Studies of Berardius of Japan indicate that breeding takes place between November and May (Nishiwaki, 1972) and the calves are born in December (Omura et al., 1955). Stomach contents from specimens taken off Vancouver Island included squid, rockfish, and skate egg cases (Pike and MacAskie, 1969).

Abundance and Distribution

Berardius is distributed north into the Bering Sea, west to Japan, and the eastern limit extends to southern California (Rice, 1977). Recent data from Japanese whaling records indicate this to be a deep water species with greater abundance occurring beyond the 1000 m contour of the continental shelf (Nishiwaki and Oguro, 1971). The population status of Berardius is unknown, it is considered uncommon but not rare (MMPA 1978).

Movements of Berardius are not known. Nishimura (1970) has shown migration of Berardius to coincide with seasonal availability of cephalopods in the western Pacific.

Scheffer and Slipp (1948) reported the first record of Berardius for Washington, that of a stranded female on the coast in the spring of 1939. They speculate that as many as eight have been taken by the Bay City Whaling Station. Pike and MacAskie (1969) report 25 Berardius taken in whaling operations off the Vancouver Island coast from 1950 to 1966 and presented body measurements for 13. The only record of this species for the inland waters of Washington comes from the stranding of a female near Port Townsend on 6 December 1962 as reported by Aruthus S. Einarsen, (Table 30). This animal was pregnant and had a near term fetus indicating that the calving period in the eastern Pacific is similar to that reported for the western portion of its range. Any future occurrences of this species are likely to be restricted to the Strait of Juan de Fuca. No observtions of live animals are known from the study area and any occurrence can be considered unlikely and rare.

Ecological Problems

One hundred to 400 of these whales have been taken annually in the Japanese small whale fishery during the past 20 years. The effect of this take on the population is unknown.

Table 30.--Measurements (in m) from a female *Berardius bairdii* stranded near Port Townsend on 6 December 1962 (Data from MMD files).

Measurement	Length (m)
1. Total length	9.25
2. Girth	4.27
3. Tip of snout to blowhole	1.17
4. Tip of snout to angle of gape	6.86
5. Upper jaw	.64
6. Lower jaw	.81
7. Total notch to anus	3.05
8. Height of dorsal fin	.25
9. Length of base of dorsal fin	.61
10. Flipper length	.38

III.B. Oil Effects on Marine Mammals

III.B.1. Literature Review

Oil Tanker traffic through the Strait of Juan de Fuca and northern Puget Sound is expected to increase over the next decade as the development of Alaskan oil reaches full production and refinery processing in Puget Sound increases. As tanker traffic in the area increases, so does the possibility of large spills of crude oil. Potential impact to components of the ecosystem must be anticipated before a regional plan to control these spills can be formulated. With respect to marine mammals, information on seasonal abundance and distribution (detailed earlier) is needed, and an understanding of the potential impact of oil to these animals is necessary. Little real documentation of the impact of oil on marine mammals exists in the literature, but as interest in this problem increases, more opportunity for research occurs. The literature that is currently available is briefly summarized here.

Cetaceans

No documentation on the direct effect of oil on cetaceans is available. Following the Santa Barbara oil blowout in 1969, some popular accounts appeared attributing small cetacean and gray whale strandings to the oil leakage. Brownwell (1971) summarized details of cetacean strandings during that period and was unable to find evidence linking these strandings to oil pollution. In the analysis of tissue samples from stranded gray whales, no evidence of excessive hydrocarbon loads was documented.

Geraci and Smith (1977) speculate that stress produced by oil contamination may be an important effect on those cetaceans most sensitive to environmental changes, e.g., the harbor porpoise. Another potential danger to cetaceans is absorption of oil through the mucous membrane lining the blow hole beyond the nasal plug (Norris, USDI, 1975). This area is always exposed to water and could become oiled during normal respiration. Eventually if penetration of the nares occurs a thin film of oil would cover much of the lungs and respiratory passages, resulting in inhibition of completer oxygen exchange, distruption of normal diving and feeding behavior, and eventual weakening the animal. Pneumonia and prabable death could result (Norris, USDI, 1975).

Pinnipeds and Mustileds

Irving and Hart (1957) described the metabolism of the harbor seal (*Phoca vitulina*) and harp seal (*Phoca groenlandica*), a study that provided descriptive physiolgical data that is useful for comparison with oiled animals. Metabolic rate for these seals ranged from 1.6 to 2.0 times that of man (BMR = 1) at lower critical temperature. Core body temperatures are maintained by vasoconstriction in peripheral areas and in the highly vasculated appendages. Blubber is the effective insulating agent for the seal (Shepeleva, 1973; Miller and Irving, 1975; and Miller et al., 1975). Controlling blood flow through the appendages is the primary means of thermoregulation.

Newborn phocid pups have a subcutaneous fat layer which is considerably less than that of immatures (Shepeleva, 1973) and demonstrate a metabolic rate 2.6 times that of an adult terrestrial mammal of the same weight (Miller and Irving, 1975). The resting rate in pups is greater than that for older seals (Irving and Hart, 1975) and infers that the higher metabolic rate helps compensate for cold during the first weeks after birth when blubber reserves are low. An intensive nursing period and high milk fat content (Shepeleva, 1973) provide for the rapid addition of the blubber layer by the time of weaning, which in harbor seals is 3 to 5 weeks after birth (Bishop, 1968).

The hair covering of phocids when wet, is less than 1 mm thick on the skin surface (Irving and Hart, 1957) and is considered of negligible value in thermoregulation. Hair covering may also be of negligible value to those ottariids which have a single hair layer and large blubber deposits (Irving and Hart, 1957). The fur seal (*Callorhinus ursinus*) and the sea otter (*Enhydra lutris*) depend on a still air layer trapped between hair and fur layers for insulation (Scheffer, 1962; Kenyon, 1969).

The sea otter's metabolism was studied extensively in metabolic chambers of Amchitka Island, Alaska (Morrison et al., 1974). The basal metabolic rate was determined to be 2.5 times that for a terrestrial mammal but comparable to that for other marine mammals (as described above).

Kenyon (1969) describes a captive otter spending 48% of its time grooming, a practice vital to maintaining the insularive properties of the fur. Dirty fur results in loss of heat preservation and rapid death (Kenyon, 1969). Otter deaths after accidental oiling occur after "several hours" (Kenyon, 1971).

Kooyman et al. (1976) measured thermal conductance of blubber-free pelts (oiled, cleaned and washed) from several species of pinnipeds. A water bath was run across the pelts and the difference in water and plate temperatures (the dry side of the pelt) was measured. Pelts of a representative phocid (Erignathus barbatus) and sea lion (Zalophus californianus) showed no conductive change. However, the fur bearing pelts (Callorhinus ursinus and Enhydra lutra) demonstrated more profound effects. Conductance of oiled pelts increased 2.1 times in Enhydra pelts and ranged from 1.7 to 2.0 times for the Callorhinus samples. A living fur seal when 30% coated with crude oil showed an increased metabolic rate 1.5 times the resting rate, and became reluctant to enter the water. It was assumed that this would result in an animal in the wild reducing its feeding effort. It could not be determned if death would result from thermoregulatory problems or the increased lethargy of the animal.

Of 3,769 fur seals collected pelagically during fur seal research from 1964 to 1971 only one was observed to be oiled, suggesting fur seals rarely contact oil in the open sea (Kenyon, 1971). However, of the animals taken near the Strait of Juan de Fuca in busy shipping lanes 12% of 107 animals exhibited oiling. Since no observations of oiled fur seals have been made on the breeding grounds, it is doubtful contaminated animals survive to return to land (Kenyon, 1971), although it is possible that the oiled animals may have cleaned themselves by the time they reached the Pribilof Islands.

Elephant seal pups (Mirounga angustirostris) contaminated by the Santa Barbara spill were compared with clean pups on San Miguel Island, California and no differences in mortality was observed (LeBoeuf, 1971). A similar observation for gray seals (Halichoerus grypus) was made with the suggestion that any differences may have resulted in the continual harassment of oiled pups by well-intentioned cleaning crews (David and Anderson, 1976). No difference in survival was found between oiled and unoiled California sea lion pups (Zalophus californianus) (Brownell and LeBoeuf, 1971).

In these studies no determination of the effect of ingested oil by suckling pups was made. Ringed seals (Phoca hispida) have been shown to rapidly absorb ingested crude oil (Engelhardt et al., 1977). Low levels of hydrocarbons were found in body tissues and high levels were seen in the bile and urine indicating rapid excretion. Harbor seals maintain body fluids metabolically, however, salt water is taken coincident with feeding (Hart and Fisher, 1971) and could represent an avenue of oil ingestion.

Immersion studies of ringed seals in the field and laboratory have shown some kidney and liver damage, but in insignificant amounts that may not be permanent (Geraci and Smith, 1976). A sonic temperature telemetry "pill" administered in these studies showed no significant changes in core body temperature between oiled and unoiled seals. All seals used in the laboratory immersion study died within 71 minutes of exposure to oil, perhaps due to stress experienced by the captive animals (Geraci and Smith, 1976). Stress was also correlated with age, older seals transported to the study died within two months while the younger seals lived. These results suggest that any environmental disturbance would not effect a seal population uniformly. Older seals and those in poor health are likely to be more sensitive than younger, healthy animals to oil contamination (Geraci and Smith, 1977).

The pinniped eye may be the organ most sensitive to oil. All pinnipeds have eyes morphologically the same (Jamieson and Fisher, 1972). Geraci and Smith (1976) reported eye damage as one the potentially serious effects of oiling in seals which may result in blindness. Blindness may reduce an animal's ability to cope with its' environment and increase mortality, however, a blind female harbor seal (cause of blindness unknown) has been observed breeding successfully for at least eight years on Gertrude Island, Washington (Newby, pers commun.), and blindness may not be critical to survival

Oil pollution does not appear to interfere with the normal mother-pup bond in elephant seals, California sea lions, and harbor seals (Brownell and LeBoeuf, 1971; David and Anderson, 1976). Premature pupping has been associated with high organochlorine levels in California sea lions (DeLong et al., 1973), but no data exists to suggest hydrocarbon contamination causing similar problems.

III.B.2. Discussion

The high metabolic rate of marine mammals (as compared with terrestrial mammals) has an adaptive significance for the cool marine environment, coupled with the development of effective insulations (Repenning 1976). Disruption of either of these mechanisms appears to be the immediate danger from oil pollution, and could occur through increased conductance and loss of the still air layer in sea otters and fur seals. Loss of this still air layer would probably prove fatal in most instances due to rapid hypothermia and/or gradual deteriorating nutritional condition. Phocids and sea lions on the other hand rely primarily on an insulating blubber layer to maintain body temperature and may be less affected by oiling. Young phocids or sea lions may be affected adversely if oiled early in life before an adequate blubber layer has developed, and for these species oil spills would be most detrimental during the breeding season.

Internal effects of oil pollution are less clear, some irreversible kidney damage may be sustained after prolonged exposure as a result of metabolizing and excreting hydrocarbons (Geraci and Smith 1976). Externally adverse effects to eyes have been demonstrated. Effects to other organs and tissues have not been observed and can probably be demonstrated only through long term studies.

Kooyman et al. (1976) reported difficulty finding a suitable agent for removing oil from fur seal pelts. Development of such an agent which is effective yet does not harm the animal is needed before any success can be achieved in cleanup of fur seals or sea otters after a spill. Cleaning operations would prove futile if animals became recontaminated easily and should only be attempted after major spills are contained.

It appears that oil will affect each species or population differently depending on the individual animal's condition. Metabolic studies on different species and various age classes must be done to resolve this question.

IV. SUMMARY AND CONCLUSIONS

A summary of the marine mammals of northern Puget Sound follows. The occurrence of species is summarized for four general areas: the Strait of Juan de Fuca (east and west), Haro Strait, Rosario Strait, and protected waters of the San Juan Islands. The relative seasonal vulnerability of these species to oil activities is discussed.

The effect of oil activities on these two animal groups is difficult to assess at this time (See Section III). For the purpose of this discussion we consider these animals vulnerable when they are in areas associated with oil activities.

IV-A. Cetaceans

Although our data is poor for the winter months, it appears that generally speaking cetaceans (a general term which includes the order Mysticeti and Odontoceti) occur with the greatest abundance and frequency in spring and summer months. This is a time when migrants moving north may wander into Puget Sound as well as more regularly occurring species which remain in the area for protracted periods during these months, perhaps in response to increased productivity in the area.

Cetaceans in this area can be considered common (C), rare (R), or accidental (A):

Species	Presence
Order Mysticeti	
Gray whale (*Eschrichtius robustus*)	C
Minke whale (*Balaenoptera acutorostrata*)	C
Fin whale (*Balaenoptera physalus*)	A
Humpback whale (*Megaptera novaeangliae*)	R
Order Odontoceti	
Whitehead grampus (*Grampus griseus*)	A
Pacific white-sided dolphin (*Largenorhynchus obliquidens*)	R
Saddleback dolphin (*Delphinus delphis*)	A
False Killer whale (*Pseudorca crassidens*)	A

Shortfin pilot whale (*Globicephala macrorhynchus*)	R
Killer whale (*Orcinus orca*)	C
Harbor porpoise (*Phocoena phocoena*)	C
Dall porpoise (*Phocoenoides dallii*)	C
Pygmy sperm whale (*Kogia breviceps*)	A
Gooseback whale (*Ziphius carirostris*)	A
North Pacific giant bottlenose whale (*Berardius bairdii*)	A

Of the 15 species of cetaceans for which we have specimen records only five can be considered common. These species may occur here irregularly at any season (rare). The remainder of species (7) have occurred accidentally and probably represent an animal wandering far outside of its normal range or a carcass carried into the area by ocean currents.

Table 31 summarizes the seasonal distribution and relative abundance of the commonly occurring cetaceans in the study area. Abundance for all species begins to increase in spring to maximum numbers in summer and a decline into fall. The exception to this is the gray whale which is most abundant during its late fall and spring migrations. Haro Strait is important to nearly all species as is the eastern half of the Strait of Juan de Fuca. Rosario Strait has animals present year round.

The time of greatest vulnerability is in late spring and summer when the greatest variety of species can occur in the study area. It is also at this time that breeding behavior is at a peak and represents an important period for early survival of young.

IV-B. Mustelids

The only mustelid studied, the river otter (*Lutra canadensis*) is locally abundant in all portions of the study area year round. An exact abundance estimate is unknown; seasonal migrations may occur between fresh and salt water.

This species is particularly vulnerable to oil development in two ways: 1) habit loss through increased shoreline development could result in a population reduction and 2) an animal coming in contact with spilled oil would succumb to rapid hypothermia leading to death. A large

TABLE 31.--Occurrence of common Mysticetes and Odontocetes in the Strait of Juan de Fuca and northern Puget Sound during the four seasons of the year. 0 = species present, + = greatest abundance, - = not present or known to occur.

Species	Location: Juan de Fuca (West)	Juan de Fuca (East)	Haro Strait	Rosario Strait	Protected waters	Season
Gray whale (*Eschrichtius robustus*)	+	0	-	0	0	Sp
	+	0	-	0	0	Su
	+	0	-	0	0	F
	0	0	-	-	0	W
Minke whale (*Balaneoptera acutorostrata*)	0	+	+	+	+	Sp
	0	+	+	+	+	Su
	-	0	+	0	0	F
	-	0	+	0	0	W
Killer whale (*Orcinus orca*)	+	+	+	+	0	Sp
	+	+	+	+	0	Su
	+	+	+	+	+	F
	0	0	+	0	0	W
Harbor Porpoise (*Phocoena phocoena*)	0	+	+	0	+	Sp
	0	0	+	+	+	Su
	-	0	+	0	0	F
	-	0	0	0	0	W
Dall Porpoise (*Phocoenoides dalli*)	0	+	0	0	0	Sp
	+	+	+	+	+	Su
	0	0	0	0	0	F
	-	-	-	-	-	W

scale spill would effectively eliminate this species from a local area.

IV-C. Pinnipeds

The pinnipeds (a general term used to describe the families Ottariidae and Phocidae) are represented in the study area by five species. Two of these, the elephant seal (*Mirounga angustirostris*) and the northern fur seal (*Callorhinus ursinus*) are uncommon occurring during seasonal movements offshore, usually during the spring and fall. Two other species, the California sea lion (*Zalophus californianus*) and northern sea lion (*Eumetopias jubatus*) are seasonally abundant in the study area. The remaining species, the Pacific harbor seal (*Phoca vitulina richardsi*) is a year round resident and is the only pinniped that breeds in these waters (Table 32).

The northern fur seal is expected in the western Strait of Juan de Fuca in fall and winter months. Numbers are not known but are expected to be low. This species is most abundant offshore. Occurrence of fur seals in Haro Strait, Rosario Strait, and the inland protected waters is rare. Fouling of the hair of a northern fur seal with oil would probably prove fatal. Its limited appearance in local waters precludes any serious damage to this stock related to development of oil activities in Washington waters.

The elephant seal also occurs in insignificant numbers in the study area. Primary periods of maximum numbers ar expected to be spring and fall. This species can probably be found most often in the Strait of Juan de Fuca, though records exist for all areas. The large number of sightings from Admiralty Inlet reflects the high density of small boats in that region and not the relative abundance of the elephant seal. Only immature and adult animals are found in Washington. Impact to these individuals from an oil spill is expected to be mimimal. No rookery areas are located in Washington and thus no breeding habitat would be impacted.

The two species of sea lions, the California sea lion and northern sea lion, occur in the study area simultaneously. Both species are most abundant in the Strait of Juan de Fuca. They begin arriving during a post-breeding season movement of animals off the rookeries in the fall. Both sexes of northern sea lions can be found here although no breeding activity takes place in Washington. Only male California sea lions are thought to move in Washington waters.

TABLE 32.--Occurrence of pinnipeds in the Strait of Juan de Fuca and northern Puget Sound during the four seasons of the year. 0 = species present, + = greatest abundance, - = not present or known to occur.

Species	Location: Juan de Fuca (West)	Juan de Fuca (East)	Haro Strait	Rosario Strait	Protected waters	Season
California sea lion (*Zalopus californianus*)	-	-	-	-	-	Sp
	-	-	-	-	-	Su
	0	0	0	-	-	F
	+	+	+	0	0	W
Northern sea lion (*Eumetopias jubatus*)	-	-	-	-	-	Sp
	-	-	-	-	-	Su
	0	0	0	-	-	F
	+	+	+	0	0	W
Northern fur seal (*Callorhinus ursinus*)	-	-	-	-	-	Sp
	-	-	-	-	-	Su
	0	0	0	-	-	F
	0	0	0	-	-	W
Harbor seal (*Phoca vitulina richardsi*)	+	+	+	+	+	Sp
	+	+	+	+	+	Su
	+	+	+	+	+	F
	+	+	+	+	+	W
Northern elephant seal (*Mirounga angustirostris*)	0	0	0	0	0	Sp
	-	-	-	-	-	Su
	0	0	0	0	0	F
	-	-	-	-	-	W

California sea lions occur in Rosario Strait and Haro Strait in limited numbers. A small hauling site is known at Dodd Narrows near southwestern Vancouver Island (Bigg, 1973). More animals would be expected in Haro Strait than other inland waters. Northern sea lions haul out regularly at only one site in the inland waters, the northern side of Sucia Island. Their abundance in the inside waters is also low.

Both Northern sea lions and California sea lions haul out on Race Rocks and Sombrio Point on the southeast Vancouver Island. After a late spring and summer absence both species first appear at these sites in October. The maximum count of California sea lions was taken in December 1977 of 76 positively identified animals. The number fluctuated at slightly lower levels during January through March, rapidly declining in May. No California sea lions remained in the study area by June.

Northern sea lions are most abundant during December through March. The counts for December 1977, January and March 1978 were about 200 animals. A rapid decline in the number of northern sea lions was observed in May and by June no northern sea lions remained on the hauling areas.

Figure 36 depicts the abundance of sea lions in the study area during the present study. Animals that could not be positively identified to species are included in the total. Sea lions would be most vulnerable to oil activities in the winter, primarily in the eastern half of the Strait of Juan de Fuca. The effect of an oil spill on either of these two species is unknown.

The remaining pinniped, the Pacific harbor seal, is abundant in the study area year round. Pupping begins in late June and lasts eleven weeks, ending by the middle of September. Peak pupping takes place during the month of August. Important breeding grounds are centered in the eastern Strait of Juan de Fuca at Minor Island, Protection Island, and Dungeness Wildlife Refuge, accounting for at least 42% of the total productivity for the study area. The San Juan Islands and Rosario Strait are the next two areas of importance for pup production accounting for a minimum productivity of 18% and 12% respectively during 1978.

Abundance of adults and immatures in the study area varies seasonally. Table 33 lists the relative seasonal abundance of harbor seals as a percentage of the total number counted during aerial surveys. The eastern Strait of Juan de Fuca contains the largest percentage of the

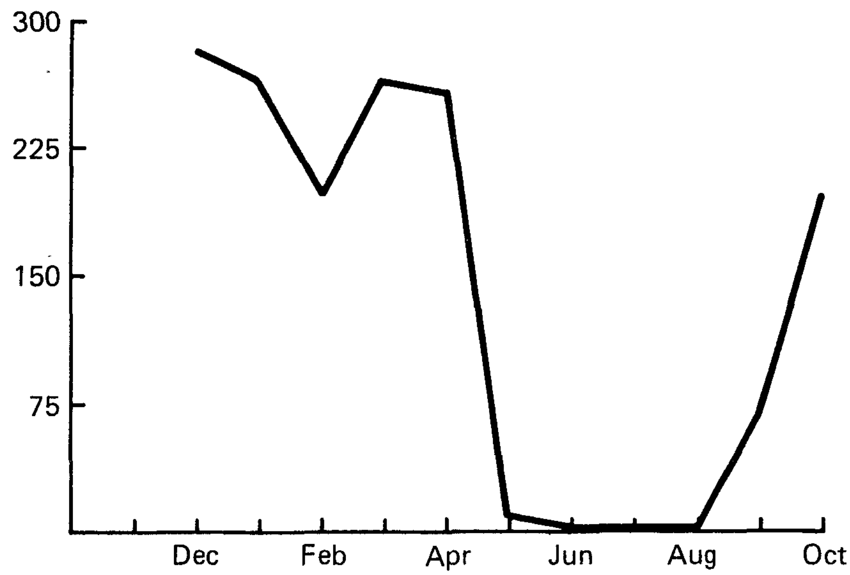


Figure 36. Total number of northern sea lions and California sea lions occurring in the waters of northern Puget Sound and the Strait of Juan de Fuca December 1977 to October 1978.

population for any season. The numbers decreased here in fall and winter corresponding to an increase in outlying areas, particularly the western Strait of Juan de Fuca and Haro Strait indicating some seasonal movement may occur.

An overall rank of areas of importance to the harbor seal population in descending order is: Strait of Juan de Fuca (east), Haro Strait, San Juan Islands, Rosario Strait, other areas (bays and estuaries), and Strait of Juan de Fuca (west).

Table 33.--Percentages of the total population of Pacific harbor seals (*Phoca vitulina richardsi*) for selected areas in northern Puget Sound and the Strait of Juan de Fuca by season. Percentages were taken from aerial surveys made in 1977-1978, numbers in parenthesis refer to Table 16.

General area	Season			
	Fall	Winter	Spring	Summer
Haro Strait (2,3)	24.8	18.1	30.1	16.9
Rosario Strait (5)	8.5	5.1	5.1	9.0
San Juan Is. (4)	18.6	4.2	6.6	23.3
Strait of Juan de Fuca (east) (7,10,11,12,17)	34.9	66.8	53.6	42.7
Other areas (1,6,8,9)	9.9	3.1	3.4	6.3

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VI. BIBLIOGRAPHY

In addition to the literature cited in the text of this report other references, both published and unpublished reports and manuscripts, are included in the bibliography that are relevant to the study of marine mammals in Washington waters. Included are general references useful to developing an understanding of marine mammal species and the different approaches to studing them. This bibliography is by no means a complete review of the marine mammal literature of the State of Washington. Additions will be made during the coming year as omissions and new publications come to our attention.

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