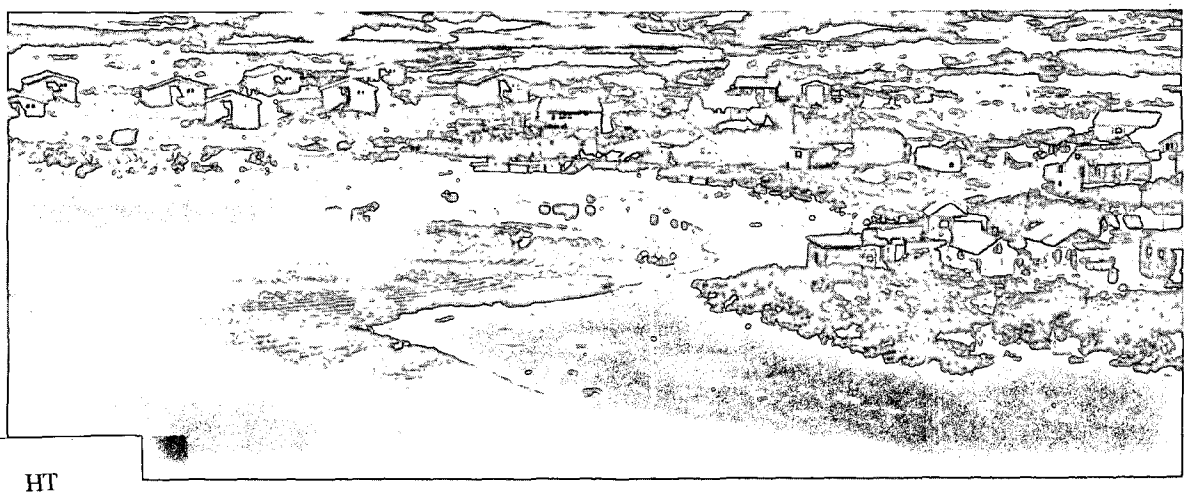
KODIAK ISLAND BOROUGH COASTAL SENSITIVITY STUDY

Technical Report



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SLAND BOROUGH COMMUNITY DEVELOPMENT DEPARTMENT

February 1985

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FEBRUARY 1985

Prepared for

Kodiak Island Borough
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ACKNOWLEDGEMENTS

The Kodiak Island Borough Coastal Sensitivity Study was funded in part by funds from the Coastal Energy Impact Program (CEIP) and the office of Coastal Zone Management, National Oceanic and Atmospheric Administration, U.S. Department of Commerce and administered at the state level by the Alaska Department of Community and Regionial Affairs, Municipal and Regional Assistance Division. The Department of Community Development, Kodiak Island Borough, was responsible for the overall direction of the study. In addition, we would like to thank the following organizations and agencies for their contribution in this study:

Kodiak Island Borough OCS Advisory Commmittee
Kodiak Area Native Association (KANA)
KANA Overall Economic Development Plan Committee
Alaska Department of Fish and Game
- Division of Habitat
- Commercial Fish Division

Alaska Department of Natural Resources
U.S. Coast Guard
U.S. Fish and Wildlife Service
National Marine Fisheries Service
Alaska Terminal and Stevedoring, Inc.
Kodiak fishermen and processors - Al Burch
- Oral Burch
- Oscar Dyson
- Dave Hernsteen
- Oliver Holm
- Chuck Jensen

1.0 INTRODUCTION

1.1 PURPOSE

The primary purpose of this study is to create a decision-making tool for use by the Kodiak Island Borough and other affected parties in the event of a petroleum product spill in the nearshore waters of the Borough. It is not intended to be a specific response plan or a contingency plan. However, it does provide information that can be used in response to a spill event by outlining resources and activities that are sensitive to petroleum spills and their seasonal occurrence.

The coastline of Kodiak is extremely complex, with rocky fjords, sandy beaches, lagoons, wetlands, and numerous islands. A variety of fish and wildlife use the coastline and nearshore waters. These resources provide the basis for the commercial fishing industry, subsistence harvest by Borough residents, and recreational hunting and fishing. Borough communities are located on the coast. In this report, attention has been focused on intertidal areas and nearshore waters of bays and outer coasts.

Previous coastal sensitivity studies of the Kodiak Island Borough have been sponsored by the U.S. Minerals Management Service in association with proposed oil and gas lease sales. These studies have focused on the coastline characteristics and biological resources, but have several limitations:

- They evaluate only shoreline sensitivity and do not address coastal waters.
- They do not clearly examine the seasonal variation in spill sensitivity.
- They do not evaluate the sensitivity of key human uses and activities, such as commercial fishing, subsistence harvests, recreation, infrastructure, and cultural resources.

This sensitivity study uses the earlier coastal sensitivity studies, along with other information to develop a report that addresses the major concerns of Borough residents. It discusses spill behavior and appropriate response procedures for a broad range of spill sources, including tank farms, vessels, and oil and gas exploration activities. It must be made clear that sensitivities delineated in this document are to be used in understanding the effects of oil pollution in the coastal areas of Kodiak. To use the document in any other way would be inappropriate.

This Technical Report is presented as a narrative discussion of physical, socio-economic and biological aspects of Kodiak accompanied by a series of maps and tables showing the sensitivities of the shoreline and nearshore waters, the resources and/or activities found there, and their seasonal occurrence. A Citizens' Manual on coastal sensitivity has also been prepared as part of this study.

2.0 REGIONAL OVERVIEW

2.1 STUDY AREA DESCRIPTION

2.1.1 Location

The Kodiak Island Archipelago lies in the western portion of the Gulf of Alaska, separated from the Alaska Peninsula by the Shelikof Strait (see Figure 2-1). Approximately 200 miles long and 100 miles wide, the archipelago includes five major island groups: The Barren Islands, Shuyak Island, Afognak-Marmot-Raspberry Islands, Kodiak Island, and the Trinity Islands. The entire archipelago has an area of 5,000 square miles and lies within the boundaries of the Kodiak Island Borough.

The area encompassed by the Kodiak Island Borough is considered to be a structural continuation of the Kenai Peninsula. It has some interior peaks over 4,000 feet but generally varies between one and two thousand feet (except for the lowlands of the southwestern portion). The islands at the north and south ends of the island have flat to gently rolling terrain. The rugged coastline is characterized by deep, narrow fjords, bays and scattered islets. Most of the shoreline is rocky; however, lagoons, estuaries and marshes are also present particularly in the bays. Exposed bedrock and shallow soils are common throughout the study area.

The northern part of Kodiak Island, as well as Afognak Island, Shuyak Island, and Spruce Island support spruce forests, but most other islands are treeless. Willow and alder are common species in the areas that support woody vegetation. Grass and herbaceous plants dominate most of the region lying above the alpine zone.

2.1.2 Climate

The Borough has a maritime climate with cool summers and warm winters. Temperature ranges are small; maximum summer temperatures occur in July and

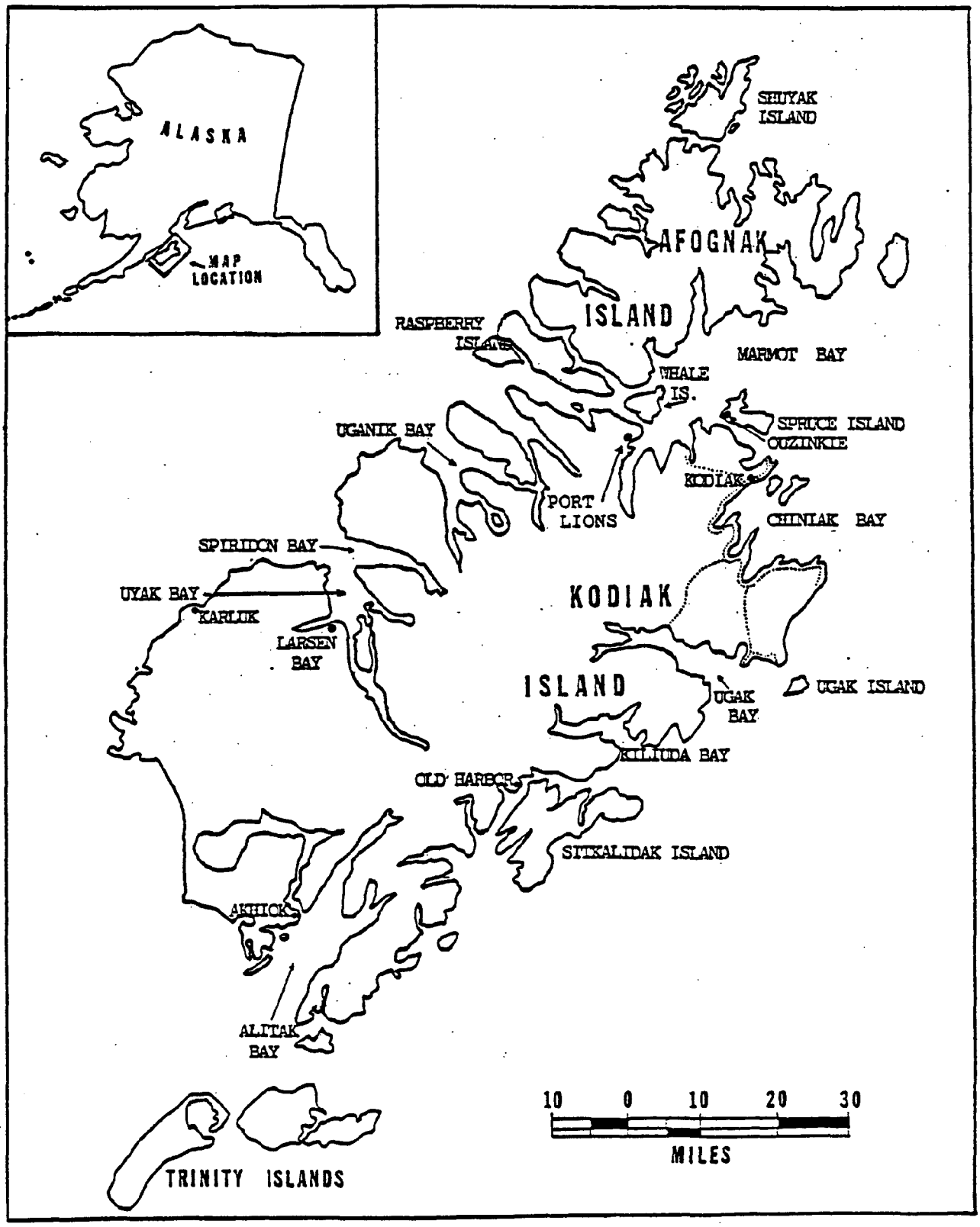

Figure 1. Kodiak Island Region

August and average between the high fifties and low sixties (Fahrenheit). In December, temperatures can drop into the low twenties. Annual precipitation ranges from 23 inches on the western side of the island to 98 inches on the eastern side of the island. Snowfall at higher elevations can average more than six feet. The region commonly experiences storms with heavy precipitation and high winds. The Shelikof Strait and the eastern and southern shores of the island have a significant fetch (exposure to long distances of open water), and are occasionally subject to large waves which can exceed 50 feet. Due to the climate, sea ice is extremely rare in the archipelago; however, freshwater ice can form at the head of the bays during periods of extremely cold weather.

2.1.3 Population

The Kodiak Island Borough contains eight communities with a total of approximately 12,000 residents. The City of Kodiak and Bells Flats are located on the Kodiak road system, along with the unincorporated areas of Chiniak and Monashka Bay. The six remaining villages include Akhiok, Larsen Bay, Karluk, Old Harbor, Ouzinkie and Port Lions. Table 2-1 presents a breakdown of the 1982 population of the Kodiak Island Borough.

Table 2-1: 1982 Kodiak Island Borough Population

PLACE	POPULATION
Akhiok	103
Kodiak	5,873
Larsen Bay	180
Old Harbor	355
Ouzinkie	233
Karluk	102
Port Lions	291
Chiniak	185
Womens Bay/Bells Flats	521
Remainder of the Borough	3,018

Source: Kana 1983.

2.1.4 Economy

The two aspects of the Borough's economy that are of importance to the spill sensitivity study are: the cash economy and the subsistence economy. Currently, commercial fishing and government are the two most important elements of the cash economy. Both are discussed in more detail in Chapter 6. The Borough economy relies heavily on commercial fishing, with salmon, crab, and halibut as the major fisheries. Until recently, Kodiak was the largest fishing port in dollar volume in the U.S. At least fourteen canneries are located in Kodiak, not including floating and fixed processors in the outlying areas. The cash economies of all six villages are heavily dependent on commercial fishing.

The U.S. Coast Guard is the major government employer, with 1,370 military personnel and 2,500 dependents. Other government employers include the State of Alaska, National Marine Fisheries Service, U.S. Fish and Wildlife Service, the Kodiak Island Borough, the Kodiak Island Borough School District, and the City of Kodiak.

2.2 OIL AND GAS LEASING AND DEVELOPMENT

Outer Continental Shelf (OCS) exploration and development activities have been a concern of the Kodiak Island Borough residents since 1975, when offshore oil and gas leasing was first proposed. Four lease sales have been proposed in the vicinity of Kodiak: #46 Western Gulf of Alaska, #60 Shelikof Strait, #100 (including Kodiak) and #88. Only one of the four lease sales has been held, resulting in seismic exploration activities in both the western Gulf of Alaska and in Shelikof Strait. Support activities have been based primarily out of Nikiski and Homer, although occasional calls have been made to the Kodiak Harbor for fuel and water.

Chevron U.S.A. has scheduled exploratory drilling in Shelikof Strait from November 15, 1984 through January 10, 1985. During this period, a semi-submersible drill rig will be on site, supported by supply boats and

helicopters based out of Homer. The estimated reserves of this lease area are 120 million barrels of oil and 680 billion cubic feet of gas. If economically recoverable reserves are discovered, development and production could occur over the next 10 to 15 years. Several potential oil and gas storage and terminal sites within the borough have been identified.

Several groups are actively involved in planning and coordination of oil and gas activities affecting Kodiak. The Kodiak Island Borough formed the OCS Advisory Committee in 1976 to act in an advisory capacity in the Borough Assembly in matters related to OCS oil and gas development. Representatives of oil industry and commercial fishing groups have been working together in the Alaska Oil, Gas, and Fisheries Alliance over the last two years. This group has successfully coordinated oil and gas and fishing activities in Kodiak and other areas.

Several oil spill response organizations serve the Kodiak area. The U.S. Coast Guard has trained personnel and equipment on base to handle small spills. Equipment includes 1500 feet of sea curtain boom, sorbent booms and pads and pumps. Additional spill response capability can be brought in from the San Francisco regional headquarters. The Cook Inlet Response Organization (CIRO) serves the oil industry in Cook Inlet and Shelikof Strait. Based out of Nikiski, CIRO can provide ocean curtain booms, skimmers, sorbent booms and pads. Palletized equipment can be quickly lifted to the spill site. Local spill response capability is provided by Alaska Terminal and Stevedoring Inc (ATS). ATS has responded to several spills in the Kodiak area of the last few years, primarily from sunken vessels. Equipment on hand includes containment booms, support vessels (workboats and tugs), oil skimmers and mops, pumps and hoses, bladder tanks, steam cleaners, and a vacuum truck. Heavy equipment can be obtained from local contractors on demand.

3.0 KODIAK ISLAND BOROUGH COASTAL SENSITIVITY TO PETROLEUM SPILLS

Both the preceeding and following chapters lay the groundwork for determining the sensitivity of Kodiak Island Borough to petroleum spills in coastal areas. The physical, biological and human use aspects of the Borough are described and the ability of oil to adversely affect them has been discussed. Based on this information, sensitivities for each of the categories are established. Sensitivity is designated as high, moderate and low. It should be pointed out that these designations are to be used within the context of this report; they do not establish intrinsic value of the Kodiak coastal areas. For example, a low sensitivity does not mean that the area is of low value or has low sensitivity to impacts other than an oil spill.

The development of oil spill sensitivity criteria must reflect the diverse resources and activities that occur within the Kodiak Island Borough. During any time of the year, it is likely that some level of important resource or human activity is present. As a result, there is always some level of oil spill sensitivity.

The challenge of this study was to develop a defensible means of evaluating the importance and vulnerability of a specific resource or activity to a spill. This information can be used at the time of a spill to make decisions on the protection of resources with the spill containment and clean up equipment on hand. By identifying those resources considered to be important by Borough residents and land managers, response actions can be chosen which will minimize damage from a petroleum spill.

The sensitivity criteria are developed for three separate categories, each of which has different spill considerations: 1) the physical shoreline and oil residence, 2) biological resources, and 3) human resources. There is no attempt to rank the importance of resources in comparison to each other. For example, a waterfowl nesting area is not considered more or less important than a recreational fishing area. However, the maps and tables may aid in determining "trade-offs" at the time of a spill.

3.1 PHYSICAL SHORE-ZONE RESOURCES AND SENSITIVITY CRITERIA

3.1.1 Physical Shore-zone Resources of Kodiak Island

The physical characteristics of the Kodiak Archipelago coastline provides part of the criteria used in evaluating shoreline sensitivity to oil spills. Shoreline sensitivity is considered to be the probability of oil residence following a spill. The physical shore-zone character is summarized primarily from Ruby et al.(1979), who conducted aerial and ground surveys of the Kodiak Island coast during 1978.

The coastline is, for the most part, steep and rugged, particularly in the northwest part of the island where long narrow fjords bisect the mountains. In this area, sediment is sparse and the shore-zone extremely steep. The southwestern part of the island is blanketed by glacial tills which, when eroded, provide coarse sediment to the beaches that are more common on this part of the island. The coastline here is highly indented by numerous bays and estuaries.

The shoreline is characterized by the seven coastal types that were described in Chapter 5.

3.1.2 Shoreline Sensitivity to Oil Spills

It is possible to make only very general estimates about shoreline sensitivity prior to an oil spill because the spill characteristics, which provide an important constraint to potential persistence, are not accurately known until the time of a spill. The quantity of oil reaching the shore, the oil type, the form of the oil (degree of weathering, degree of emulsification, etc.) and environmental conditions at the time of the spill are all important factors that must be evaluated when a spill occurs. Because of these uncertainties, three sensitivity levels are provided and indicate areas of primary, secondary, and tertiary oil residence concern.

High sensitivity is defined as oil residence greater than one year due to low wave exposure. This level applies primarily to protected inlets, estuaries, lagoons, tidal flats and marshes. The residence time of oil entering these habitats can be substantial, but most of the oil generally resides at higher intertidal levels. At lower levels, the substrate is smooth and wet, so that stranded oil floats off on succeeding tides. Oil that is somehow mixed into the sediment, however, will remain in the habitat for long periods of time. Seagrass is more susceptible than algae to the effects of oil contamination. In areas dominated by seagrass, damage from oil could be substantial.

Moderate sensitivity denotes areas where oil residence may vary from weeks to months depending upon environmental conditions at the time of the spill. Coarse-sediment beaches with moderate wave exposure are examples of this sensitivity level. However, the structural complexity of the habitat increases the potential residence time for oil that stands in the area. Duration of residence may also be inversely correlated with exposure to wave action. Thus, in an area exposed to ocean swells, strong wave action tends to wash and flush oil out of the interstices of the rock matrix more rapidly than in a protected area where agitation of the water is limited to tidal currents and wind chop.

Areas of low sensitivity are those where oil residence is short, usually only a matter of days or, at most, weeks. Wave exposure in these areas is high. Rocky headlands, wave-cut platforms and exposed rocky beaches are in this category. On rocky headlands, the rock surfaces are steep so that the oil drains off and there are few protected or flat areas in which oil can collect. Oil is constantly flushed from the area by the waves so that it does not have time to consolidate on the rock surfaces. On wave-cut platforms, boulders increase the complexity of the habitat and create numerous pockets in which oil can collect. Thus, oil can accumulate in the area under rocks and remain in the habitat for a greater period than on the exposed rocky headlands.

3.1.3 Factors Affecting Oil Residence

The three physical shore-zone factors affect oil residence in the following ways:

Wave exposure - High wave exposure leads to a relatively rapid mechanical breakdown of oil in the shore-zone and, as such, areas of high wave exposure are likely to be naturally cleaned in a short time period. Conversely, the lack of mechanical energy in areas of low wave exposure, such as bay and estuary shorelines, is likely to result in lengthy oil residence periods.

Shoreline substrate - Shorelines comprised of porous materials, such as coarse sand or gravel beaches, can retain greater volumes of oil in the pore space than can shorelines of fine material (ie, fine sand, mud, and clay). Also, penetration of the oil into the sediments prevents dispersion of the oil by mechanical wave action which is active only on the surface.

Coastal processes - Movement of sediment along the shore or in the on-offshore direction can affect oil residence by (a) burying the oil, or (b) eroding the oil. On shores that are being built up, oil may be buried within the beach and may persist for a considerable time period. On erosional shores, oil will likely be exposed to wave action and, therefore, residence time will likely be short.

These processes interact in a complex manner to affect the potential residence time of oil in the shore-zone.

The effect of wave exposure is the most important in controlling potential oil residence in that oil persistence in areas of high wave exposure is likely to be short no matter what type of substrate is present (Table 3-1). Similarly, oil residence in protected, low wave-exposure environments, will likely be lengthy regardless of substrate type. Wave exposure levels are estimated for the Kodiak Island shoreline by using

TABLE 3-1: Evaluation Criteria Used in Assigning Oil Residence Indices

SUBSTRATE	WAVE EXPOSURE: LOW (Fetch 0-10km)	MODERATE (Fetch 10-100km)	HIGH (Fetch 100-1000km)	VERY HIGH (Fetch >1000km)
Rock	1	2-3	3	3
Rock & Sediment	1	2	3	3
Boulder	1	1-2	3	3
Cobble	1	1-2	2	3
Pebble	1	1-2	2	3
Sand	1	2	3	3
Mud	1	1-2	N/A	N/A
Marsh	1	1	N/A	N/A

Note: 1 - Primary Level of Concern
2 - Secondary Level of Concern
3 - Tertiary Level of Concern

fetch distances over which waves may be generated; if fetch distances are great, the area is likely to be frequently exposed to high waves whereas if the fetch distances are small, the area is likely to be affected by low waves most of the time. This relationship has held true for many spills in other geographical areas.

Substrate types are reflected in the coastal types discussed in Chapter 5. Rocky substrates and fine sediments (mud and fine sand) prevent penetration of oil, whereas coarse sediments, particularly pebble, cobble and boulder-sized gravel, are susceptible to considerable oil penetration.

Sedimentation patterns (i.e. erosion and accretion) are not well documented for Kodiak Island shores; however, patterns can be estimated indirectly from coastal types. Rocky shorelines (Types 1 and 2, and parts of 6) are highly erosional in natural whereas estuarine tidal flats and marshes are accretional in nature (Type 7). Sand and gravel beaches (Types 3, 4, 5, 6) can be erosional or accretional but tend to be erosional in these areas. Oil persistence will be greater on accretional shorelines than on erosional shorelines.

These criteria were used to provide guidelines as to the potential oil residence in the shoreline. It should be emphasized that the criteria provide only relative information of shore-zone sensitivity and that absolute residence periods cannot be estimated until the time of the spill.

3.2 BIOLOGICAL SENSITIVITY CRITERIA

Establishing biological criteria is a complex task because, as described in Chapter 6, Kodiak has a wide variety of fish and wildlife resources which must be considered when establishing sensitivities. As with the physical coastline, biological sensitivities are expressed as high, moderate and low. This in no way represents the intrinsic value of the resource, but rather the susceptibility of populations and/or individuals to petroleum pollution and the sensitivity of the species to oil toxicity. Using these basic criteria,

it can be seen that areas where animals are concentrated are sensitive as are areas inhabited by species which are not numerous in the Kodiak area. Some animals are concentrated only during critical life stages which place an added stress on them, while others are concentrated during their entire lives.

Another measure of sensitivity is the ability of the population to recover from mortality caused by oil pollution, and recolonize previously used habitats. Some organisms such as barnacles and sea urchins are readily able to accomplish this, so that even though local populations may suffer extensive mortality as the result of an oiling incident, the species are so widespread and recolonize so quickly that they would not be considered particularly sensitive.

Areas of high sensitivity have been identified as the following:

1. seabird colonies
2. waterfowl high intensity use areas for nesting, staging and wintering
3. sea lion haulouts and rookeries
4. sea otter high intensity use areas
5. black-tailed deer high intensity winter use areas
6. elk high intensity winter use areas
7. brown bear spring and fall high intensity use areas
8. razor clam beds
9. mouths of anadromous fish streams
10. herring spawning areas

These represent areas where current knowledge of the Kodiak Archipelago is sufficient to allow delineation of use areas. There are other areas which perhaps should be included; for example, harbor seal haulouts and rookeries, but these have not been identified and have therefore not been included. The oil spill sensitivity maps should be periodically updated to reflect refinements in current knowledge.

Areas of moderate sensitivity have been identified as the following:

1. sea otter moderate use areas
2. general wintering areas for waterfowl
3. general wintering areas for black-tailed deer
4. general wintering area for elk
5. nearshore areas near mouths of anadromous fish streams (but not including the stream mouth)

Areas of low sensitivity include any parts of the coastline which do not fall in the high or moderate categories. Since this designation may reflect only the current state of resource knowledge and not the actual use or importance of the habitat, it is important that the sensitivity maps be reviewed and updated often.

An important component of coastal sensitivity is seasonality. The time of year can greatly influence animals' usage of specific coastal areas. For example, a seabird colony is probably more sensitive in the summer when nesting birds are present than in the winter when few, if any birds are there. Coastal areas occupied by black-tailed deer are sensitive during winter months but their sensitivity may decrease during the summer when many deer are inland. In indicating coastal sensitivities; however, each area is classified according to its highest sensitivity throughout the year. The maps are accompanied by tables which indicate why each area is considered sensitive and when. It should also be kept in mind that, in many cases, oil persists for a considerable length of time in coastal environments. As an example, if oil is heading towards a known seabird colony in February when birds are not present, precautions should be taken to keep it from reaching the area because oil may still be present in the colony when the birds return in May and June.

3.3 HUMAN USE SENSITIVITY CRITERIA

The sensitivity of a particular human resource, facility, or activity to an oil spill is determined by a number of factors:

- level of importance (i.e. economic, social)
- relative abundance and distribution
- frequency of use
- seasonal availability
- available alternatives
- regulatory status

An analysis of sensitivity must also reflect who is using the resource. For example, reliance on marine mammals as a subsistence resource varies widely among villages, and may be of great importance (high sensitivity) to one community and of lesser importance (low sensitivity) to another. This section presents the human resource sensitivity criteria used in preparing the human use maps; resources are designated as being of high, moderate and low sensitivity. These categories are solely for the purpose of petroleum spill sensitivity and do not indicate value or sensitivity to other potential impacts.

3.3.1 Commercial Fisheries

The delineation of sensitive commercial fishing areas was based primarily on those fisheries at greatest risk to an oil spill; i.e. shrimp, herring and salmon fisheries, which are pursued in shallow, nearshore waters.

The recent salmon catches in each Alaska Department of Fish & Game (ADF&G) statistical subarea were grouped as follows:

Sensitivity	Catch
High	>100,000 salmon/year
Medium	10,000 - 100,000 salmon/year
Low	<10,000 salmon/year

Similarly, the roe herring fishery was categorized according to catches:

Sensitivity	Harvest
High	>20 tons/year
Medium	<20 tons/year

No "low" values were assigned because limited catches of herring are taken in many Kodiak bays, but these low catches are intermittent and/or not always recorded.

In past years, large catches of shrimp have been taken throughout the Kodiak area, but recent catches have been very low; most bays have been closed to commercial shrimp fishing. In 1984, only Alitak Bay was open for shrimp. Because this represents the only such opportunity for Kodiak area residents, shrimp fishing in Alitak was assigned a "high" ranking.

Other fisheries, such as crab, halibut, and whitefish are pursued further offshore, in deeper waters, and are judged to be less at risk. Because of this and because the locations of these fisheries are both widespread and diffused, they do not appear on the human-use maps. However, the timing of these fisheries is shown on the charts accompanying the maps.

3.3.2 Subsistence

Knowledge of the resources and harvest areas used by specific communities will indicate who will be affected by a petroleum spill in a specific area at a specific time of year. Other sensitivity considerations include, the type of resource, how heavily it is utilized by a community, how common or widely distributed it is, harvest methods, seasonal availability, proximity to a community, and whether it is found solely on the coastline.

Table 3-2 summarizes resources and activity sensitivity by community.

Table 3-2: General Subsistence Resource Sensitivity by Village

	AKHIOK	KARLUK	LARSEN BAY	OLD HARBOR	OUZINKIE	PORT LIONS	KODIAK/CHINIAK
HIGH SENSITIVITY							
Salmon:	May-October	May-October	May-December	May-December	May-November	April-November	May-November
Waterfowl:	September-May	October-April			September-May		September-December
Deer-close proximity:	November-March	November-March	November-March	November-March	November-March	November-March	November-January
MODERATE SENSITIVITY							
Waterfowl:			August-November	October-March		September-May	
Marine Mammals:	Year-round	Year-round	Year-round	Year-round	Year-round		
Shell Fish-close proximity:	Year-round	Year-round	Year-round		Year-round		
Deer-remote areas:	November-March	November-March	November-March	November-March	November-March	November-March	
LOW SENSITIVITY							
Shellfish-remote areas:	Year-round	Year-round	Year-round	Year-round	Year-round	Year-round	
Marine Mammals:							Year-round
Waterfowl-remote areas:	September-May	October-April	August-November	October-March	September-May	September-May	
Other Fish:	Year-round	Year-round	Year-round	Year-round	Year-round	Year-round	Year-round

Several general assumptions were made on sensitivity:

- salmon harvest areas were generally given a high sensitivity because villages heavily rely on that resource, its availability is seasonally limited, and harvest activities are very susceptible to gear fouling or exclusion from a spill area

- depending on location, waterfowl are moderately to highly sensitive due to limited seasonal availability and reliance on shoreline areas

- some resources, such as deer, marine mammals and shellfish were considered to be more sensitive closer to communities where they are more intensively harvested. While this conclusion might be considered subjective, harvest of resources located further away require greater expenditures of time and fuel.

- resources available in inland areas are considered to be sensitive only when concentrated in shoreline areas

3.3.3 Recreation

Sensitivity of recreational facilities and activities in Kodiak is dependent upon time of year, and proximity to populations and access. Seasonal importance is usually tied to availability of fish and/or game. This is reflected in the fact that summer and fall experience a greater level of recreation than winter and spring. Other factors include: type of use or activity, level of activity, economic contribution, and management/ regulatory status. Activities and sensitivities are as follows:

High Sensitivity:

- State Parks (Ft. Abercrombie, Buskin River, Pasagshak Bay, Shuyak Island)
- Sport fishing areas (marine and intertidal)
- Commercial lodges (Seal Bay, Port Lions, Karluk Lagoon)
- Waterfowl hunting areas
- Popular picnic and outing areas.

Moderate Sensitivity:

- Coastal deer hunting areas
- Boating areas
- Remote areas with moderate documented use (usually seasonal).

Low Sensitivity:

- Remote areas with occasional documented use (usually seasonal).

3.3.4 Community Infrastructure

In general, community infrastructure and commercial and residential property are considered highly sensitive to petroleum spills. This is primarily due to the potential for property damage and the high costs of cleanup or reimbursement. The factors used in determining sensitivity to a petroleum spill includes economic value and importance, availability of alternative facilities (particularly important to transportation facilities), and level of use. Marine transportation facilities such as docks and harbors are highly sensitive due to their support of commercial fishing and their role as a primary mode of transportation. Sensitivity classifications are listed below:

High Sensitivity:

- boat harbors
- docks and boat launching facilities
- residential property
- commercial property (warehousing, fish processing)
- shoreline boat and gear storage areas

Moderate Sensitivity:

- o shoreline transportation routes (i.e. three-wheelers and other vehicles)

3.3.5 Archaeological and Historical Resources

The sensitivity of archaeological and historical resources is generally considered to be high due to the potential for damage from oiling and clean-up activities. Areas with a high density of sites are considered more sensitive than single sites. In order to protect the location of cultural resources, their sensitivity will not be mapped. However, detailed information on location and site characteristics are available from the State Historic Preservation Officer (SHPO). In case of a petroleum spill, response and cleanup activities should be coordinated with the SHPO and the Department of Community Development in the Kodiak Island Borough.

4.0 PETROLEUM PRODUCT SPILLS

This chapter discusses the sources of oil spills into coastal waters, behavior of oil in the environment and methods of containing, cleaning up and disposing of spilled oil. The purpose is to understand how oil reaches sensitive coastal environments and how cleanup activities differ depending on coastal habitat type and equipment used. Since this document is aimed at determining coastal sensitivities and is not an oil spill contingency plan, government notification procedures and the legal aspects of oil spill containment, cleanup and disposal will not be addressed. It should be noted, however, that actions taken in the event of an oil spill must be coordinated with the appropriate federal and state agencies.

4.1 SOURCES OF SPILLS

Petroleum product spills can be the result of "one-time" occurrences such as drilling platform blow-outs or ship accidents, or they can occur over time such as leaking storage tanks or waste oil dumping. If lease sales in the Kodiak area result in oil exploration and production, the Kodiak coastline is vulnerable to potentially severe oiling incidents due to the presence of drill rigs in the vicinity, increased tanker and ship traffic, and pipeline operation.

4.1.1 Blow-outs

Platforms supporting oil drills for offshore drilling can either be fully or partially submerged, or floating and anchored to the seafloor. When the platform is in place, a drill bit attached to a series of hollow shafts is rotated into the seafloor. "Drilling mud" consisting of water, clay and chemicals is injected through the hollow shafts, recovered through the space between the walls of the well hole and the drill shaft, and pumped out of the hole. The mud is used to lubricate the drillbit, and lift the rock cuttings out of the well.

Pockets of oil or gas encountered by the drill shaft are under pressure and when the pressure is released, the fluid forces itself into the well.

This is controlled by the drilling mud injected into the well and by "blow-out protectors", which are large valves attached to the top of the well casings. These measures allow a controlled release of pressure. A blow-out is an uncontrolled release of oil and gas.

In 1969, a drill rig offshore of Santa Barbara, California suffered a blow-out which oiled 30 miles of coastline. In this case, a used drill bit was being pulled out of the hole when it passed a fault in the substrate. The oil, which was under pressure from natural gas, followed the cracks in the strata to the surface instead of coming up the well and blew out in a flood of oil and gas at the ocean surface. Approximately 700,000 gallons of oil were released. In addition to releasing large volumes of oil to marine waters, in some cases, blown out oil is ignited at the surface, endangering those on the platform.

Blow-outs can be stopped by two methods: capping the well or drilling another well nearby to relieve pressure in the reservoir. The first method is very hazardous and the second is an option only if there is access to another drill ship or rig in the area.

4.1.2 Tanker and Ship Accidents

Ocean-going oil tankers often have carrying capacities of over 100 million gallons. Tanker and ship accidents can be expected to occur as a result of grounding and collisions, particularly during bad weather. The petroleum products carried by tankers include crude oil, jet fuel, heating oil and other refined products. Ship fuels include diesel and bunker products. Characteristics and behavior of oils is covered in Section 3.2.

Examples of major tanker accidents include the grounding of the ARGO MERCHANT on Nantucket Shoals in December 1976. The ship broke up after salvage efforts were unsuccessful and 7.6 million gallons of heavy oil were spilled, moving into the Georges Bank fishing area. In January 1975, a tanker unloading crude oil near Philadelphia was struck by another ship carrying a variety of petroleum products. The CORINTHOS was carrying 13 million gallons of crude oil which ignited, blowing it up and killing

several people. In addition, an oil slick spread down the Delaware River for 50 miles. The ZOE COLOCOTRONI ran aground near Puerto Rico in March 1973. To free the ship, the captain discharged 2 million gallons of crude oil to the sea instead of waiting for barges in which to lighter it. The oil spread to the coastline, oiling beaches and mangrove swamps. In some beach areas, oil penetrated 12 inches into the coarse sand. These are only a few of the tanker incidents which have occurred over the last 25 years.

Large fishing vessels and commercial ships also pose a threat to shorelines in that these vessels often have large fuel capacities. If grounded near the coast, a spill of large quantities of oil may reach the shoreline. Recent incidents where extensive segments of shoreline were polluted by ship fuel spills include the LEE WANG ZIN spill in southeast Alaska and the VANLENE spill near the mouth of Juan de Fuca Strait. The LEE WANG ZIN, a bulk ore carrier which capsized in Dixon Entrance, resulted in the oiling of approximately 200 miles of coastline in southeast Alaska. The VANLENE carried a cargo of automobiles from Japan and was grounded in Barkley Sound near the entrance of Juan de Fuca Strait. Large quantities of oil were released into the island archipelago, although strong surface runoff from heavy rains prevented significant shoreline contamination. These incidents illustrate the fact that grounding of moderate to large fishing or commercial shipping vessels near the coast may result in oil quantities of comparable size to tanker or exploration drilling spills in terms of shoreline contamination.

4.1.3 Pipeline Ruptures

Pipelines are often used to transport oil from offshore drilling rigs to onshore storage facilities. These pipelines can be ruptured during vessel accidents, by earthquakes, or as the result of sabotage or insufficient maintenance of couplings and other fittings. Small pipeline leaks are often not detected immediately; large ruptures usually are. Although pipelines can be shut down during repairs, there still is potential for large petroleum spills.

4.1.4 Oily Bilge

Tankers usually fill their empty oil tanks with seawater to provide ballast before they arrive at the port where they are to take on oil. This oily water, which may amount to several millions of gallons, must be discharged before oil is loaded. In most cases, including the Valdez terminal, treatment facilities are available to remove most of the oil from the water before it is discharged back into the ocean. If an accident occurs to the tanker, untreated oily bilge may be spilled.

4.1.5 Storage Tanks

Storage tanks may range in size from the massive crude oil tanks at the pipeline terminal in Valdez to smaller tanks containing diesel and other fuel oils which are present at most harbors. Earthquakes, sabotage, human error, faulty fittings and disintegration due to age may allow petroleum products stored in the tanks to escape. Spill size can range from a few gallons to millions of gallons. Spills can be catastrophic single occurrences or the result of chronic leakage.

4.1.6 Refueling and Maintenance of Vessels

Another common source of spills into coastal waters is refueling and maintenance of vessels. Sloppy techniques in refueling can result in numerous small spills over long periods of time. In addition, it is a common practice in many parts of Alaska to dump oily waste derived from oil filter changing and other operations overboard rather than containing it and disposing of it in approved sites onshore. These chronic spills can often be as damaging as one catastrophic spill to plants and animals in the area.

4.2 CHARACTERISTICS AND BEHAVIOR OF PETROLEUM PRODUCTS

4.2.1 Crude vs Refined Products

Petroleum products, i.e. crude and refined oils, have a wide range of physical properties. They can be divided into three main groups: light

distillates, heavy distillates and crude oil. The first group includes gasoline, kerosene and jet fuel. These are refined products with high rates of evaporation and they are extremely flammable; that is, they are easy to ignite. Also, light distillates dissolve more quickly in water than do the oils in the other categories. Some of the components, such as benzene and toluene, may dissolve in water quickly but then may evaporate to the atmosphere. Oils in this category tend to form oil/water emulsions and have great penetrating powers in marsh substrates where they may persist rather than evaporate or dissolve.

Heavy distillates include diesel oils and bunker fuel oils. These products contain less volatile components than do light distillates and they tend to become more viscous at lower temperatures. The aromatic portions (i.e. volatile compounds) evaporate rather quickly; the heavy portions can penetrate substrates. They also will emulsify with water, a process which can occur rapidly depending upon wind and wave conditions. Emulsified oil and water forms what is known as "chocolate mousse" - a viscous substance which may contain up to 80 percent water. Because the added water increases the volume of the spill, mousse formation compounds cleanup and disposal problems.

Crude oil is raw, unprocessed oil which has been altered very little if at all since taking it from the well. Crude oils with a greater percentage of lighter end compounds (usually less than 25 percent) may change characteristics fairly rapidly due to evaporation and other weathering actions. After weathering, many heavy crude oils may sink. Crude oil also can form emulsions. Lighter crude oils also have been shown to be more soluble in low salinity water than high salinity water.

The toxicity of oil appears to depend upon the amount of aromatics it contains. These lighter fractions such as benzene, toluene and xylene can dissolve in water or evaporate quickly. Laboratory experiments with juvenile salmon and various marine organisms have shown sensitivity to the aromatic fractions. Some tests found that respiratory rates in juvenile king salmon increased with 5 parts per million (ppm) benzene in water while mortality

occurred at 15 ppm. In others, shrimp and crab larvae were adversely affected by less than 1 ppm Cook Inlet crude oil in water. Soft-shell clams (Mya arenaria) exhibited a 20 percent reduction in production in an oiled area whereas an increase of 250 percent occurred in adjacent, non-oiled areas. Even if death does not result from exposure to oil, other behavioral changes may occur. Animals may be near death and thus, may fall prey to predators; or they may avoid areas necessary to life functions if those areas are oiled. For example, juvenile coho salmon were found to avoid water containing mixtures of benzene, toluene and xylene (aromatics found in oil) in concentrations of less than 2 ppm.

Jet fuels, gasoline, kerosene and other light, refined products appear to be more toxic to biological organisms than are heavy crudes; although it should be noted that all oils contain some quantity of these toxic aromatics. Crude oils, because they are heavier, may have a greater tendency to sink, potentially smothering sessile (attached or non-moving) organisms. Heavy fractions may persist in the environment for years as tarballs.

4.2.2 Factors Affecting Spill Movement

Oil spilled into the ocean generally will first form large slicks whose movements and behavior are then affected by a number of factors, the most important of which are wind, waves and currents. Oil will tend to spread out into a thin layer. On calm water, this may result in a layer less than a millimeter thick within an hour. Generally, however, oil on the ocean is subject to waves, tides, currents and wind, etc. and will form windrows (thick patches of oil separated by areas where the oil layer is very thin).

Wind is the most important factor in determining the movement of an oil spill. It will influence direction and height of waves, which in turn will push the oil in a specific direction and will cause it to form oil/water emulsions. Oil slicks appear to move at about 3 percent of wind speed. Wind can influence the spread and the shape of the spill and the evaporation rate of the oil.

Currents also determine oil spill direction and will have an effect on how quickly a spill moves. Tides can displace oil, carrying it away from a coastal area on an ebbing tide and re-oiling the coast on each high tide. Waves may have a significant influence on emulsion formation. Typically, the stormier the wind and wave conditions, the more likely it is for emulsions to form. Wave conditions also provide practical constraints to the type of containment or cleanup equipment that can be used. In the event of a spill, aerial reconnaissance is an important tool in determining where and when oil may reach a coastal area.

4.2.3 Behavior of Oil in Cold Water

Cold water conditions tend to retard evaporation rates and favor formation of chocolate mousse and tarballs. In this case, toxic fractions may persist in oil longer than in warm water situations where aromatics evaporate or dissolve more quickly. Coastal ice, although unusual in the Kodiak area, can also influence oil spill behavior.

4.3 RESPONSE ACTIONS IN EVENT OF A SPILL

4.3.1 General Approach

Response activities during a spill are highly variable and depend upon spill size, the product spilled, spill location, and environmental conditions at the time of a spill. However,

- Appropriate agencies and personnel are notified of the spill and initial spill characteristics are determined.

CONTROL AND CONTAINMENT - Initial response efforts focus on shutting down the spill source and containment at the spill site.

CHEMICAL TREATMENT - In the case of offshore spills, the option of using chemicals will be evaluated to disperse the spill by government response team members and, if advisable, arrangements for aerial and/or vessel spraying will be implemented.

PROTECTION - If containment at the spill site is unsuccessful and if there is a risk of oil reaching sensitive resources, there will be a need to protect these resources. Various strategies such as booming, water spraying or construction of solid-fill barriers may be implemented to prevent the spill from reaching sensitive coastal resources.

CLEANUP AND OIL RECOVERY - In spite of containment and protection strategies, coastal resources may be contaminated and require cleanup. Cleanup activities may range from mechanical cleanup of beaches to cleaning oiled birds.

DISPOSAL - Disposal of the spill material itself and of contaminated debris often poses a significant problem in remote areas. Material that cannot be recycled or burned may require permanent burial.

A general overview of techniques that may be used in spill response on Kodiak Island is provided in the following sections. The review is intended as background for the reader and not as a response guide. The use of oil spill countermeasures is complicated and the selection of appropriate countermeasures can only be accomplished at the time of the spill by trained personnel. Improper selection and use of countermeasures may cause more environmental damage than if no response action is taken. It is also important to note that all of these response activities may be operating simultaneously for larger spill incidents.

4.4 OIL CONTAINMENT AND EXCLUSION TECHNIQUES

When oil is spilled, it often must be corralled or contained in some manner to prevent it from spreading and to aid in cleanup. This section describes several ways of accomplishing this. In addition, these techniques can also be used to keep oil out of an area.

4.4.1 Booms

Booms are floating barriers which can be used to contain oil or keep it away from a particular area. They generally consist of a bouyant system strung along a line. Attached to the flotation device is a skirt which prevents the oil from "diving" under the boom floats. The skirt is weighted with ballast in order to maintain its position.

Booms may be deployed by two boats surrounding a slick on open water or may be anchored to shore at one end and deployed by boat across an estuary mouth or other area. The latter is a technique to keep oil from entering an area or it may be a containment technique to keep oil corralled in a certain area.

The usefulness of booms is affected by a number of factors. Oil will generally be entrained (i.e. flow) under a boom if the water current is greater than 0.7 knots. Therefore, booms would not be effective if stretched from one bank to another of a river or inlet where currents are swifter than this. This situation can be compensated for by deploying booms at an angle to reduce the current along the face of the boom. However, if the current is 4 knots or greater, the length of boom needed to achieve the proper angle becomes unmanageable. When boats are used in open water, they can sometimes drift with the current, thus reducing the current speed relative to the boom.

Tides can also reduce the effectiveness of booms by changing the current direction. Usually several booms can be placed in a series to compensate for this. Anchors may also be positioned the same way for all booms to keep them from tangling on rocks or pulling the anchors.

Waves can affect the usefulness of booms. Usually booms can handle long swells but they must be very flexible to be useful in medium swells. In cases where waves are greater than 3 meters in height, oil may be pushed under the boom. Choppy waves may cause oil to be splashed over booms.

4.4.2 Berms

Earth berms or dams can be constructed in some beach or tidal flat areas to prevent oil from moving into adjacent areas. Usually a trench is dug in the intertidal area with a berm being constructed on the inland side of the trench. In rivers, dams may be built to totally block water and oil flow or they may be built with culverts or weir systems which can be designed to allow water to pass while retaining oil. In some cases a combination of berms and booms may be used to block oil flow and contain it for cleanup. They may be built in a series across a water course or parallel to one another.

4.4.3 Animal Warning Systems

Animals, especially birds may need to be excluded from a coastal spill area. Warning devices include propane cannons, sirens or shotguns with blanks. Most birds and other animals can be discouraged from entering an area simply because of the increased human activity. If a spill appears to be headed for a bird use area, it is usually better to exclude the birds while trying to divert or contain the oil than it is to try to rehabilitate oiled wildlife later.

4.4.4 Chemical Containment

Chemical containment systems have generally proved to be less effective than mechanical containment methods. There are several types of chemical systems.

a. Herding - Chemical herders or barriers are used to keep a spill from spreading. They are applied around a spill but must have a dock or boom or other hard barrier on at least one side. They are effective primarily for small spills in sheltered areas and may sometimes be used to keep oil from adhering to shorelines or structures.

b. Gels - These are added to oil to form a gelatinous substance to facilitate cleanup. However, their usefulness has not been fully proven.

c. Sinking agents - These chemicals can cause the oil to sink to the seafloor. Although they do clean up the water surface, the oil merely ends up coating the seafloor where it is very difficult to clean up and may cause adverse biological impacts. Use of sinking agents is usually discouraged.

4.5 CLEANUP TECHNIQUES

After oil has been contained, it must be removed from the water or from coastal areas. This can be accomplished mechanically, by hand or through the use of chemicals. This section describes several of these techniques.

4.5.1 Skimmers

Skimmers are mechanical devices used to pick oil up from the surface of water. There are seven types of skimmers: weir and oleophilic skimmers (overflow skimmers), booms with skimming devices, disc skimmers, belt skimmers, vortex skimmers, and vacuum skimmers. Each type has advantages and disadvantages which are shown on Table 4-1.

Table 4-1: Skimmers: Uses and Limitations

Skimmers	Type of oil	Capacity	Weather conditions: waves-wind-currents	Observations
Overflow skimmers o Self-leveling units	Efficient with all kinds of oil and even with water-in-oil emulsions provided viscosity is not too high.	Max. 10 m^3/h	Do not work very efficiently in waves higher than 0.3 m.	They must be connected to pumps, road tankers or vacuum tanks. Solids and debris plug these skimmers very easily.
o Floating saucer units		Collect less than 20% of water in calm water.	They need only 0.3 m water depth to work.	They must be used in calm water: rivers, lakes, harbors, or estuaries.
Disc skimmers	All kinds of oil. Their efficiency is poor in emulsion	10 to 400 m^3/h Collect 10 to 60% of water with the oil	Claimed to be able to work in rough seas: 1-3 m waves.	Some of them are floating units: others must be installed aboard and moved by a hydraulic system. They work better if used with booms.
Bank skimmers	Work in non-viscous oil	10 to 300 m^3/h 10 to 50% of water is collected	Efficient in calm water, poor efficienty in waves.	The tow speed is 2 to 9 km/h max. (1 to 5 knots). The ban can suffer from tearing according to the presence of solids and debris, and also with too high tow speed.
Vortex skimmers	All kinds of oil except viscous oil and emulsions	10 to 700 m^3/h 20 to 60% of water is recovered	Used with waves up to 1.5 m.	Must be towed by a ship or fixed to the boat's hull. To be efficient the speed of the apparatus must be from 2 to 15 km/h (1 to 8 knots).
Skimming barrier	All kinds of oil except highly viscous emulsions	100 too 2700 m^3/day	The efficiency decreases drastically in waves greater than 0.5 m.	Must be towed at certain speed to ensure a sufficient oil thickness to pump the oil.
Vacuum skimmers	All kinds of oil and emulsions	5 to 200 m^3/h	Never used at sea, only on shore	Collect a lot of water with oil. Efficient with viscous emulsions, can be used with demulsifiers.

From Tramier et. al. (1981)

Skimmers generally do not pick up oil/water emulsions. Also, skimmers will bring up a certain amount of water, so, depending upon the ultimate disposition of the oil, oil-water separators may need to be used after oil has been recovered. Skimmers are most useful in sheltered areas where waves are less than 6 feet in height.

4.5.2 Dispersants

Dispersants are chemicals which break up oil slicks into fine droplets on the water surface and in the water column. The drops are prevented from re-joining after they are dispersed. Oil concentration is decreased and biodegradation is enhanced.

Dispersants are of two general types: conventional and concentrated. Conventional dispersants are applied full strength and are effective on even very viscous oils. Concentrated dispersants are diluted based on viscosity of the oil (light oils may receive a treatment of 1:30 parts dispersant to water whereas a dilution of 1:10 would be used for crude oils). Usually these dispersants are less effective with viscous oils.

The chemicals are sprayed on the water surface from boats or airplanes. Conventional dispersants may be applied on shores or nearshore waters using any pumping equipment. The following advantages and disadvantages with the use of dispersants have been identified.

Advantages:

- Effective in all sea and weather conditions.
- Allows fast response to oil spills.
- Minimizes oil contamination of birds and marine mammals.
- Enhances biodegradation by increasing surface area for bacterial attack.
- Inhibits photo-oxidations of oil to toxic peroxides and acids.
- Reduces fire hazard.
- Reduces possibility of emulsion formation.
- Reduces possibility of shore pollution.
- Less expensive than recovering oil which has reached shore.

Disadvantages:

- Dispersants may be detrimental to mollusks or other slow-moving animals.
- May cause tainting of fish.
- May adversely affect sensitive areas such as saltmarshes, estuaries, spawning or nursery grounds or aquaculture areas.
- Increases penetration of oils into beach sands.
- May increase turbidity in water.
- Ineffective on heavy or weathered oils.
- Reduces photo-oxidation of oil, thus avoiding partial disposal of oil.

From Tramier et. al. (1981)

4.5.3 Sorbents

Sorbents are substances which absorb or adsorb oil floating on water. They can continue to float after absorbing oil and thus can be picked up mechanically. Sorbents can be natural items such as straw or sawdust, or they may be polypropylene or polyurethane foam. Of these types, straw has the lowest absorption capacity whereas polyurethane foam has the highest. Sorbents generally are less effective with heavy or weathered oils than with lighter oils. They are used best in sheltered waters and in inaccessible places such as under docks. Sorbents used in off-shore areas may be dispersed by currents or wind and may spread oil pollution. Once sorbents have absorbed oil, they should be removed from the area and disposed of in an approved manner.

4.5.4 Burning

In some areas, the most effective cleanup method may be to burn off the oil. This technique is best used immediately after a spill occurs. Oils which have lost most of their volatile fractions may not be easy to ignite and if in close proximity to cold seawater may be slow burning. The decision to burn must be balanced against public safety, air pollution, hazards and effect on wildlife and habitats.

4.5.5 Mechanical Methods

When oil has reached shores, the most effective means of cleanup may be using heavy equipment such as backhoes and draglines. The use of several different types of heavy equipment in the types of coastal habitat are shown on Table 4-2.

Each method of cleanup involving the use of heavy equipment must be evaluated in terms of the environmental sensitivity of the area to be cleaned. In some areas, heavy equipment can damage the habitat or work oil into the substrate. The area, the oiling incident and accessibility may not warrant the disruption which will result from the use of such equipment. In these cases, manual cleaning may be required. These methods are very labor-intensive but may be effective in sensitive areas or where oil accumulation is heavy.

Manual scraping involves using shovels, scrapers or putty knives to scrape oil off rocks or other hard substrates. Animals or vegetation can be left undisturbed. Rakes and shovels can be used to gather up oiled vegetation, debris, mud and sand and place it in burlap bags or barrels for removal from the site.

Other mechanical methods include water and sand blasting. Flushing with water, both under high and low pressure, is very effective for cleaning rocks, boulders and structures. The area or structure to be hydroblasted can be boomed or cordoned off in some way so that oil washed off can be contained and removed. In areas where the substrate should not be disturbed by water under high pressure, low pressure flushing can be used. This is most effective with lighter oils. Runoff must be carefully channeled and collected to avoid contamination of new areas.

Steam cleaning raises the temperature of viscous oils allowing it to flow off boulders, rocks and structures. It is, however, detrimental to plants and animals and should be used only in areas where organisms will not

Table 4-2: Heavy Equipment and Its Uses in Coastal Cleanup

Equipment	Habitat/Use
Grader and scraper	Sand and gravel beaches with oil penetration less than 3 cm. Mud flats if trafficability permits.
Elevating scrapers	Sand and gravel beaches with oil penetration less than 3 cm. Can remove tarballs from beaches and haul oily material to temporary storage sites.
Front-end loader and motor grader	Sand and gravel beaches, mudflats with good trafficability and oil penetration less than 3 cm.
Front-end loader with rubber tires or tracks	Mudflats, sand and gravel beaches with poor trafficability and light to moderate oiling. Use to remove oily debris and loading material into tracks.
Bulldozer/rubber-tired front-end loader	Coarse sand, gravel or cobble beaches with poor trafficability and deep oil penetration. Can use to remove oily vegetation.
Backhoe	Can be used to remove oiled mud or silts on steep banks.
Dragline or clamshell	Sand, gravel or cobble beaches with poor trafficability and deep oil penetration.
Beach cleaner	Sand, gravel beaches lightly oiled. Used to separate oily sand from clean sand.
Vacuum pumping	Hard sand or mud beaches, boomed areas or rivers or nearshore where oil has accumulated enough to be pumped into trenches.

From Breuel (1981)

be affected. Runoff should be carefully channeled. Sandblasting is useful in removing thin oil coatings from manmade structures. It also should not be used in areas inhabited by plants or animals.

4.5.6 Animal Cleaning

Oil spills in coastal waters may affect seabirds, shorebirds, waterfowl and marine mammals. Oil on feathers or fur decreases the insulative and water resistant properties causing the animals to suffer from exposure. In addition, animals may ingest harmful quantities of oil while trying to clean themselves. Birds and mammals which become disabled may be preyed upon by predators. Cleaning of birds and mammals is very difficult and should be undertaken only by experts. The animals must be kept warm and dry. Dehydration and starvation must be avoided. Special detergents which do not destroy the waxy coating on feathers must be used. Animals must be returned to the wild as soon as possible. Usually only a fraction of the oiled individuals can be successfully treated; therefore, efforts should be spent on keeping animals away from the oiled area. Treatment should be given to endangered or threatened species first.

4.5.7 No Action

In some cases, a "no action" alternative may be the most logical course. Some criteria which may be applied include: a) weather conditions at the spill site, b) accessibility of the site, c) availability of proper equipment, d) type and amount of oil spilled, e) sensitivity of the habitat, f) sensitivity of species in the area, and g) opportunity for biodegradation of the oil. If, for example, the area oiled is a high energy rocky seacliff in a remote area which has very few birds or animals living there, a decision not to deploy an oil spill crew may be made. The oil should be kept under surveillance because if weather abates or spill direction changes, other measures may need to be taken. The "no action" decision must, of course, be made by the appropriate government agencies.

4.6 DISPOSAL OF OILY MATERIAL

4.6.1 Burning

Oiled vegetation and sorbents can be trucked to incinerators to be burned. Incinerators must be approved by the Department of Environmental Conservation.

4.6.2 Burial

There has been considerable attention focused on disposal of oily debris by burial. Land disposal sites must be carefully chosen and constructed and must be approved by the Department of Environmental Conservation. Basically, a disposal site must be situated so that oil from debris does not leach into ground or surface water. It must be built so that it offers the maximum opportunity for biodegradation. Sites where oily debris can be spread out in layers separated by non-oily soils afford the most opportunity for biodegradation.

4.6.3 Recycling

In some cases, sorbents can be wrung out and reused; the oil they contained also can be recycled. Oil picked up by vacuum trucks can often be processed through oil/water separators and reused. Recycling spilled oil should, whenever possible, be a first choice over burning or burial.

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5.0 KODIAK COASTAL HABITATS

5.1 INTRODUCTION

This chapter describes the coastal habitats of the Kodiak Archipelago in terms of geomorphology and vegetation. The Alaska Coastal Management Program (ACMP) has defined eight coastal habitats which are discussed at length in the Kodiak Island Borough Coastal Management Plan: offshore areas; barrier islands and lagoons; rocky islands and seacliffs; high energy coasts; estuaries; wetlands and tideflats; rivers, lakes, and streams; and important upland areas. These habitat types, which were established primarily for planning purposes, do not lend themselves easily to determining coastal sensitivities to oil pollution. Therefore, it was decided to use a modified version of the coastal habitats delineated by Ruby et al. (1979) for the Kodiak Archipelago.

These modified habitat types are listed below with the corresponding ACMP designation for reference (see Table 5-1):

Table 5-1: Coastal Habitats Types

ACMP Habitat Designation	Coastal Sensitivity Habitat Designation
Offshore Areas	N/A*
Rocky Islands and Seacliffs	Rocky Headlands
Exposed High Energy Coasts	Wave Cut Platforms Gravel Beaches Rocky Headlands
Barrier Islands and Lagoons	N/A* (any lagoons in Kodiak will be considered estuaries)
Estuaries	Sand beaches and tidal flats Mixed sand and gravel beaches Estuarine tidal flats and marshes Sheltered rocky and gravel shores
Wetlands and Tideflats	Estuarine tidal flats and marshes Sand beaches and tidal flats
Rivers, Lakes and Streams	N/A*
Important Upland Areas	N/A*

*Not applicable to this study.

The coastal sensitivity designations are based to a large extent on wave energy. It is mainly this factor that determines the type of substrate and the morphology of the coastline and, therefore, the potential residence of oil (Chapter 3.0). The percentage of occurrence of the seven coastal types in the Kodiak area is found on Table 5-2.

Table 5-2: Occurrence of Coastal Types

Class Description	Percent Occurrence
1. Rocky Headlands	8.8
2. Wave-Cut Platforms	16.5
3. Sand Beaches/Exposed Tidal Flats	0.9
4. Mixed Sand and Gravel Beaches	22.1
5. Gravel Beaches	14.9
6. Sheltered Rocky and Gravel Shores	34.2
7. Protected Estuarine Tidal Flats and Marshes	2.6
	100.0

(Total shoreline length 4,270 km)

Plant assemblages occur in most rocky habitats and in protected habitats with soft substrates such as mud or sand. The assemblages in rocky habitats usually exhibit substantial vertical zonation, i.e., particular species of algae are found within distinct elevation zones, and are not distributed generally throughout the entire intertidal zone. Thus, lichens and thin algal mats are found in the spray zone of the intertidal zone, rockweed (*Fucus* sp.) occurs in the highest zone that is routinely submerged, foliose (leafy) red and green algae occur at intermediate levels, and kelps occur at lower levels that are exposed only occasionally during periods of exceptionally low tides. The description of the algal assemblages in each of the rocky intertidal habitats identified will address this pattern of zonation where information is available.

Algae generally do not exhibit long-term susceptibility to the effects of crude oil. The brown algae are protected by production of a mucilaginous slime on the surface of the blade. Red algae appear to be the most sensitive to crude oil and have suffered substantial short-term damage in several major oil spills. Heavy crude oil has been reported to cause removal of rockweed in areas where it settled for a long enough period to partially solidify on the fronds. In these areas, the additional weight and surface area from the oil caused the rockweed to be ripped from the rocks by wave action. However, most algae are sensitive to the effects of refined petroleum products.

Algal assemblages generally recover from the impacts of oil spills fairly rapidly. Many of the more delicate algal species are prolific annuals that normally recolonize each year. The success of these species is often enhanced following a spill because many of the grazing animals that normally would limit their development have been eliminated by the spill. Thus, because of their natural abundance and relief from grazing pressures, algae often flourish following a spill.

Plant assemblages in protected habitats with soft substrates do not always exhibit the clarity of zonation that is apparent in rocky habitats and will be addressed more generally.

5.1.1 Rocky Headlands

These are narrow bedrock cliffs with high wave exposure levels. Intertidal zones are steep.

Algal assemblages in the exposed rocky coastal habitats are usually moderately diverse and exhibiting considerable coverage and moderate biomass. Factors that limit diversity and biomass are the high energy level associated with exposure to ocean waves, the steepness of the rock surface, and relatively limited amount of surface area available for algal colonization.

Algal assemblages on exposed rocky coasts exhibit strong zonation. The horizontal extent of the zone is small because of the steepness of the habitat, but the vertical extent is great because wave action routinely causes seawater to splash high up on the rocks.

The plant assemblage in the highest intertidal (spray) zone has low species diversity; it comprises only a few species. The assemblage is dominated by gray or orange lichens, as well as a dark green algal film. Plant cover can be substantial, but since the algal cover is mainly a thin film, biomass is low.

The plant assemblage in the routinely submerged zone also has low diversity. It is dominated by the brown seaweed rockweed (Fucus sp.), but a few small red algae are also common. Plant cover can be complete, and biomass can be moderate because of the size and density of rockweed plants.

The intermediate zone has a moderate level of algal diversity and of biomass, and, as above, cover of the substrate by algae can be complete. Common genera include sea lettuce (Ulva sp.), red algae such as Gigartina sp., Rhodomela sp., Halosaccion sp., Odonthalia sp., and Porphyra sp., and brown algae such as Scytosiphon sp.

The lower intertidal zone also has a moderate level of algal diversity and a moderately high biomass. Algal cover can be complete, especially in the summer when the various types of algae form several levels or layers. Kelps such as Laminaria sp. and Alaria sp. often dominate the algal assemblage in this zone and form a canopy over a second layer of smaller algae such as those indicated for the intermediate zone. A veneer of encrusting algae covering much of the available rock surface usually forms a third layer under the upper layers.

Surfgrass (Phyllospadix sp.) is commonly observed along the coast of the Gulf of Alaska, and is probably common in the lower intertidal zone along the eastern coast of the Kodiak Archipelago. As in the case of all seagrasses, surfgrass is not protected from the toxic fractions of oil by

mucus production. As a consequence, surfgrass is far more sensitive to exposure to oil than are seaweeds.

5.1.2 Wave-cut Platforms

These are wide, wave-eroded rock platforms, sometimes backed by a narrow gravelbeach and rocky cliff. They are generally located in areas of high wave exposure.

Algal assemblages in wave-cut rock platforms also are usually moderately diverse and exhibit moderate to considerable coverage. Biomass can be high. Factors that limit diversity are the high energy level associated with exposure to ocean waves. The boulders present increase habitat complexity and afford a relatively large amount of surface area for algal colonization. Zonation is less defined on the wave-cut platforms than it is on steeper rock habitats. The horizontal extent is greater because of the flatness of the habitat, and the vertical extent is less than on the steep habitats because the force of the waves is dissipated as the waves move across the boulder-strewn platform. Nevertheless, rockweed dominates higher levels of the intertidal zone, small red and green algae dominate the intermediate levels, and kelps, the lower levels. Despite the reduced definition in zonation, the composition and distribution of the species in the algal assemblage on wave-cut platforms are quite similar to those on exposed rocky headlands. Biomass and algal cover are often greater because of a reduction in the force of the waves.

5.1.3 Sand Beaches and Tidal Flats

This category is rare within the Kodiak Archipelago, comprising less than 1 percent of the coastline. These types of coasts vary between flat hard-packed fine sand beaches to steep coarse sand beaches to wide, sandy wave-cut terraces or tidal flats.

Attached seaweeds generally are not encountered on sand beaches because of the absence of hard surfaces on which to attach. Where boulders are present on sand beaches, algae will frequently extend above the scour zone.

5.1.4 Mixed Sand and Gravel Beaches

These are wide to narrow beaches comprised of sand and gravel. The material is generally more coarse near the high water line and may be made up of pebble- and cobble-sized sediments. Wave exposure may vary from low to high.

The composition of the algal assemblage growing on beaches with mixed sediments of sand, gravel, and boulders varies considerably depending on the wave exposure and the stability of the sediment. In areas where the sediment is unstable because of exposure or the abundance of sand, algal development is generally poor as a consequence of sand scouring. In more protected locations, algal development can be moderate, but is generally limited to rockweed and red and green algae. Dominant species are often prolific, rapidly colonizing forms. Zonation is poorly defined.

5.1.5 Gravel Beaches

Beaches in this category are usually narrow pockets occurring in association with rocky headlands. Gravel may vary in size from pebbles and cobbles to boulders.

Gravel, cobble, and boulder beaches can be highly unstable in areas exposed to wave action, or can be stable in protected locations. In the unstable areas, algal development is poor due to the grinding and abrasion associated with the movement of the rock.

5.1.6 Sheltered Rocky and Gravel Shores

These are sections of low wave exposure shoreline which often occur as a series of narrow rock beachlands separated by narrow gravel beaches. Because wave exposure is low, the coarse gravel, cobbles and boulders beaches often support a flora and fauna similar to that of the rocky sections.

On rocky habitats in protected locations where the substrate is more stable, algal development can be lush due to the complexity of the habitat and the availability of hard substrate for attachment. Species diversity, algal cover, and biomass both can be very high in areas with moderate exposure.

Zonation is less defined in algal assemblages on protected gravel, cobble, and boulder beaches than it is on steeper rock habitats. The horizontal extent of the algal bed is greater because of the flatness of the habitat than on the steep habitats, but the vertical extent is less because the force of the waves is dissipated as the waves move across the complex beach. Nevertheless, rockweed dominates higher levels of the intertidal zone, small red and green algae dominate the intermediate levels, and kelps, the lower levels. Despite the reduced definition in zonation, the composition and distribution of the species in the algal assemblage on sheltered rocky shores are quite similar to those on exposed rocky headlands. Biomass and algal cover vary substantially with exposure, but the relationship is not straightforward. Lush algal assemblages generally do not develop in highly protected areas because the limited exchange of water leads to nutrient deficiencies and silt deposition. On the other hand, development of algal assemblages is also limited in areas of strong wave action.

5.1.7 Estuarine Tidal Flats and Marshes

Tidal flats and marshes occur primarily at fjord head deltas where wave exposure is extremely low and fine sediments are present. They are also present in coastal lagoons behind barrier islands and spits.

Plant assemblages on protected flats of mud and sand frequently include several seaweeds, but are often dominated by seagrass (*Zostera* sp.). The assemblages have low species diversity. Plant cover and biomass are quite variable, depending upon the water quality on the flats and the composition of the assemblage. Factors that limit species diversity incude availability of hard or stable substrate, salinity, water clarity, and availability of inorganic nutrients. Factors that affect cover and biomass include species composition; biomass will be greatest in areas dominated by seagrass.

Evidence of zonation is limited in plant assemblages on tidal flats. Rockweed found on exposed rock generally are more abundant at midtidal levels than at low levels. Seagrass increases in density at lower tide levels. Kelps such as Laminaria sp. occur mainly at lower tide levels. Both seagrass and kelps are more abundant subtidally than in the intertidal zone.

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6.0 FISH AND WILDLIFE

The sensitivity of the Kodiak Archipelago coastline goes beyond the oil retention capacities of its substrates. It relates primarily to the potential for oil to adversely affect living resources and habitats. Plant assemblages in intertidal areas have been covered in Chapter 5.0; this chapter focuses on fish and wildlife. The many fjords and bays of the Kodiak islands provide sheltered habitats for numerous species of birds, fish and marine mammals. Upland areas are used by various terrestrial mammals and birds. Oil in these areas could have detrimental effects on populations of fish and wildlife.

To understand the importance of the Kodiak coastline and the vulnerability of it and the species it supports to oil pollution, a discussion of the fish and wildlife of the archipelago is presented. Each section in the chapter begins with a list of representative species found in the Kodiak area followed by a brief description of life history, habitat preference and sensitivity to oil pollution (if known) for selected species.

6.1 BIRDS

6.1.1. Seabirds

Table 6-1: Representative Seabirds Found in Coastal Areas of the Kodiak Archipelago

Common Name	Scientific Name	Seasonal Presence			
		W	Sp	S	F
Northern fulmar	*Fulmarus glacialis*	C	C	C	C
Sooty shearwater	*Puffinus griseus*	U	A	A	A
Short-tailed shearwater	*P. tenuirostris*	U	A	A	A
Scaled petrel	*Pterodroma inexpectata*		U	U	U
Fork-tailed storm petrel	*Oceanodroma furcata*	C	C	C	C
Leach's storm petrel	*O. leucorhoa*		U	U	U
Double-crested cormorant	*Phalacrocorax auritus*	C	U	U	U
Pelagic cormorant	*P. pelagicus*	C	C	C	C
Pomarine jaeger	*Stercorarius pomarinus*		C	C	C
Parasitic jaeger	*S. parasiticus*		C	C	C
Long-tailed jaeger	*S. longicaudus*		U	U	U
Glaucous-winged gull	*Larus glaucescens*	A	A	A	A
Herring gull	*L. argentatus*	U	C	U	C
Bonaparte's gull	*L. philadelphia*		U	U	U
Mew gull	*L. canus*	A	C	C	A
Sabine's gull	*Xema sabini*		U	U	U
Black-legged kittiwake	*Rissa tridactyla*	U	A	A	A
Arctic tern	*Sterna paradisaea*		C	C	R
Aleutian tern	*S. aleutica*		U	U	
Common murre	*Uria aalge*	A	C	C	A
Pigeon guillemot	*Cepphus columba*	C	C	C	C
Marbled murrelet	*Brachyramphus marmoratus*	C	C	C	C
Ancient murrelet	*Synthliboramphus antiquus*	U	U	U	U
Cassin's auklet	*Ptychoramphus aleutica*		U	U	U
Crested auklet	*Aethia cristastellata*	A			C
Horned puffin	*Fratercula corniculata*	R	C	C	C
Tufted puffin	*Lunda cirrhata*	R	A	A	A

W = December-February
Sp = March-May
S = June-August
F = September-November

A = Abundant
C = Common
U = Uncommon
R = Rare

Sources: ADF&G 1984; Amer. Orinth. U. 1983; Forsell and Gould 1981; Gabrielson and Lincoln 1959; Kessel and Gibson 1978; MacIntosh 1981; Sowls, Hatch and Lensinle 1978.

The Kodiak Archipelago hosts several hundred seabird colonies containing a variety of bird species. Most of these birds arrive in the Kodiak area in the spring, nest in the breeding colonies and depart in the fall. Some, however, may remain throughout the winter. Species which have been seen in Kodiak waters in the winter are shown on Table 6-1.

The majority of seabird colonies are located on the north ends of Afognak and Kodiak Islands. The largest colony in the archipelago is on East Amatuli Island in the Barren Islands. This colony combined with those on neighboring West Amatuli and Sugarloaf Islands numbers over half a million birds, primarily murres, black-legged kittiwakes, and tufted puffins, in addition to cormorants, glaucous-winged gulls, herring gulls, horned puffins, parakeet auklets, and pigeon guillemots. East Amatuli is also distinctive because it has a colony of 300,000 fork-tailed storm petrels. This bird is estimated to be at a population of slightly over 500,000 in the western Gulf of Alaska, making East Amatuli Island the primary fork-tailed storm petrel colony in this part of Alaska.

Other major colonies in the Kodiak area are as follows: Nord Island (20,000 black-legged kittiwakes; 30,000 common murres; and 5,000 tufted puffins), Flat Island (30,000 tufted puffins; 1,000 black-legged kittiwakes), Cathedral Island (4,000 black-legged kittiwakes, and 12,000 tufted puffins), Boulder Bay (40,000 black-legged kittiwakes), Chiniak Cape (9,800 black-legged kittiwakes and 6,900 tufted puffins), The Triplets (60,000 tufted puffins), and Noisy Island (20,000 tufted puffins). Each of these colonies also contain varying numbers of glaucous-winged gulls, cormorants, murres, horned puffins, terns, and pigeon guillemots.

Different species of seabirds utilizing the same colony will occupy different habitats within the colony. For example, the typical seabird colony is usually on a rocky, steep cliff with little vegetation other than grasses on the top of the cliff. Gulls' nests are usually found in the vegetated areas on top of the cliffs with the nests of tufted puffins, storm petrels, auklets and ancient murrelets just below on the vegetated margin. These birds typically build nests in burrows. Murres occupy cliff

ledges and horned puffins use rock crevices. Kittiwakes and cormorants are found along the cliff faces. Below them, among the loose boulders and rocks leading down to the water's edge, are auklets, pigeon guillemots and black oystercatchers.

Surveys by the U.S. Fish and Wildlife Service indicate that populations of several seabird species overwinter in the Kodiak area. These species and the areas in which the largest numbers were seen are as follows: loons (Uganik Bay), grebes (Uyak Bay, Sitkalidak Strait), cormorants (throughout Kodiak in bays), murres and marbled murrelets (Uyak Bay, Shelikof Strait, Marmot-Izhut Bay), and crested auklets (Viekoda Bay, Kupreanof Strait, Afognak Strait). Crested auklets are seen in Kodiak waters only in the winter. It appears as if Kodiak may be a major overwintering area for this bird. Fulmars, shearwaters and petrels also overwinter in Kodiak water to some extent; however, they are usually found over the edge of the continental shelf outside the area considered in this document.

Black-legged kittiwakes generally overwinter at sea and move to their breeding colonies in May. They aggregate in large, noisy colonies where they aggressively drive off any intruders. Two to three eggs are laid in each nest which is constructed of grasses and seaweed on cliff ledges or in rock crevices. Young birds hatch in late July. Kittiwakes feed in flocks on fish and small crustaceans at the water's surface.

Glaucous-winged gulls nest on sand bars, cliff tops and along beaches. Females usually lay three eggs in a shallow, grass-lined scraped nest. Nesting begins in May when resident birds congregate in the breeding colonies. Gulls are scavengers and will consume garbage, carrion, spawned-out salmon, young birds, bird eggs and a variety of mollusks. In the Kodiak area, glaucous-winged gulls overwinter in bays and tideflats.

Common murres are residents of Kodiak waters year-round and congregate on breeding grounds in the spring. Murres do not build nests; females lay single eggs on bare rock ledges. The young leave nests before they can

fly by simply jumping or falling off the ledge into the water below. Tremendous mortality is experienced among those birds who land on rocks instead of water and those who do not reunite with their parents. Murres feed on small fish by diving beneath the water and propelling themselves with their wings. They often feed far from their nesting grounds.

Tufted puffins winter primarily at sea, returning to nesting areas in June. Nesting occurs in burrows along cliff tops. They lay single eggs. Tufted puffins are generally sensitive to disturbance while eggs are incubated and may desert their nests if disturbed. Puffins feed on sea urchins and other mollusks, but their major food source is small fish which they capture by diving beneath the surface of the water.

Seabirds are among the most vulnerable and sensitive coastal inhabitants to oil spills. Photographs of oiled seabirds accompany nearly all reports of coastal oil spills. A recent (11/84) spill from the tanker PUERTO RICAN near the Farallon Islands, California killed over 1000 birds. Exact numbers were not obtainable because it was not known how many birds may have sunk before they could be recovered and counted. Seabirds, because they live and feed in coastal waters are highly likely to come into contact with oil on beaches or in nearshore waters. Species such as puffins and murres which feed by diving into water may attempt to dive through oil on the surface. The resulting oiling of their plumage decreases buoyancy and insulation. The birds then normally succumb to drowning or die of exposure. In addition, birds may ingest oil while attempting to clean their feathers. Gulls and other birds which feed on garbage and carrion may ingest oil by feeding on animals which have died as a result of the oil spill and washed up on shore. Nesting colonies, because of their close association with marine waters are vulnerable to being oiled. Oiling of these areas during summer months can have a disastrous effect on bird populations since great numbers of adults, young and eggs are concentrated in relatively small areas. Studies with herring gulls and black-legged kittiwakes show that high mortalilty of eggs results when either weathered or "raw" crude oil is applied to the shells.

6.1.2 Waterfowl

Table 6-2: Representative Waterfowl Found in Coastal Areas of the Kodiak Archipelago

Common Name	Scientific Name	Seasonal Presence			
		W	Sp	S	F
Common loon	*Gavia immer*	U	U	U	U
Yellow-billed loon	*G. adamsii*	U	R		R
Arctic loon	*G. arctica*	U	U		U
Red-throated loon	*G. stellata*	U	U	U	U
Red-necked grebe	*Podiceps grisegena*	U	U		U
Horned grebe	*P. auritus*	U	U		U
Canada goose	*Branta canadensis*		U		U
White-fronted goose	*Anser albifrons*		U		U
Brant	*B. bernicle*		A		
Emperor goose	*Philacte canagica*	C	C		U
Mallard	*Anas platyrhynchos*	A	A	A	A
Gadwall	*A. strepera*	U	U	U	U
Pintail	*A. acuta*	U	A	C	C
Green-winged teal	*A. crecca*	U	C	C	C
Northern shoveler	*A. clypeata*		C	R	R
American wigeon	*A. wigeon*	U	C	C	C
Greater scaup	*Aythya marila*	A	C	A	A
Common goldeneye	*Bucephala clangula*	C	C	U	C
Barrow's goldeneye	*B. islandica*	C	C	U	C
Bufflehead	*B. albeola*	C	C		C
Oldsquaw	*Clangula hyemalis*	A	A		A
Harlequin duck	*Histrionicus histrionicus*	A	A	C	A
Steller's eider	*Polystecta stelleri*	C	C		U
Common eider	*Somateria mollisima*	U	U	U	U
King eider	*S. spectabilis*	C	C	R	U
White-winged scoter	*Melanitta deglandi*	A	A	U	A
Surf scoter	*M. perspicillata*	C	C	R	C
Black scoter	*M. nigra*	A	A	U	A
Common merganser	*Mergus merganser*	C	C	C	C
Red-breasted merganser	*M. serrator*	C	C	C	C
Tundra swan	*Cygnus columbiana*	R	C	C	C

W = December-February
Sp = March - May
S = June - August
F = September- November

A = Abundant
C = Common
U = Uncommon
R = Rare

Sources: ADF&G 1984; Amer. Ornith. U. 1983; Armstrong 1980; Belrose 1976; Gabrielson and Lincoln 1959; MacIntosh 1981.

Kodiak has a number of resident waterfowl species in its nearshore areas (Table 6-2). However, it appears as if the Kodiak Archipelago is not a major staging area (as is the Alaska Peninsula) for waterfowl which migrate north to western Alaska nesting grounds in the spring and south to overwinter in the fall. Storms over Bristol Bay or the Gulf of Alaska could force migrating birds to stop in Kodiak temporarily, however. Waterfowl can be considered in six groups: loons, grebes, geese, swans, dabbling (or puddle) ducks and diving ducks.

Grebes and loons usually inhabit freshwater ponds and lakes during breeding and nesting, but are seen with regularity in nearshore marine waters in the winter and during migrations. Both are diving birds and feed primarily on fish.

Tundra swans are fairly common in the Kodiak area from spring to fall when they return to wintering grounds in California. Swans nest near lakes and ponds. Egg incubation occurs between late May and late June. Molting occurs between early July and mid-August. Swans begin moving south in September. Aquatic plants are their principal food. On east coast wintering grounds, tundra swans inhabit brackish estuarine bays and may do so in Kodiak. Overwintering on Kodiak was documented in 1982 and 1983.

Canada geese and white-fronted geese migrate through the Kodiak area in the spring and fall on their way to the Yukon Delta. Spring migration occurs between April and May (although some may arrive as early as February); they return south in October. Brant are seen in the Kodiak area primarily in the spring as they migrate to their major breeding ground in the Yukon-Kuskokwin Delta. They do not pass through the Kodiak area in fall but rather fly directly from their staging area in Izembek Lagoon to overwintering areas in California and Mexico.

The Emperor geese breed in Siberia and western Alaska and overwinter in the Aleutian Islands and the Kodiak Archipelago. The Kodiak population is estimated at 2,000 to 3,000 geese. They are considered common in Kodiak from late November through April. During the winter, they occupy rocky

intertidal areas. Emperor geese are found in shallow waters connected with the sea. They feed primarily on eelgrass and marine algae.

Diving ducks include greater scaup, goldeneyes, buffleheads, oldsquaws, harlequin ducks, eiders, scoters, and mergansers. This group is also known as "sea ducks" because of their common association with salt-influenced waters. Of these, greater scaup, common and Barrow's goldeneyes, harlequin ducks, king eiders, common eiders, scoters and mergansers are resident in Kodiak nearshore waters. The others may spend all but nesting season in Kodiak. During the summer, buffleheads, oldsquaw, and steller's eiders head north to nest. Buffleheads and goldeneyes usually nest in trees near water; mergansers nest in trees or, where none are available, on the ground. Scoters usually nest in grassy depressions near beaches whereas harlequin ducks nest on rocky river banks.

The nesting cycle of the diving ducks begins with egglaying in mid-May to mid-June. Hatching begins within 20 to 30 days. Adults molt in July and early August and are flightless during that period. Feeding habits vary with the species as follows: greater scaup (clams and other mollusks), common goldeneye (crustaceans, aquatic plants), Barrow's goldeneye (insects, mollusks, crustaceans), bufflehead (crustaceans and mollusks), oldsquaw (crustaceans), harlequin duck (crustaceans and mollusks), eiders (mollusks and crustaceans), scoters (blue mussels and other mollusks), and mergansers (fish). These birds all feed by diving into the water after their prey. King eiders and oldsquaw feed in waters up to 150 feet in depth. The other diving ducks usually feed in waters around 20 to 30 feet deep.

Dabbling ducks (mallards, gadwalls, pintails, teal, wigeon and shovelers) feed to the depth that they can reach with their necks while still on the surface of the water. They eat mainly vegetation although animal material is usually ingested along with the plants. With the exception of the northern shoveler, these ducks can be found in Kodiak nearshore waters throughout the year. The northern shoveler overwinters in California and Mexico returning to Alaskan waters in May. Shovelers pass through the Kodiak

area on their way to nesting grounds in western Alaska. Mallards begin to nest in April and young hatch 26 to 30 days later. Some females will renest if their nests are destroyed. Males and females molt in July and August; usually males molt first. Although mallards are resident in Kodiak, there is also a migrating population. This is especially true for pintails, wigeons, gadwalls and teal which overwinter in Kodiak. The other dabbling ducks' chronology are similar to that of the mallard. In winter, dabbling ducks are found in back bays, estuaries and lagoons rather than on the open coastline as are most diving ducks.

Waterfowl would be vulnerable to oil spills occurring in nearshore coastal waters especially during summer months when they are flightless. Birds would be susceptible to ingesting oil directly during feeding and when trying to clean feathers which have been oiled. Oiled waterfowl lose their bouyancy and insulation. They then may succumb to exposure or may be taken as prey by other birds or animals. Although experimental data on the effects of various petroleum products on ducks and geese is lacking, many major oil spills have documented extensive bird kills. Bird cleaning programs are generally considered unsuccessful for the majority of oiled birds.

6.1.3 Shorebirds

Table 6-3: Representative Shorebirds of Kodiak Nearshore Waters and Intertidal Zone

Common Name	Scientific Name	Seasonal Presence			
		W	Sp	S	F
Northern phalarope	*Phalaropus lobatus*		C	C	C
Red Phalarope	*P. fulicarius*		U	U	U
Semipalmated plover	*Charadris semipalmatus*		A	A	U
Lesser golden plover	*Pluvialis dominica*		C	U	C
Black-bellied plover	*P. squatarola*		C	U	U
Greater yellowlegs	*Tringa melanoleuca*		C	C	C
Lesser yellowlegs	*T. flavipes*			C	C
Wandering tattler	*Heteroscelus incanus*		C	C	U
Western sandpiper	*Calidris mauri*		R	A	U
Least sandpiper	*C. minutilla*		A	A	R
Pectoral sandpiper	*C. melanotos*		R	U	C
Sharptailed sandpiper	*C. acuminata*				C
Rock sandpiper	*C. ptilocnemis*	C	C	U	C
Dunlin	*C. alpina*	U	C	R	U
Common snipe	*Gallinago gallinago*	R	C	C	C
Short-billed dowitcher	*Limnodromus griseus*		C	C	U
Black oystercatcher	*Haemotopus bachmani*	C	C	C	C
Black turnstone	*Arenaria melanocephala*	U	C	C	U
Surfbird	*Aphriza virgata*	U	U	C	U

W = December - February
Sp = March - May
S = June - August
F = September - November

A = Abundant
C = Common
U = Uncommon
R = Rare

Sources: Amer. Ornith. U. 1983; Forsell and Gould 1981; Gabrielson and Lincoln 1959; Kessel and Gibson 1978; MacIntash 1981.

Although a number of shorebirds species are found in the Kodiak Archipelago, this area is not considered a major overwintering area for these birds (Table 6-3). USFWS surveys found that rock sandpipers were the most common wintering shorebird. Black oystercatchers can also be seen during winter months. The other species generally return to overwintering areas in the Pacific Northwest, California and Mexico in the fall.

In coastal areas, shorebirds are inhabitants of tide flats and beaches. They can be seen in flocks flying above the surf or running along after the waves to feed on invertebrates. Most shorebirds nest on the ground in wet meadows. Usually three or four eggs are laid in each nest and the young hatch in approximately 18-20 days. The birds form large flocks in the fall prior to moving south. Males assume the majority of responsibility in incubating and caring for young birds in many shorebird species. Usually the fall flocks are larger and more concentrated than those in the spring. Phalaropes can be found swimming over kelp beds relatively far from shore. Oystercatchers inhabit rocky outer shores (high energy coasts) where they feed on mussels and other mollusks. They are usually solitary except during migrations.

Coastal oil spills can be detrimental to shorebird populations particularly if the oil comes ashore on beaches and in tidalflats. Birds can be adversely affected by ingesting food species that have been oiled or by attempting to clean oil off their plumage. Although data regarding the effect of oil on shorebirds is generally lacking, it appears as if they may not be as vulnerable to oil in nearshore water as are seabirds and waterfowl due to the fact that they feed primarily on shore rather than in the water. Fall and spring staging flocks are probably the most vulnerable since staging generally takes place on tidal flats.

6.1.4 Other Birds

Table 6-4: Other Birds Found in Kodiak Coastal Areas

Common Name	Scientific Name	Seasonal Presence			
		W	Sp	S	F
Bald eagle	*Haliaeetus leucocephalus*	C	C	C	C
Golden eagle	*Aquila chrysaetos*	U	U	U	U
Peregrine falcon	*Falco peregrinus*	C	C	U	C
Belted kingfisher	*Ceryle alcyon*	C	C	C	C
Black-billed magpie	*Pica pica*	C	C	C	C
Common raven	*Corvus corax*	C	C	C	C
Northwestern crow	*C. caurinus*	C	C	C	C
Hermit thrush	*Catharus guttatus*		A	A	C
Song sparrow	*Melospiza melodia*	C	C	C	C
Winter wren	*Troglodytes troglodytes*	C	C	C	C

W = December-February
Sp = March-May
S = June-August
F = September-November

A = Abundant
C = Common
U = Uncommon
R = Rare

Sources: Amer, Ornith. U. 1983; Armstrong 1980; Forsell and Gould 1981; Gabrielson and Lincoln 1959; Kessel and Gibson 1978; MacInthos 1981.

The Kodiak Archipelago hosts a number of raptors, corvids, and song birds (passerines); Table 6-4 lists only representative species that commonly use the intertidal zone considered in this report. Bald eagles are probably the most noticeable of these birds. Eagles are present year-round in the Kodiak area. Winter surveys by the U.S. Fish and Wildlife Service found the highest numbers of eagles in Uyak Bay, Sitkalidak Island, islands near the City of Kodiak and the Alitak Peninsula. Bald eagles prefer rocky coastal areas or areas which are heavily forested. Their nests are large, untidy collections of sticks and vegetation primarily in the tops of trees. Usually 1-3 eggs are laid in the nest. Bald eagles feed mostly on fish but they will scavenge beaches and other coastal areas for carrion.

Peregrine falcons are not as common in the Kodiak area as on the Alaska Peninsula. It is estimated that there are 3 to 5 pairs of nesting falcons on Kodiak. The falcon found here is the Peale's peregrine, which is not considered to be endangered. Peregrines nest on rocky cliff ledges where they raise 2 to 4 young per nest. The falcon is an efficient bird of prey, taking unwary waterfowl in the air.

Belted kingfishers, black-billed magpies, ravens and crows are all common year-round residents of Kodiak. Kingfishers live in forested areas along fresh- and saltwater where they feed on small fish. The other species take carrion, garbage and other available food in coastal and inland areas. Crows and magpies will feed on eggs and young of other bird species.

The hermit thrush migrates to Kodiak in the spring and remains through the summer and early fall, wintering in the southern United States. They nest in the forest margins along the oceanshore and forage along the ground for insects. Song sparrows are very common in marine beach habitats where they rummage through driftwood accumulations at the high tide line. They also utilize shrub thickets along the beach margin and nest in clumps of grass on the ground, rarely wintering inland. Winter wrens are found in rocky beach areas and commonly nest in cliffs and rocky slopes. The intertidal area is also used by numerous other birds who move into the area as opportunity presents but which are not highly dependent upon coastal areas for nesting or feeding.

Birds such as eagles and peregrine falcons which live in coastal areas could be adversely affected by oil spills in coastal waters. The nests of these species are not likely to be affected but the birds may be adversely impacted during feeding. Bald eagles catch fish at the surface of the water and could be oiled if a spill were present. In addition, birds which feed on beach carrion could ingest oil from animals which were oiled, died and were washed up on shore or which were oiled while lying on the beach. Data are lacking on the effects of ingested oil on corvids and raptors. Passerines, like the hermit thrush, song sparrow and winter wren are less likely to be adversely affected as they are not dependent upon intertidal areas for food.

6.2 FISH AND INVERTEBRATES

6.2.1 Marine Fish

Table 6-5: Marine Fishes in Kodiak Nearshore Waters

		WINTER			SPRING			SUMMER			AUTUMN		
Common Name	Scientific Name	D	J	F	M	A	M	J	J	A	S	O	N
Pacific Herring	*Clupea harengus*	J	J	J	J	A J S	A J S	A J	J	J	J	J	J
Capelin	*Mallotus villosus*	J	J	J	J	A J S	A J S	J	J	J	J	J	J
Yellowfin Sole	*Limanda aspera*	A J	A J	A J	A J	A J S	A J S	A J	A J	A J	A J	A J	A J
Rock Sole	*Lepidopsetta bilineata*	A J	A J	A J	A J	A J	A J	A J	A J	A J	A J	A J	A J
- Groundfish Complex -		J	J	J	J	J	J	J	J	J	J	J	J
Alaska Pollock	*Theragra chalcogramma*												
Pacific Cod	*Gadus macrocephalus*												
Sablefish	*Anaplopoma fibria*												
Pacific Ocean Perch	*Sebastes alutus*												
Halibut	*Hippoglossus stenolepis*												
Turbot	*Atheresthes stomias*												
Flathead Sole	*Hippoglossoides elassodon*												

A = Adult
J = Juvenile
S = Spawning

Sources: Hart 1973; BLM 1980, 1981; Niggol 1982; Pereyra et al. 1976.

For the purposes of this report, the marine fishes of the Kodiak region can be grouped into two general categories: (1) those that concentrate in the nearshore zone during part of their adult life, and (2) those that spend their adult life stages entirely offshore (Table 6-5). The former species are more sensitive to oil pollution than are the latter.

Pacific herring are a good example of the first category. As adults, they are found offshore, but they concentrate in the sheltered, inshore waters of bays and fjords to spawn in the spring. There, the herring extrude adhesive eggs onto kelp and eelgrass. After spawning, the adults move into deeper waters. The eggs and larvae remain in the nearshore area, where studies have shown that they are extremely vulnerable to oil pollution. The survival of the first year of life is a strong determinant of the eventual recruitment of adults to the fishery. Larvae and young herring typically occupy surface waters.

Capelin usually spawn later than herring on the gravel and rocks of beaches. In the Kodiak area, they typically spawn in May and June. Many of the adults die after spawning. Capelin feed intensely in late winter and early spring, but feeding slows immediately before spawning. Generally, capelin spawn in somewhat higher energy environments than do herring. Relatively little is known about Alaska's capelin stocks, but they are thought to be large and of good commercial potential. Like herring, capelin are most sensitive to oil pollution when the adults, eggs and larvae are concentrated in the nearshore zone.

Two common species of flatfish, yellowfin sole and rock sole, also spend most of their adult life offshore, but spawn in the spring in nearshore waters. Both of these flatfish are relatively small, as compared to starry flounder or Pacific halibut, and are not found as deep as are the larger fish. Eggs are demersal, and spawning occurs somewhat deeper than it does for herring. Nevertheless, the eggs and larvae are still within the nearshore zone and are therefore vulnerable to oil pollution.

In general, the larvae and juveniles of almost all species of marine fishes considered here are found in inshore waters, including fjords and bays, especially in the spring. As these fishes mature, they gradually move into deeper waters.

Table 6-6 shows the principal groundfish species of the Kodiak area. These fishes are found well offshore as adults, and most of them spawn in

Table 6-6: Seasonal Distribution of Principal Groundfish Species in the Kodiak Region

Life history characteristics		SPECIES						
		Pollock	Cod	Sablefish	Ocean perch	Halibut	Turbot	Flathead sole
Bottom depths of common occurrence (fath.)		30-200	10-150	50-450	50-250	10-250	30-300	30-200
Depths of high availability by season (fath.)	winter	100-200	50-150	150-350	150-250	50-225	> 200	100-200
	summer	50-150	< 100	150-450	80-150	10-100	50-200	50-150
Spawning period		March to June	January to March	December to April	March to June	November to March	December to February	March to June
Spawning area		Shelikof Strait	Continental Slope	150-350 Fathoms	Deep water	Deep water	Deep water	Not localized

Source: NPFMC 1984
Niggol 1982

deep water in the winter and early spring. Because of their similarities, this group of fishes is frequently referred to as the "groundfish complex". Atka mackerel, rock sole and cod spawn adhesive demersal eggs, while the eggs of sablefish, pollock and most flatfish are pelagic. Pacific Ocean perch (and other rockfish) release pelagic larvae. Regardless of their spawning method, however, the larvae (and some juveniles) of most groundfish species are pelagic and are carried by surface currents into the shallow, nearshore waters, which are important nursery areas. Although information on certain individual species is limited, various studies have indicated that in this area, particularly in the spring, young fishes are present in nearshore waters and are vulnerable to oil pollution. They are less able to avoid oil than are the adults, and they are more sensitive to it.

6.2.2 Anadromous Fish

Table 6-7: Anadromous Fish Found in Kodiak Nearshore Waters

Common Name	Scientific Name	Seasonal Presence*			
		W	Sp	S	F
Pink salmon	*Oncorhynchus gorbuscha*		J	J,A	A
Chum salmon	*O. keta*			J,A	A
Sockeye salmon	*O. nerka*	J	J,A	J,A	J,A
Coho salmon	*O. kisutch*	J,A	J	J,A	J,A
Chinook salmon	*O. tshawytscha*	J	J,A	J,A	J
Steelhead	*Salmo gairdneri*	J,A	J,A	J,A	J,A
Dolly Varden char	*Salvelinus malma*		J,A	J,A	A
Pacific lamprey	*Entosphenus tridentatus*			A	A
Arctic lamprey	*Lampetra japonica*			A	A

W = December - February
Sp = March - May
S = June - August
F = September - November

A = adult
J = juveniles

* in nearshore waters

Sources: Hart 1973, Morrow 1980, Robins et al. 1980.

The Kodiak Archipelago is rich in anadromous fish resources (Table 6-7). Its rivers host all five species of Pacific salmon in addition to steelhead and Dolly Varden char. These resources form the basis of Kodiak's salmon commercial fishery and its sport fishery (see Sections 7.1 and 7.2).

The life histories of the salmon are similar in many aspects. Adult salmon return to rivers in which they were hatched and ascend to spawning areas. Depressions (redds) in the gravel are constructed by the female, and eggs and sperm are extruded by female and male over the redd. The fertilized eggs are covered by gravel and the young hatch the following spring. After remaining in freshwater for varying lengths of time, the young fish go out to sea where they remain for one to six years, depending upon the species, before returning to spawn. Adults die after spawning.

Pink (humpback) salmon are the most widespread salmon species in Kodiak; there are over 300 pink salmon streams in the area. The life cycle of pink salmon is the shortest of all the salmon. After hatching in the spring, pink salmon fry go immediately to sea where they remain in estuaries for a month feeding on copepods, and other zooplankton. They then head to offshore waters before returning to their natal streams the following summer to spawn. Adults are seen in bays and estuaries from early June to early September. The average run estimates for Kodiak are eight million pink salmon in odd years and 13 million in even years.

Chum (dog) salmon are often associated with pink salmon in many Kodiak rivers. Adults return to spawning streams from early June to early September. Eggs hatch in April and young fish migrate to saltwater in June. Chum salmon juveniles remain in bays, estuaries and other nearshore waters until August when they move into deeper waters. While in nearshore waters, young chum salmon eat zooplankton. Adults feed on squid, small fish, zooplankton and other organisms while in saltwater. Chum salmon are found throughout the North Pacific and Bering Sea where they remain for one to six years before returning to spawn. The average run estimate for Kodiak is 1,726,700 chum salmon.

Sockeye (red) salmon are documented in 30 streams in the Kodiak area. Major spawning streams are the Karluk, Ayakulik, Dog Salmon and Upper Station rivers. Sockeye spawn only in lakes. They ascend streams from June to October (adults are seen in nearshore waters from early May to mid-September). Young fish emerge from the gravel in April through May and remain in the lakes for one to four years before going to saltwater. Young sockeye salmon feed in nearshore waters (within 50 km of shore) on small crustaceans, zooplankton, sandlance, bigeye, whiting, rockfish, eulachon, starry flounder, herring, pricklebacks and hake. As they mature, sockeye head further out to sea. Adults return to spawn after two or three years at sea. The average run estimate for Kodiak is 2.4 million sockeye salmon.

Coho (silver) salmon return to their natal streams later than the other Kodiak species. They are seen in nearshore waters from early July to early October, but spawning may continue into December. Coho usually prefer short coastal streams in which to spawn although they are also found in large systems like the Karluk River. Adult fish usually form large groups at the mouths of rivers, moving up to spawn on the rising tide. Fry emergence from the gravel is probably in May or June. Young cohos may spend from one to four years in freshwater before heading to sea in late May & June. Average run estimates for coho on Kodiak are 200,000 fish. This estimate is based only on streams along the road system and may, therefore, be conservative.

Chinook (king) salmon are native only to the Karluk and Ayakulik rivers, although they have been introduced into the Dog Salmon and Pasagshak rivers. Adult chinook are seen in Kodiak nearshore waters from mid-March to early July. Spawning takes place primarily in June and July. Fry emerge from the gravel the following April and remain there for one or two years. Juvenile salmon move out of the rivers into saltwater in May and June. Here, they stay only briefly, feeding on herring, sandlance, crustaceans, mollusks and insects before moving into offshore waters. Chinook salmon spend one to six years in the sea before returning to spawn. Average run estimates for Kodiak are 13,500 fish.

Steelhead are the anadromous form of rainbow trout. These fish are a sought-after sport species particularly in the Karluk and Ayakulik rivers where they are most abundant on Kodiak. In addition, they are found in many other streams in the area. All steelhead spawning occurs in the spring between April and June. However, the adults may return to the rivers throughout the fall, winter and spring months. Fry emerge from the gravel in May and June and remain in freshwater for one to four years. They then move downstream in the summer to saltwater where they remain for up to four years (average is two years). Steelhead range throughout the North Pacific and feed on squid, amphipods, and fish such as greenling. It is not known if young fish concentrate in nearshore waters before heading offshore. Adults do not usually die after spawning but return to sea. They may return one or more times to spawn.

Dolly Varden char are found throughout the Kodiak Archipelago in brackish water deltas and lagoons and nearshore waters. In saltwater, they eat a variety of fish (smelt, herring, juvenile salmon, sandlance, greenling, sculpins, flounders, cod) and zooplankton. Adult Dolly Varden return to streams to spawn from late July to early December although the peak of the run occurs from September through November. Most Dolly Varden die after spawning although some do survive and spawn again the following year. Eggs hatch four to five months after spawning and fry emerge from the gravel two to three weeks later (February - May). The juveniles live in streams for two to seven years, overwintering in freshwater and moving into marine waters to feed from April through June. Dolly Varden generally stay in shallow marine waters near their natal streams and do not migrate substantial distances as do salmon. Immature fish begin their move to overwintering areas in July and continue through September.

Lampreys are jawless fish which are parasitic on other fish, particularly salmon. They move upstream from saltwater in the summer and fall but do not spawn until the following spring. Eggs hatch within four weeks and the young remain in the streams for up to four years before moving to sea. Here they parasitize other fish and are in turn, consumed by various fish species including salmon. The extent of harm done by lampreys on salmon has not been established.

Oil, particularly its aromatic components, can be quite harmful to salmon eggs, fry and adults. Studies have shown that small concentrations (less than 15 ppm) of benzene, toluene and xylene can cause impairment of physical faculties and death in juvenile salmon. Juveniles are apparently more sensitive to the toxic portions of oil than are eggs or adults. Juveniles may also be affected if populations of their food species are reduced by oil contamination or they may avoid feeding areas which have become contaminated. In addition, adult fish have been shown to be deterred from moving up spawning streams when oil was present in small concentrations (3.2 mg/l). Juvenile salmon may avoid areas where concentrations of aromatic hydrocarbons are less than 4 ppm as shown in some studies. Pink salmon fry have been shown to avoid concentrations of 1.6 mg/l Prudhoe Bay crude oil in seawater.

6.2.3 Marine Invertebrates

Table 6-8: Representative Species of Marine Invertebrates in Kodiak Nearshore Waters

Common Name	Scientific Name	Seasonal Presence			
		W	Sp	S	F
Red King crab	*Paralithodes camtschatica*	J	J,A	J	J,A
Tanner crab	*Chionocetes bairdiil*			J	J
Dungeness crab	*Cancer magister*			A	A
Flexed shrimp	*Pandalus goniurus*	A	A	J,A	J,A
Humpback shrimp	*P. hypsinotus*	A	A	J,A	J,A
Pink shrimp	*P. borealis*			J	J
Spot shrimp	*P. platyceros*	A	A	J,A	J,A
Blue mussel	*Mytilus edulis*	J,A	J,A	A	A
Razor clam	*Siliqua alta, S. patula*	A	A	A	A
Steamer clam	*Prototheca staminea*	A	A	A	A
Butter clam	*Saxidomus giganteus*	A	A	A	A
Softshell clam	*Mya sp.*	A	A	A	A
Barnacle	various	A	A	A	A
Sea urchin	various	A	A	A	A
Sea star	various	A	A	A	A
Blood star	*Henricia* spp.	A	A	A	A
Sun star	*Pycnopodia helianthoides*	A	A	A	A

W = December - February
Sp = March - May
S = June - August
F = September - November

A = Adult
J = Juveniles

Sources: Butler 1980; Domeracki et al. 1980.

6.2.3.1 King Crabs

The two major species of king crab in Alaska are the red and the blue king crab. Red king crab is the predominant species in the fisheries of the Gulf of Alaska and the southern Bering Sea. The blue king crab is generally uncommon in these areas, but is common in the vicinity of the Pribilof Islands.

Red king crabs are highly migratory organisms. They annually move across a broad range of habitats during feeding and reproductive activities. During a year, adults can move from barely subtidal habitats to depths exceeding 100 fathoms, and will occur in abundance on both rocky and soft substrates. Although they move great distances over the period of a year, adult king crab generally live in areas exposed mainly to ocean water and generally are not found in areas which experience wide variations in temperature or salinity.

Adult king crab commonly aggregate in protected shallow-water hard-bottom and soft-bottom habitats in the late winter to molt and mate; this is the period when adults are most susceptible to oil pollution. After mating females carry the eggs for approximately 11 months. The larvae drift in the water for about six months before settling to the sea floor as post-larvae. The larval life history, encompassing about six stages, is fairly complex. Settling post-larvae appear to concentrate in nearshore areas on rocky current-swept substrates with substantial coverage by epibenthic animals such as bryozoans and hydroids. Juveniles are sometimes common in rocky intertidal areas, but are more common subtidally. It is thought that juveniles may bury themselves in gravel/cobble substrates for several years. Growth is fairly slow with specimens taking several years to attain a carapace length of 25 mm.

King crabs are predatory. As adults, they will feed on a wide variety of organisms, including clams, snails, polychaete worms, and barnacles.

Larvae and juveniles are generally more sensitive to oil than adults and all stages are more sensitive during a molt than between molts. Larvae and juveniles molt more frequently than adults (8 to 11 times for the young of the year), and are therefore more susceptible to oil contamination than adults. King crab larvae are less sensitive to oil contamination than shrimp larvae. Concentrations at which molting king crab larvae exhibit appreciable mortality are equal to or below concentrations reported to occur during periods of chronic or acute spill situations. The mortality rate increases considerably with increasing duration of exposure.

6.2.3.2 Shrimps

The main species of shrimps found in nearshore waters around Kodiak include the flexed shrimp (*Pandalus goniurus*), the humpback shrimp (*P. hypsinotus*), the pink shrimp (*P. borealis*) and the spot shrimp or prawn (*P. platyceros*). Habitats vary widely by species, and, within a species by time of day and, in some cases, by age.

All of the shrimps have a fairly complex planktonic larval life history lasting at least four months. Habitats occupied as juveniles or adults range from muddy to rocky bottoms and include both deep and shallow waters. However, some species live mainly in deep embayments. During the day, shrimp generally are found on or buried in the sea floor. During the night, most species swim up into the water to feed and often move close to the sea surface. Juveniles often occupy the shallower portions of the habitat and migrate into deeper areas as they grow older.

Breeding occurs in the fall and eggs are carried by the female until early spring, when they hatch to release larvae. Shrimp larvae drift in the plankton for about four months before metamorphosing to the adult form and settling to the sea floor. Shrimp live about two or four years, depending upon the species. They become sexually mature as males at the age of 18 months and transform into females at about the age of two years.

The type of food consumed varies considerably by species. Some species feed largely on planktonic crustaceans whereas others feed mainly on benthic forms such as polychaetes and crustaceans.

Larvae are generally more sensitive to oil contamination than adults. Half of the larvae become moribund (near death) during a 96-hour exposure to the water-soluble fraction (WSF) of Cook Inlet crude oil at concentrations ranging from 0.95 to 1.8 ppm (parts per million), depending upon species. Half of the adults become moribund during a 96-hour exposure to the WSF at concentrations ranging from 1.9 to 4.2 ppm. Molting larvae were far more sensitive to oil exposure than adults, and even short exposures (e.g., 6 hours) to moderate concentrations (1.2-1.9 ppm) of the WSF caused reductions in molting success. Long exposures to low concentrations of the WSF (0.15-0.55 ppm did not inhibit molting appreciably but subsequent mortality of the exposed larvae were high. Shrimp larvae are more sensitive to oil contamination than king crab larvae. Concentrations at which molting shrimp larvae exhibit appreciable mortality are equal to or below concentrations reported to occur during periods of chronic or acute spill situations. The mortality rate increases considerably with increasing duration of exposure.

6.2.3.3 Blue Mussels

Mussels on Kodiak Island are primarily found intertidally, occurring in rocky habitats, or in current-swept gravel/cobble tidal flats or channels such as in the entrance to lagoons or the mouths of rivers and streams. Blue mussels tolerate a broad range of temperature and salinity conditions like many other intertidal organisms. They usually form extensive beds in most of the habitats in which they occur, and because of their abundance, constitute important food items to many predatory species (e.g., sea otters, shorebirds, diving ducks, and starfish), and also act to stabilize gravel substrates in the mouths of rivers and lagoons.

Mussels have planktonic larvae and a somewhat mobile post-larval stage. The larvae are widely dispersed by the currents. Reproduction seems to occur

at several times during the year but the major period of settlement is in late winter and early spring. The post-larvae have the ability to move limited distances in order to locate more suitable microhabitats. Adults, on the other hand, are mainly sessile, moving only if dislodged from a surface, and then reattaching by byssus threads as soon as possible. All stages feed on suspended food material. The type of food probably includes mainly phytoplankton and fine detrital material and bacteria.

Reproductive potential of blue mussels is great in suitable areas; like barnacles, enormous numbers of larvae occur in the water during spawning periods. The post-larvae can literally coat intertidal surfaces for limited periods of the year. Growth can be rapid, with specimens attaining a shell length of over 20 cm in one year in favorable areas. Mussels are generally one of the first organisms to colonize newly introduced or exposed surfaces in the intertidal zone.

Mussels are susceptible to suffocation from heavy oiling as well as physiological damage stemming from exposure to water-soluble fractions of crude oil. Types of physiological damage range from reduced rates of filtration to the inability to close the shell, and include reductions in growth and reproductive rates and in the ability to produce byssus threads, an absolutely necessary activity for remaining attached to the substrate.

6.2.3.4 Clams

Several species of clams are important in the intertidal and shallow subtidal areas around Kodiak Island. They include the razor clam (*Siliqua patula* and *S. alta*), the butter clam (*Saxidomus giganteus*), the steamer or littleneck clam (*Protothaca staminea*), and the softshell clams (*Mya* spp).

All of the clam species indicated are most abundant at lower intertidal levels or in shallow subtidal areas. Razor clams are found primarily on exposed sandy beaches where they have the ability to bury deeply in the sand but maintain an adequate supply of water for food and oxygen through the

combined efforts of their long siphon and rapid digging efforts. Butter and littleneck clams are most common on protected gravel or gravel/cobble beaches, especially in current-swept areas such as entrances to bays or lagoons. Both species live within about 15 cm of the sediment surface and do not have the ability to burrow rapidly. Softshell clams are most common in stable, protected mud flats. They inhabit semi-permanent burrows that often extend at least 30 cm into the sediment.

All of these clams have planktonic larvae that spend at least several weeks drifting in the ocean. Upon settling to the seafloor all are extremely sedentary, although they have varied but limited abilities to dig. All remain within a very short distance of the point at which they settle. Growth rates and maximum size vary by species, but all probably live at least 10 years.

Adult clams appear to be relatively insensitive to crude oil for short periods of time but exhibit moderate sensitivity to refined products. It appears that the level of sensitivity depends substantially on the degree to which the oil is emulsified, regardless of the type oil. However, the tendency of many clams to assimilate and retain petroleum hydrocarbons for a considerable period of time has been demonstrated in numerous studies.

6.2.3.5 Barnacles

Barnacles are a dominant organism on rocks in the intertidal zone in most areas. Several species occur in rocky habitats in the Kodiak region.

Barnacles produce large numbers of planktonic larvae. The major period of settlement is during late winter and early spring. The sessile adult lives from one to several years, depending upon the species. Barnacles feed mainly upon planktonic organisms.

Both the planktonic larvae and the sessile adult stage are somewhat sensitive to oil contamination but the adult stage is most susceptible

because contact is more direct and concentrations are generally higher. Adults have a limited degree of protection from oil contamination because the animals can seal themselves inside their shells for a period of time thus isolating themselves from unfavorable conditions in the environment. The greatest cause of mortality in intertidal barnacles is smothering rather than toxicity. This results when the deposition of a coating of crude oil on the rocks and barnacles is thick enough to cover the barnacles and prevent them from obtaining oxygenated water. Barnacle populations generally recover rapidly from such a spill event. Recolonization of the affected area usually commences soon after deposition of oil ceases; even in cases where the oil remains on the rocks and weathers, juvenile barnacles will settle on the weathered surface.

6.2.3.6 Sea Urchins

Sea urchins in Alaska mainly inhabit rocky habitats in both intertidal and subtidal zones but are most abundant in subtidal habitats. They feed primarily on kelps and other seaweeds. Their abundance on the Kodiak Archipelago is probably quite variable; they are often quite abundant in areas where otters are absent; but, as a consequence of predation, they are usually uncommon where otters are common. In areas where sea urchins are abundant, they can exert a strong influence on the structure of the benthic assemblages.

Sea urchins have a life history that is analogous to that of barnacles in that both have planktonic larvae and benthic adults. Adult sea urchins, however, are not sessile, but can move limited distances in order to feed, etc. Sea urchins may live for more than ten years.

Sea urchins are more sensitive to direct contact with oil than are barnacles because they cannot isolate themselves from the surrounding environment as effectively. However, sea urchins are generally located under rocks or subtidally and are thus not as exposed to direct contact with crude oil. They are highly sensitive to the water-soluble fractions of oil. Where

mortality occurs in areas where sea urchins were initially abundant, the consequences can be dramatic but are not necessarily deleterious. A substantial reduction in grazing pressures of sea urchins is generally accompanied by a large increase in algal standing stocks and the abundance of epibenthic invertebrates that previously were eaten by sea urchins.

6.3 MAMMALS

6.3.1 Marine Mammals

Table 6-9: Representative Marine Mammals Occurring in Kodiak Nearshore Waters

Common Name	Scientific Name	Seasonal Presence			
		W	Sp	S	F
OTTERS					
Sea otter*	*Enhydra lutris*	X	X	X	X
PINNIPEDS					
Harbor seal*	*Phoca vitulina*	X	X	X	X
Steller sea lion*	*Eumetopias jubatus*	X	X	X	X
CETACEANS					
Harbor porpoise	*Phocoena phocoena*	X	X	X	X
Killer whale	*Orcinus orca*		X	X	
Minke whale	*Balaenoptera acutorostrata*		X	X	
Humpback whale*	*Megaptera novaeangliae*	X	X	X	
Gray whale*	*Eschrichtius robustus*	X		X	

W = December - February
Sp = March - May
S = June - August
F = September - November

* Species that are discussed in the text

Sources: Calkins 1983; Fiscus et al. 1976

6.3.1.1 Sea Otters

Sea otters in the vicinity of Kodiak mainly inhabit kelp beds in rocky inshore areas but are also commonly encountered in soft-bottom habitats supporting clams and crabs. They usually feed in areas where the depth is less than 60 m. The major population centers for sea otters on the Kodiak Archipelago are probably located in the vicinity of Shuyak and Afognak Islands, in the north, and the Trinity Islands and Chirikof Island in the south. Populations appear to be expanding into areas that are, at present, sparsely populated.

Sea otters are not migratory but can move considerable distances to locate new feeding areas. In stable populations, they usually live in the same general area for their entire life. In areas of expansion such as the Kodiak Archipelago, they may emigrate from a home ground into a less crowded area with more favorable prey availability. Sea otters only rarely come on shore, spending most of their life afloat. Reproductive potential is low and populations do not recover quickly from losses. Sea otters are a key predator in inshore habitats. They feed on a broad variety of organisms, e.g., clams, snails, crabs, sea urchins, and demersal fishes. Where sea otters occur, they undoubtedly are an important factor determining the population structure for many of those organisms. They are not reported to feed on either adult or juvenile salmonids.

Sea otters are totally dependent upon the air retained in their fur for insulation and thermal protection. Since oil destroys the insulative capabilities of the fur, sea otters are extremely susceptible to damage from petroleum products. Contact with oil generally leads to hypothermia, and probably death. Ingestion of oil through consumption or as a consequence of grooming activities is also of concern as it can cause digestive upsets and disrupt feeding behavior. Since sea otters need to consume a quantity of food equal to approximately 25% of their body weight, any disruption in their feeding habits can quickly result in malnourishment, especially during the winter.

Oil contamination of otter habitat can also have indirect effects on otter populations. Stable sea otter populations appear to be primarily food-limited, and any reduction of the food supply, e.g., from mortality caused by oil spills, will probably result in a reduction of the sea otter population, either through emigration or through starvation.

6.3.1.2 Harbor Seals

As the common name implies, harbor seals generally occupy relatively protected bodies of water. They are commonly encountered at the heads of bays or near mouths of rivers. Haulouts are generally located on small rocks, islands, or sand bars in protected areas. The largest concentration of harbor seals in the Kodiak Archipelago are reported from the northern islands and the eastern side of the archipelago.

Harbor seals occur around Kodiak throughout the year. They appear to spend most of the year in bays or protected areas. During the summer, many seals move into the mouths of rivers to feed on salmon and other fish migrating into the rivers to spawn. They feed heavily on bottomfish such as starry flounder but also prey on salmon and eulachon in season.

Harbor seals depend upon a layer of fat for insulation rather than upon their fur. As a consequence, oil has only a small effect upon the thermal protection of adults. However, pups without a well-developed layer of fat are susceptible to hypothermia. Moreover, individuals that are already stressed by poor nutrition, molting, disease, etc., may be stressed further by oil contamination. Oil contamination can cause eye irritation in adults, which leads to stress, which in turn leads to mortality.

6.3.1.3 Sea Lions

Sea lions are typically located in relatively open waters or at sea. Their rookeries or haulouts are found on small islands or isolated headlands adjacent to open water. On the Kodiak Archipelago, most major haulouts are located along the eastern side, and only two major haulouts are located on

the western side of the archipelago. Some haulouts are occupied primarily in the winter whereas some are used only during the summer. There is no documentation to indicate whether any of the haulouts in the Kodiak Archipelago are used for breeding and pupping. The only such recorded habitat is on Sugarloaf Island in the Barren Islands.

Sea lions occur around Kodiak throughout the year, but individuals are highly mobile and move widely throughout the Gulf of Alaska. They often spend the spring and summer months in offshore waters and move to more protected open-water areas in the winter. They feed heavily on capelin, pollock, and Pacific cod, as well as octopus. Herring are also a major prey item during spring spawning season in many areas.

Sea lions depend upon a layer of fat for insulation rather than upon their fur. As a consequence, oil has little effect upon the thermal protection of adults. However, pups without a well-developed layer of fat are susceptible to hypothermia. Oil contamination can cause eye irritation in adults, which may lead to stress. Moreover, individuals that are already stressed by poor nutrition, molting, disease, etc., may be stressed further by oil contamination.

6.3.1.4 Gray Whales

Gray whales are most commonly encountered in nearshore waters within several kilometers of the coast. They frequently feed within a few hundred meters of shore mainly on benthic organisms such as gammarid amphipods. Feeding is generally associated with soft substrates such as sand or gravel.

The gray whale is a highly migratory species. The west coast population migrates annually between breeding and calving lagoons in Baja California and summer feeding grounds in the Chukchi Sea. During this migration, individuals mainly travel near the coast. Most of the sightings on the Kodiak Archipelago have been made along the eastern shore of Afognak and Kodiak Islands. The gray whale is a transitory species in Kodiak, occurring there only as it moves to and from the Bering Sea.

Little information is available on the direct effects of oil on cetaceans but it is possible that oil could be inspired into the respiratory system if the animals surfaced while moving through an oil slick. Also, gray whales, as benthic feeders, could ingest petroleum hydrocarbons in the form of deposited droplets or as contaminants in food organisms. However, the probability is low that exposure to oil in the Kodiak Archipelago would cause significant damage to the population in view of the short period of residence of gray whales in the area.

6.3.1.5 Humpback Whales

Humpback whales generally occur in offshore areas in the vicinity of the Kodiak Archipelago. Most have been observed either northwest of Shuyak Island or south of Kodiak Island. Humpback whales feed on free-swimming organisms such as euphausiids or herring.

Humpback whales are highly migratory. The north Pacific population travels annually from winter breeding and calving ground in Hawaii to summer feeding areas in Alaska. Although they spend a considerable portion of each summer in Alaska, few spend any time in Kodiak waters.

Effects of oil on the humpback whale is similar to that described above for the gray whale.

6.3.2 Terrestrial Mammals

Table 6-10: Representative Terrestrial Mammals found in Kodiak Coastal Areas

Common Name	Scientific Name	Seasonal Presence			
		W	Sp	S	F
River otter	*Lutra canadensis*	X	X	X	X
Red fox	*Vulpes fulva*	X	X	X	X
Brown/Grizzly bear	*Ursus arctos middurdorfi*		X		X
Sitka black-tailed deer	*Odocoileus hemionus sitkensis*	X	X	X	X
Roosevelt elk	*Cervus canadensis*	X	X	X	X

W = December-February
Sp = March-May
S = June-August
F = September-November

Sources: ADF&G; BLM 1977; KIB 1983; Ryan 1984

The Kodiak Archipelago is home to a variety of upland mammals. Animals which are likely to be found in intertidal areas are listed in Table 6-10.

River otters are present mainly along watercourses. Otters feed on small fish in rivers and in saltwater; in saltwater, they consume small fish such as sculpins and mollusks such as mussels, snails and sea urchins. They often live in upland habitats, coming down singly or in groups to forage along rocky shorelines and tidal flats in protected bays and estuaries. Otters may be found along these areas at any season of the year.

Red fox are indigenous to most of the islands in the Kodiak Archipelago with the exception of Tugidak and Chirikof Islands. Red fox hunt extensively along the shorelines, feeding on small mammals (such as voles), carrion, clams, crabs and amphipods. They are present all year.

Brown bear utilize intertidal areas in the spring, summer, and fall. In early spring when they have just emerged from their dens, bears will

wander along the intertidal zones searching for dead marine mammals to feed on. As the season advances, the bears move to higher elevations and then to the salmon streams where they are present in great numbers during the summer and fall. In late fall, brown bears again are found foraging in intertidal areas. In the winter months, bears move into their dens to hibernate. Sedge flats at the heads of bays are also used for spring and summer feeding.

There are an estimated 2,400 brown bears on Kodiak Island. Concentration areas include the drainages of the Karluk River, the Dog Salmon River, Kaiugnak River, Uganik River, and the tributaries to Terror River. Bears emerge from their dens around mid-April and return to them by mid-November.

Elk were introduced to the Kodiak Archipelago in 1928. They are currently found on Afognak, Raspberry, Little Raspberry and Shuyak Islands and small numbers of elk have been reported from Kodiak in recent years. Although elk prefer grassy meadows and spruce forests, they use heath-type habitat at or near sea-level in areas of windblown bluffs and capes to overwinter, particularly on Tonki Cape and Raspberry Island. They may use saltmarsh plants as a food source during the winter and spring. During the rest of the year, they are found in upland habitats away from intertidal zones.

Deer are another introduced animal; they were brought to Kodiak Island in 1934. During the spring, summer and early fall months, many deer use upland habitats. As the snow level descends in the fall, these deer may be pushed down to the beach areas. They remain at these low elevations through much of the winter, feeding in the beach/timber fringe. In severe winters, deer will forage in intertidal areas. Other Kodiak deer populations can be found along beaches or in intertidal areas throughout the year. Deer consume kelp as a secondary food source in the winter and early spring.

Terrestrial mammals could come into contact with oil on intertidal areas in the event of a coastal oil spill. River otters may be oiled as they enter the water to feed. When oiled, their pelage loses its insulative properties

which may lead to mortality through hypothermia. Otters may also consume invertebrates or fish which have been exposed to oil. There are no data regarding the effects of oil ingestion on river otters. Foxes and bears feeding on dead sea mammals and birds which have been oiled may also be adversely affected, although there are no data on this either. It is speculated that mammals such as bears and foxes may also ingest oil in attempts to clean their fur. How much ingested oil may be harmful is not known. Black-tailed deer and elk may be exposed to oil on beaches and tidal flats if spills occur in the winter. Deer, especially, may be vulnerable during severe winters when they are feeding on kelp. Since deer tend to concentrate in overwintering areas, there is potential for doing damage to the population depending on the severity and longevity of the spill. Again, there are no data specific to the effects of ingested oil on deer or elk.

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7.0 HUMAN USES

7.1 INTRODUCTION

Human resources are a major concern of local residents during an oil spill. Commercial fishing, subsistence harvest, and recreation are all sensitive to oil spills. These Activities are critical to the livelihood of Kodiak Island Borough residents and to the Borough economy as a whole. The sensitivity of community infrastructure, transportaton routes and modes, and cultural resources must also be considered. Along with sensitive biological resources and shoreline types, human resources strongly influence priorities for oil spill countermeasures.

Seven communities are located on the coastline of the study area. The City of Kodiak is one of the major commercial fishing ports within Alaska and is the site of a U.S. Coast Guard base. The remaining six communities are predominantly Koniag Eskimo, locally refered to as Aleuts. Akhiok, Karluk, Larsen Bay, Old Harbor, Ouzinkie, and Port Lions and are heavily dependent on commercial fisheries and subsistence resources. Some 500 to 600 people live outside of these communities and the road system.

Commercial fishing activities occur during nearly every season of the year. Salmon are fished from the shore at set net sites and in nearshore waters using gill nets and purse seines. Dungeness, king and tanner crab and shrimp are harvested in the region. Other important resources include halibut, other groundfish, herring, clams and scallops. Fish processing occurs at fixed land based sites and on floating processors.

Recreational resources important to local and outside residents are also scattered throughout the Kodiak Archipelago. Major activities relevant to this study include sport fishing (salmon, steelhead, Dolly Varden/char, halibut) and hunting (deer, bear, elk). Much of this use is concentrated around the Kodiak road system and areas accessible by boat from the seven communities.

The history of Kodiak reflects the Koniag Eskimo culture, occupation by the Russians, and the period following the United States' acquisition of Alaska from Russia. Archaeological and historical resources occur throughout the study area, most of them located on the coast. Many of these sites are protected under state and federal law. Others have been selected by Native Corporations under the Alaska Native Claims Settlement Act.

Finally, all seven communities are coastally oriented. Housing and commercial facilities are often located on the coast itself. Each community has either a small boat harbor or stores boats and fishing gear on the beach. In addition, the beaches are often used for vehicle access to set net sites, summer camps, and subsistence access.

7.2 COMMERCIAL FISHING

7.2.1 Species

The fish species harvested commercially from Kodiak waters can generally be grouped into eight categories: herring, salmon, shrimp, crab, halibut, whitefish (bottomfish), blackcod and scallops (Table 7-1). The biology of these fishes, and their sensitivity to oil pollution, was discussed in Section 6.2.

7.2.2 Seasons, Areas, Gear, and Processing

Pacific herring are fished briefly but intensively in the spring (April - June) during spawning. When the large schools of fish move inshore into bays on both sides of the archipelago, they are taken with purse-seine and gillnet gear from relatively small boats. The herring are delivered to floating processors or shore plants, where the roe sacs are extracted and packaged. Some of the carcasses are processed as bait. Herring roe that has already been deposited by the fish onto kelp is harvested with long-handled rakes or by divers. Both the sac roe and the roe-on-kelp products are intended primarily for export markets. Plans are being made for a fall-winter fishery for food herring that would open approximately on 15 August.

Table 7-1: Commercial Fisheries of the Kodiak Region

Fish or Shellfish	Scientific Name	Gear[1]
Salmon-Chinook	Oncorhynchus tshawytscha	GN, PS, SN
Sockeye	O. nerka	GN, PS, SN
Coho	O. kisutch	GN, PS, SN
Pink	O. gorbuscha	GN, PS, SN
Chum	O. keta	GN, PS, SN
Pacific Herring	Clupea harengus pallasii	GN, PS
Pink Shrimp	Pandalus borealis	TR, PT
Crab - Dungeness	Cancer magister	PT
Tanner	Chionoecetes bairdi	PT
Red King	Paralithodes camtschatica	PT
Brown King	Lithodes aequispina	PT
Pacific Halibut	Hippoglossus stenolepis	LL
Whitefish[2]		
Pacific Cod	Gadus macrocephalus	TR, LL
Alaska Pollock	Theragra chalcogramma	TR
Arrowtooth Flounder	Atheresthes stomias	TR
Starry Flounder	Platicthys stellatus	TR
Blackcod	Anoplopoma fimbria	LL, PT, TR
Weathervane scallop	Patinopecten caurins	DR

(1) GN = Drift Gillnet
PS = Purse Seine
SN = Set (gill-)net
TR = Trawl
LL = Longline
DR = Dredge
PT = Pot

(2) Whitefish (i.e. bottomfish or groundfish) actually refers to a wide variety of flatfish and roundfish species, all of which are caught on or near the bottom. The species listed here are the most common commercially.

Both the roe herring and the food herring are fished in most bays in the archipelago.

Salmon are traditionally the steady "cash crop" for the Kodiak fishermen. They are fished by purse-seine and gillnet (drift and set), as they return to the rivers to spawn. Like herring, salmon are fished fairly close to shore, well within the 3-mile limit of state waters, usually in bays and fjords. They are fished throughout the Archipelago, but 35 to 40 major river systems produce most of the fish. Most sockeye salmon are produced in the Karluk, Fraser and Red River systems. Salmon are harvested during the summer beginning with sockeyes, which peak in late June. These are followed by pinks and chums during July and August. The salmon fishing season ends with coho in September. King salmon are not targeted; they are taken incidently to the sockeye fishery. Salmon are delivered to floating processors and shore plants, where they are processed into a variety of fresh, frozen, canned, sac roe, and smoked forms, for both the domestic and export markets.

Shrimp are fished mostly by trawl gear, with some fishermen using pots. They are usually fished from mid-June to the end of February, in most of the large bays on Kodiak and Afognak Islands, especially along the Shelikof Strait. Shrimp stocks have been in poor condition for many years, so most fishing sections are open only for a short time, if at all. In 1984, Alitak Bay was open for eight days; all other bays were closed. Shrimp are steamed and sold fresh or frozen.

Crab are fished with pots, and until recently, were economically more important to Kodiak than were salmon. The 1981 - 1982 season was the last big season for king crab before the stocks declined abruptly. The red king crab fishery was not opened in 1983 or 1984, because of the poor condition of the stocks. Brown (golden) king crab are beginning to be fished, but at a lower level than were red king crab. The status of the brown king crab stocks is uncertain. Both species are fished May - December. Tanner crab harvests have declined somewhat since the late 1970s, but are still an important winter/spring (February - May) fishery. Both king and tanner crab are fished well offshore. Dungeness crab are fished in near-

shore waters and the major bays of the Archipelago. The condition of Dungeness stocks appears to be good, and they are fished heavily from May through January, mostly in July and August. All crab are delivered live to the processors where they are steamed and sold fresh or frozen.

Halibut are fished inshore and offshore by longline from a wide variety of vessels. The number of fishermen in the fishery is increasing rapidly, leading to reductions in season length from a couple of months to a few days. Kodiak produces by far the most halibut of any area in Alaska. The fish are proccessed into fillets, steaks and whole fish, and are usually frozen.

Whitefish (i.e. bottomfish or groundfish) are fished mostly by trawl, with some cod being taken by longline. Pollock fishing intensifies from January through March (to take roe pollock), and cod fishing is heavy in April and May. Generally speaking, whitefish are harvested year-round. Although cod, pollock and flatfish venture into the bays of the archipelago, they are usually harvested offshore, on or near the bottom. The Shelikof Strait experiences intense fishing during the late winter months. Cod and flatfish are sometimes taken in the bays on the west side of Kodiak, but more often they are found approximately along the 100-fathom contour off Marmot, Sitkalidak, Ugak, and Twoheaded Islands. Pollock are less specific in their location. Good catches of flatfish have been taken east of Ugak Island, but schools of these fish are also widely spread. It is characteristic of the fleet to move about a great deal as they fish. The vast majority of whitefish are delivered at sea to foreign processing ships (i.e.-"joint-ventures"). However, at least three processors in Kodiak have recently been buying whitefish, mostly cod. Most whitefish are sold frozen, in fillets, blocks and headed-and-gutted forms.

Blackcod (sablefish) are fished year-round by pots, trawls and longline gear offshore, in 250-400 fathoms of water, mostly off Uganik Bay and Raspberry Island. Harvesting of blackcod by U.S. fishermen is increasing rapidly, tending to displace foreign fishermen. Blackcod are bled aboard the fishing vessel and are sold fresh, frozen and smoked.

Weathervane scallops are harvested year-round by steel dredges from the heads of bays, out to 20 miles from the coast. Heavy concentrations of scallops are found off Kodiak's southwest coast, Old Harbor, Marmot Island and Kupreanof Strait. Scallops are usually sold shucked (without shells) and frozen.

7.2.3 Importance To Economy

The fisheries of the Kodiak Archipelago have traditionally provided the basic income for most of the residents. In 1982, the most recent year for which complete statistics are available, the fisheries of the Kodiak area generated almost 103 million pounds of fish, worth over $91 million in ex-vessel value (Table 7-2). The totals for the Western Region of Alaska, including Kodiak, were 340 million pounds and $262 million, respectively.

Table 7-2: Catch and Value to Kodiak Fishermen, 1982

	1000 POUNDS	1000 DOLLARS
Salmon	50,335	18,822
Other Finfish	12,383	1,900
Shellfish	40,175	70,624
Total	102,893	91,347

Source: ADFG, 1984, Alaska 1982 Catch and Production Commercial Fisheries Statistical Leaflet No. 35

In 1982, processors in the Western Region produced 203 million pounds of seafood, worth almost $505 million.

Much of the revenue generated by fishing and processing forms the economic base and livelihood for the communities of the borough.

7.2.4 Sensitivity To Oil Pollution

As discussed in Chapter 6, all species of fish and shellfish, particularly those in the inshore areas, are sensitive to oil pollution. Species most at risk are those which spend important portions of their life cycle in the area of impact, such as herring, which spawn in bays close to the beach. Eggs, larvae, and in some cases, juvenile fishes cannot avoid oil spills as well as the adults can. Further, the results of a kill of large numbers of eggs or larvae could remain unnoticed until the time when that year-class should have recruited to the fishery.

Salmon and herring fisheries are more sensitive to oil pollution than other fisheries because they occur: (1) near the surface; (2) in shallow water; and (3) in bays, inlets and fjords where oil is retained longer than on exposed coasts. Gear fouling (and subsequent discarding of the gear), and disruption of the spawning patterns are serious risks. Herring spawn (roe-on-kelp) in nearshore areas would be adversely impacted. Most adult fish would probably tend to avoid the oiled waters. If a spill is severe enough to warrant the closure of an area, the impact would be tied closely to the duration of the closure. If a producing bay was closed for one week during the peak herring or salmon spawning runs, the effect upon the Kodiak economy could be significant.

Fisheries that occur over a wide area, from inshore to offshore, such as shrimp, Dungeness crab and scallops, would be somewhat less sensitive to oil pollution. Shrimp and Dungeness crab are often fished in the relatively shallow waters of the bays and fjords. If oil were to contact these species in these areas, the localized impacts could, be severe. However, the fishing grounds for all of these species extend well offshore. Here, the main risk might be tainting of the catch, and fouling of the gear by tar balls on the bottom.

Tainting of fish and shellfish can be caused by a wide variety of volatile components found in crude oil and refined petroleum products. The

organisms may contain low concentrations of these substances in their tissues; concentrations that are below the toxic level but which can be detected when the fish or shellfish is consumed. The fish or shellfish can absorb the tainting agents directly from the water or from oil-covered fishing gear. In some cases, "perceived tainting" can be a problem, i.e. people who are aware that an oil spill has occurred may think that a product is tainted and will not buy it.

Parenthetically, it should be noted that few fishermen will attempt to lift their gear (trawl, longline, dredge, or pot) up through an oil slick. To avoid fouling the gear or tainting the catch, it is better to either leave the gear in place, or to move out of the impacted area. If an oil spill were to persist in an area for any length of time, it would effectively close that area for the duration.

All three types of crab (king, Tanner and Dungeness) are delivered live to the processors. The crab are transported in holding tanks ("live-tanks") aboard the fishing vessel. Seawater is pumped aboard the boat and circulated through these tanks. If oil were entrained with the seawater, or if circulation was suspended while the boat passed through a slick, tainting or loss of the catch might result.

Longline fisheries for halibut and blackcod, pot fisheries for king and Tanner crab, and trawl fisheries for whitefish are not as sensitive to oil pollution, because they typically occur outside of the nearshore zone, in relatively deep water. The main risk in these fisheries would be the coating of the bouys of the pot and longline gear, making them less visible and harder to recover.

Interference between commercial fishing boats and oil spill cleanup vessels could occur if both were operating in close quarters, such as bays and fjords. However, most fishermen would tend to avoid areas of oil pollution and the subsequent cleanup efforts. Further, all marine vessel traffic must obey the U.S. Coast Guard "Rules of the Road" for passing other

vessels, towing booms or nets, etc. If the spill is severe enough to require frequent rotation of cleanup vessels to the Kodiak dock, the fishermen may experience impacts related to port congestion, such as waiting to re-fuel, crowded docks, etc.

7.3 SUBSISTENCE HARVEST

The value of subsistence resources and associated activities to village residents cannot be over emphasized. It provides the foundation of village culture and economy. Subsistence activities occur throughout the year, using a variety of resources and types of gear. Subsistence is often conducted in conjunction with other activities such as commercial fishing. The resources harvested are traditionally shared throughout the community, and are often shared between communitiees. Residents of the City of Kodiak and surrounding areas also harvest subsistence resources. While such activities may not have the social value present in the other communities, subsistence still contributes to the way of life and economy of these residents.

7.3.1 Subsistence Resources

There are seven categories of subsistence resources used by Borough residents: fish, clams, crabs, deer, rabbit (snowshoe hare), birds (waterfowl and ptarmigan), and marine mammals. Seasonal use of subsistence resources is discussed under village subsistence profiles (Section 6.3.2). For most island villages, salmon is the most important subsistence resource.

Salmon: Village subsistence salmon harvests range from 33 to 67 percent in weight of mean household harvest. All five species of salmon are harvested: sockeye, chinook, coho, pink and chum. Salmon are harvested by set and drift gillnets, purse-seine (often incidently to commercial catch) and by rod and reel.

Halibut: Although not as important as salmon, halibut represent between 6 to 34 percent of mean household subsistence by weight. Halibut are harvested primarily by longline and by rod and reel.

Dolly Varden and Steelhead: Dolly Varden and steelhead are primarily harvested by rod and reel, although some are caught with gillnets in some communities.

Butter and Razor Clams: Clams are harvested at low tide by shovel. Relatively accessible to all communities, they are heavily utilized and are easy to obtain year round.

King, Tanner and Dungeness Crab: The three species of crab are harvested using crabpots, often incidentally with fishing and other activities.

Deer: Deer are a major subsistence resource, particularly in northern communities. Hunted in inland areas and along the coastline in winter months. Deer and other game make up between 15 and 19 percent of mean village household harvest by weight.

Rabbit: Rabbit are harvested by all communities, often incidentally to other activities.

Birds: The primary birds hunted for subsistence include waterfowl, ptarmigan, and bird eggs. These resources usually contribute less to the subsistence diet than other game resources.

Marine Mammals: Harbor seal and sea lion are the two marine mammals harvested by Borough residents. Marine mammals are hunted by boat and along the shoreline. Reliance on marine mammals varies widely by community; harvest by mean household harvest weight varies from 3 to 28 percent.

7.3.2 Village Subsistence Patterns

As mentioned earlier, village residents harvest resources both, in the immediate vicinity of their villages and over large areas outside the villages. Figures 7-1 and 7-2 show the resource areas used by the six Kodiak Island villages. This information was obtained during household surveys by the Kodiak Area Native Association and the Alaska Department of

Figure 7-1: Resource Use Areas: Akhiok, Larsen Bay, Port Lions, 1982-1983

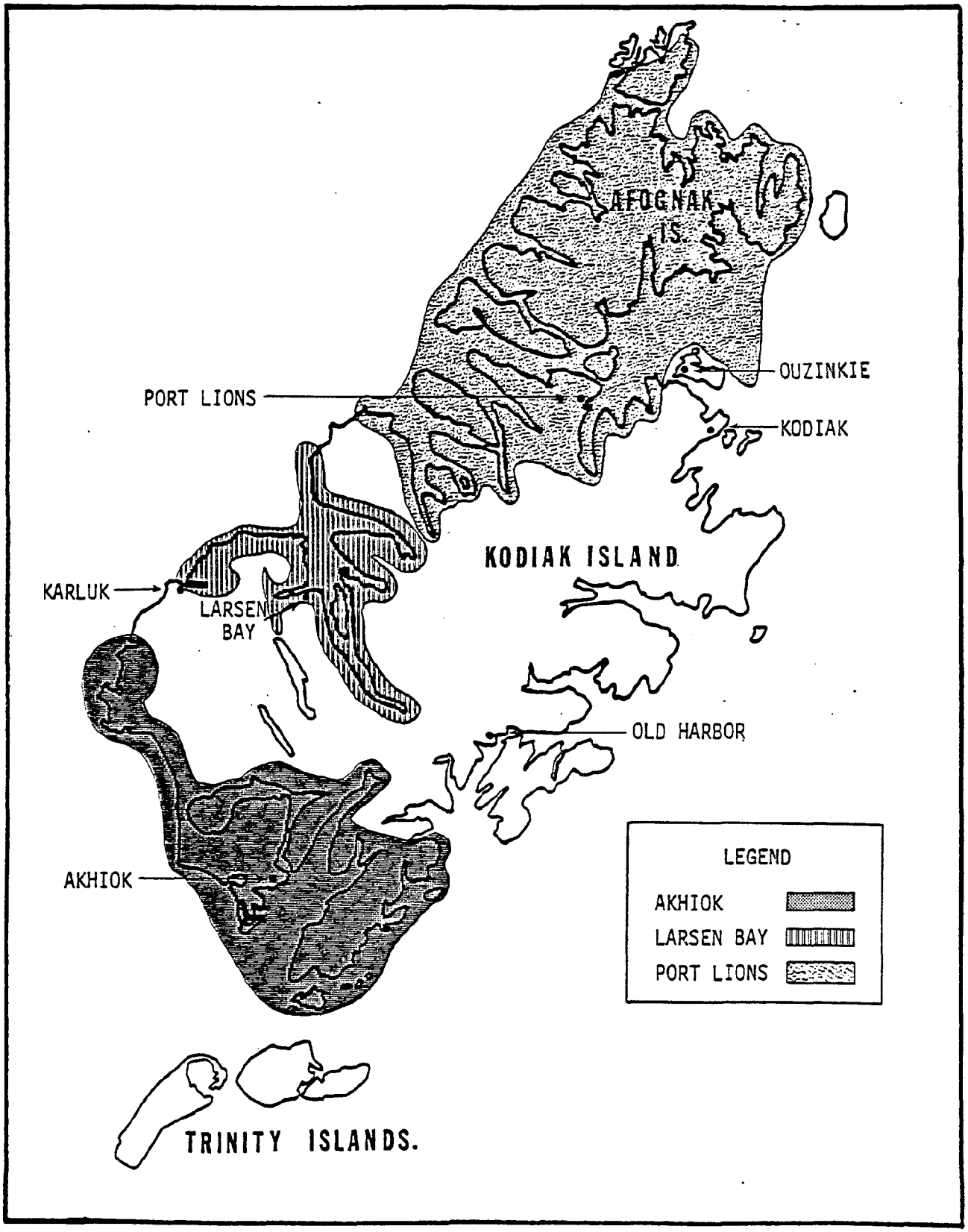
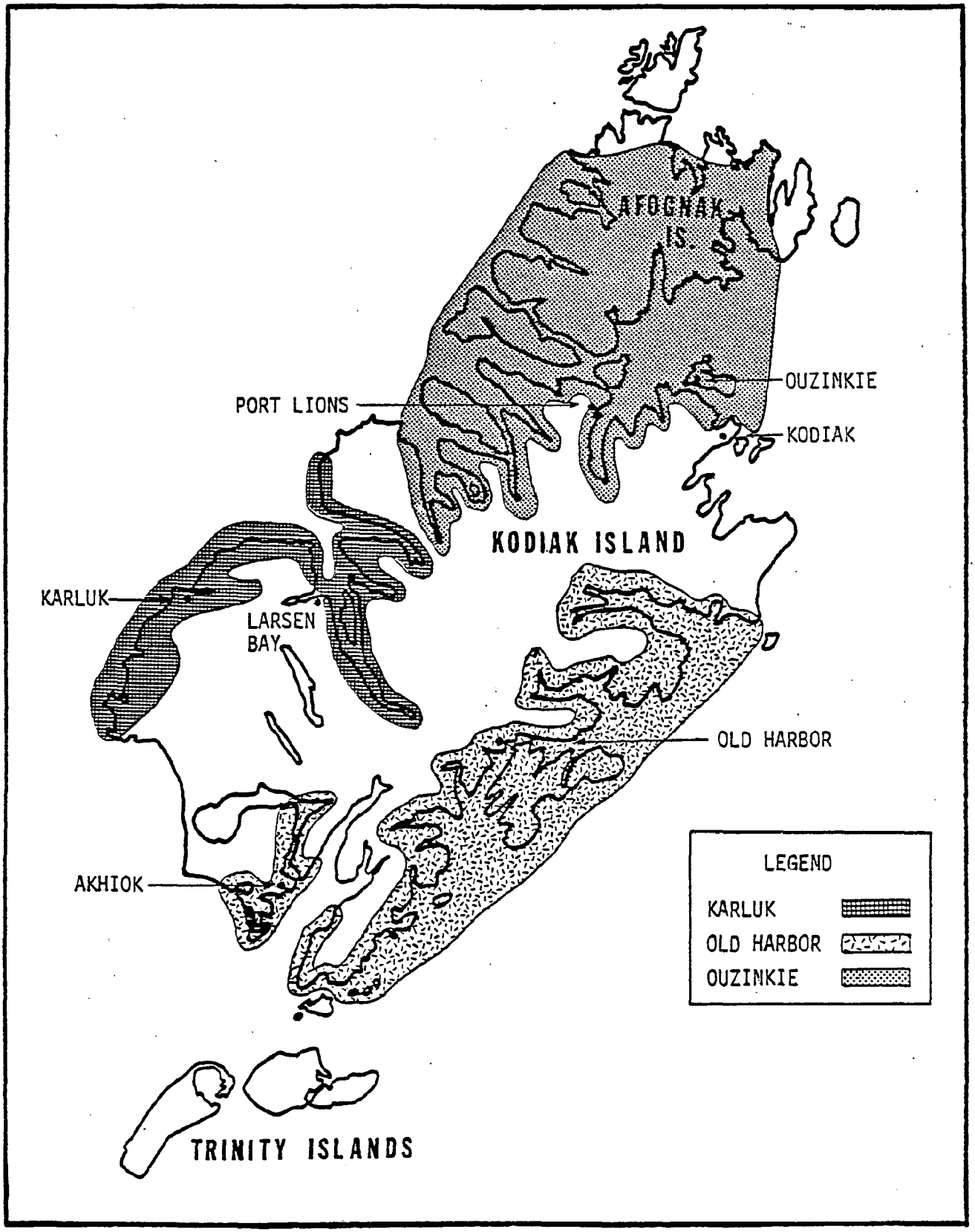


Figure 7-2: Resource Use Areas: Karluk, Old Harbor, Ouzinkie, 1982-1983



Fish and Game. Residents of the City of Kodiak utilize the road system and areas easily reached by boat.

Tables 7-3 and 7-4 present mean household harvests in pounds for Kodiak Island villages and residents of road connected areas.

The final set of Figures (7-3 through 7-8) represent seasonal rounds of subsistence resource harvests for each of the six island villages. Brief summaries of village and road system use are presented below. Percentages identified refer to percent of total weight harvested.

Akhiok: Akhiok residents consumed an average of 518.4 pounds per capita per year of subsistence resources between 1982 and 1983. Using mean household harvest in pounds, salmon were most heavily harvested by Akhiok residents (42 percent), followed by marine mammals (28 percent), game (15 percent), clams and crabs (9 percent), and other fish (6 percent). With the exception of sockeye salmon, salmon are harvested primarily between May and October. Sockeye salmon are also harvested during winter months. Waterfowl and other bird resources are harvested from September through May. All other subsistence resources are harvested year-round.

Karluk: Karluk residents consumed an average of 834.5 pounds per capita of subsistence resources between 1982 and 1983. Using mean household harvests in pounds, Karluk residents harvested salmon most heavily (67 percent) followed by game (11 percent), marine mammals (10 percent), other fish (10 percent), and marine invertebrates. Subsistence salmon harvests occur from May to October. Game resources are harvested primarily from August through April. All other subsistence resources are harvested year-round.

Larsen Bay: Between 1982 and 1983, Larsen Bay residents consumed 400.4 pounds of subsistence foods per capita per year. Based on mean household harvests in pounds, Larsen Bay residents harvested salmon most heavily (40 percent), followed by game (19 percent), other fish (16 percent), marine mammals (14 percent), and marine invertebrates (11 percent). Salmon are harvested from May through December. Game is most intensively harvested from

Table 7-3

MEAN FOOD WEIGHT OF FISH AND GAME HARVEST PER HOUSEHOLD, PER CAPITA FOOD WEIGHT, KODIAK RURAL COMMUNITIES, 1982-1983[1,2,3]

	Akhiok	Karluk	Larson Bay	Old Harbor	Ouzinkie	Port Lions
No. Households Surveyed	21	20	32	76	32	55
Species Group						
All Salmon	845.0	2223.2	663.2	795.9	522.5	287.1
All Fish	954.5	2532.2	936.9	1034.5	707.2	580.9
All Crab	47.2	6.5	26.6	29.6	69.9	64.6
All Invertebrate	185.3	62.1	190.0	121.0	163.6	118.6
Deer	156.3	235.4	251.1	235.9	110.7	113.1
Marine Mammals	547.9	324.7	227.8	281.0	93.0	24.7
Small Game	131.2	128.0	59.7	66.6	115.9	30.3
All Game	835.4	702.0	538.6[4]	606.6	325.6	168.1
All Species	1975.2	3296.3	1665.5[4]	1758.3	1196.3	865.9
Mean Household Size (persons)	3.81	3.95	4.16	3.79	3.34	3.30
Per Capita Food Weight of Harvest	518.4	834.5	400.4	463.9	358.2	262.4

1. Food weight given in pounds, converted from harvest number using standard conversion factors, see Table 21.
2. Data are for a 12 month period, most often from June 1982 through May 1983. See methodology section for details.
3. Because of rounding and the computer technique used to deal with missing data, the column, row, and category totals may not always equal 100% or the total expected from the addition of constituent numbers.
4. Adjusted total for Larsen Bay, does not include bear.

Source: Data from KANA 1983 survey; table prepared by Subsistence Division, Alaska Department of Fish and Game.

Table 7-4

MEAN FOOD WEIGHT OF FISH AND GAME HARVEST PER HOUSEHOLD, PER CAPITA FOOD WEIGHT, KODIAK ROAD-CONNECTED AREA, 1982-1983[1,2,3]

KODIAK ROAD-CONNECTED AREA

	General Sample	Coast Guard	Chiniak	Filipino	Native
No. Households Surveyed	155	76	17	34	35
All Salmon	132.0	64.5	264.7	113.1	181.5
All Fish	331.6	326.4	465.1	280.0	258.3
All Crab	26.0	34.0	49.4	5.3	12.5
All Invertebrate	54.7	54.2	96.7	52.2	55.0
Deer	57.7	24.3	190.6	41.9	65.4
Marine Mammals	9.7	0.0	17.1	0.0	1.3
Small Game	5.1	4.4	17.1	5.8	17.6
All Game	82.8	29.6	232.1	54.3	90.8
All Species	475.2	412.7	793.9	386.6	404.2
Mean Household Size (persons)	3.32	2.41	3.94	4.18	3.49
Per Capita Food Weight of Harvest	143.1	172.0	203.6	92.0	115.5

1. Food weight given in pounds, converted from harvest number using standard conversion factors, see Table 21.
2. Data are for a 12 month period, most often from June 1982 through May 1983. See methodology section for details.
3. Because of rounding and the computer techniques used to deal with missing data, the column, row, and category totals may not always equal 100% or the totals expected from the addition of constituent numbers.

Source: Data from KANA 1983 survey; table prepared by Subsistence Division, Alaska Department of Fish and Game.

Figure 7-3

SEASONAL ROUND OF RESOURCE HARVESTS: AKHIOK 1982-1983[1,2,3,4,5]

SPECIES	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
FISH												
Red Salmon	xxxx	xxxx			xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
King Salmon						xxxx	xxxx	xxxx	xxxx			
Silver Salmon							xx	xxxx	xxxx	xxxx		
Pink Salmon							xxx	xxxx	xxx			
Chum Salmon						xx	xxxx	xxxx	xxxx	x		
Halibut	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Dolly Varden	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Steelhead (Rainbow)	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Butter Clams	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Crab:												
King Crab	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Tanner Crab	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Dungeness Crab	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
GAME												
Deer	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Hare	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Ptarmigan	xxxx	xxxx	xxxx	xxxx					xxxx	xxxx	xxxx	xxxx
Ducks	xxxx	xxxx	xxxx	xxxx					xxxx	xxxx	xxxx	xxxx
Geese	xxxx	xxxx	xxxx	xxxx	xxxx						xxxx	xxxx
Harbor Seal	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Sea Lion	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec

1. Each "x" represents one quarter of a month.
2. An "x" means that named species are typically harvested during indicated time period.
3. The symbol "?" means that harvest during indicated time period has not been documented but may occur.
4. Refer to Tables 2 to 5 for magnitude of harvest and use.
5. Seasonal round data for other species is on file with the Subsistence Division, ADF&G.

Source: 1983 Field Interviews, Subsistence Division, Alaska Department of Fish and Game.

Figure 7-4

SEASONAL ROUND OF RESOURCE HARVESTS: KARLUK 1982-1983[1,2,3,4,5]

SPECIES	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
FISH												
Red Salmon					xxx	xxxx	xxxx	xxxx	x			
King Salmon					xxx	xxxx	x					
Silver Salmon							xx	xxxx	xxxx	xxx		
Pink Salmon							xx	xxx				
Chum Salmon							xx	xxx				
Halibut						xxxx	xxxx	xxxx	xxxx			
Dolly Varden	xx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Steelhead (Rainbow)					xxxx				xx	xxxx	xxxx	xx
Butter Clams	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Crab:												
King Crab	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Tanner Crab	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Dungeness Crab	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
GAME												
Deer	x???	????	????	????	????	????	????	xxxx	xxxx	xxxx	xxxx	xxxx
Hare	xxxx	xxxx									xxxx	xxxx
Ptarmigan	xxxx	xxxx	xxxx								xxxx	xxxx
Ducks	xxxx	xxxx	xxxx	xxx						xx	xxxx	xxxx
Geese				xxxx								
Harbor Seal	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Sea Lion	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.

1. Each "x" represents one quarter of a month.
2. An "x" means that named species are typically harvested during indicated time period.
3. The symbol "?" means that harvest during indicated time period has not been documented but may occur.
4. Refer to Tables 2 to 5 for magnitude of harvest and use.
5. Seasonal round data for other species is on file with the Subsistence Division, ADF&G.

Source: 1983 Field Interviews, Subsistence Division, Alaska Department of Fish and Game.

Figure 7-5

SEASONAL ROUND OF RESOURCE HARVESTS: LARSEN BAY 1982-1983[1,2,3,4,5]

SPECIES	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
FISH												
Red Salmon						xxxx	xxxx	xxxx	xxxx	xxx		
King Salmon					xxxx	xxxx	xxx					
Silver Salmon							xxxx	xxxx	xxxx	xxxx	xxxx	xxx
Pink Salmon						xxxx	xxxx	xxxx	xxxx	xxx		
Chum Salmon						xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	x
Halibut	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Dolly Varden		x	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx			
Steelhead (Rainbow)	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Butter Clams	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Crab:												
King Crab	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Tanner Crab	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Dungeness Crab	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
GAME												
Deer	xxxx	????	????	????	????	????	????	xxxx	xxxx	xxxx	xxxx	xxxx
Hare	xxxx	xxxx	xxx						xxxx	xxxx	xxxx	xxxx
Ptarmigan	xxxx	xxxx	xxxx	xxxx					xxxx	xxxx	xxxx	xxxx
Ducks	(in season only, Oct. 8 to Jan. 22)											
Geese	(rarely present locally)							xxxx	xxxx	xxxx	xxxx	
Harbor Seal	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Sea Lion	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.

1. Each "x" represents one quarter of a month.
2. An "x" means that named species are typically harvested during indicated time period.
3. The symbol "?" means that harvest during indicated time period has not been documented but may occur.
4. Refer to Tables 2 to 5 for magnitude of harvest and use.
5. Seasonal round data for other species is on file with the Subsistence Division, ADF&G.

Source: 1983 Field Interviews, Subsistence Division, Alaska Department of Fish and Game.

Figure 7-6

SEASONAL ROUND OF RESOURCE HARVEST: OLD HARBOR 1982-1983[1,2,3,4,5]

SPECIES	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
FISH												
Red Salmon	xxxx	x			xx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
King Salmon							xxxx	xxxx				
Silver Salmon								xx	xxxx	xxxx	xxxx	xx
Pink Salmon						x	xxxx	xxxx	x			
Chum Salmon								xx	xxxx	xx		
Halibut					xxxx	xxxx	xxxx	xxxx	xxxx			
Dolly Varden	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Steelhead (Rainbow)	(rarely found)											
Butter Clams	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Crab:												
King Crab	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Tanner Crab	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Dungeness Crab	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
GAME												
Deer	xxxx	????	????	????	????	????	????	xxxx	xxxx	xxxx	xxxx	xxxx
Hare	xxxx	xxxx	xxxx								xxxx	xxxx
Ptarmigan	xxxx	xxxx	xxxx								xxxx	xxxx
Ducks	xxxx	xxxx	xxxx							xxxx	xxxx	xxxx
Geese	xxxx	xxxx	xxxx							xxxx	xxxx	xxxx
Harbor Seal	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Sea Lion	xxxx	xxxx	xxxx								xxxx	xxxx
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.

1. Each "x" represents one quarter of a month.
2. An "x" means that named species are typically harvested during indicated time period.
3. The symbol "?" means that harvest during indicated time period has not been documented but may occur.
4. Refer to Tables 2 to 5 for magnitude of harvest and use.
5. Seasonal round data for other species is on file with the Subsistence Division, ADF&G.

Source: 1983 Field Interviews, Subsistence Division, Alaska Department of Fish and Game.

Figure 7-7

SEASONAL ROUND OF RESOURCE HARVEST: OUZINKIE 1982-1983[1,2,3,4,5]

SPECIES	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
FISH												
Red Salmon					xx	xxxx						
King Salmon	(not usually present)											
Silver Salmon								xx	xxxx	xxxx	xxxx	
Pink Salmon							xxxx	xxxx	xxxx	xxxx		
Chum Salmon							xxxx	xxxx	xxxx	xxxx		
Halibut	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Dolly Varden				xxxx	xxxx	xxxx	xxxx	xxxx				
Steelhead (Rainbow)				xxxx	xxx				xxxx	xxxx		
Butter Clams	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Crab:												
King Crab	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Tanner Crab	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Dungeness Crab	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
GAME												
Deer	x???	????	????	????	????	????	????	xxxx	xxxx	xxxx	xxxx	xxxx
Hare	xxxx	xxxx	xxxx							xxxx	xxxx	xxxx
Ptarmigan	xxxx	xxxx	xxxx							xxxx	xxxx	xxxx
Ducks	xxxx	xxxx	xxxx	xxxx	xxxx				xxxx	xxxx	xxxx	xxxx
Geese				xxxx	xxxx			xx	xxxx	xx		
Harbor Seal	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Sea Lion	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.

1. Each "x" represents one quarter of a month.
2. An "x" means that named species are typically harvested during indicated time period.
3. The symbol "?" means that harvest during indicated time period has not been documented but may occur.
4. Refer to Tables 2 to 5 for magnitude of harvest and use.
5. Seasonal round data for other species is on file with the Subsistence Division, ADF&G.

Source: 1983 Field Interviews, Subsistence Division, Alaska Department of Fish and Game.

Figure 7-8

SEASONAL ROUND OF RESOURCE HARVESTS: PORT LIONS 1982-1983[1,2,3,4,5]

SPECIES	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
FISH												
Red Salmon					xxxx	xxxx	xxxx	xxxx	xx			
King Salmon				xx	xxxx	xxxx	xxxx	xxxx	xx			
Silver Salmon								xxx	xxxx	xxxx	xxxx	
Pink Salmon						xx	xxxx	xxxx				
Chum Salmon						xx	xxxx	xxxx	xx			
Halibut	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Dolly Varden				xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xx	
Steelhead (Rainbow)						xx	xxxx	xxxx	xx			
Butter Clams	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Crab:												
King Crab	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Tanner Crab	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Dungeness Crab	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
GAME												
Deer	xxxx							xxxx	xxxx	xxxx	xxxx	xxxx
Hare	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Ptarmigan	xxxx	xxxx									xxxx	xxxx
Ducks	xxxx	xxxx	xxxx							xxxx	xxxx	xxxx
Geese				xxxx	xxxx				xxxx	xxxx		
Harbor Seal	xxxx	xxxx	xxxx	xxxx				xxxx	xxxx	xxxx	xxxx	xxxx
Sea Lion	xxxx	xxxx	xxxx	xxxx				xxxx	xxxx	xxxx	xxxx	xxxx
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.

1. Each "x" represents one quarter of a month.
2. An "x" means that named species are typically harvested during indicated time period.
3. The symbol "?" means that harvest during indicated time period has not been documented but may occur.
4. Refer to Tables 2 to 5 for magnitude of harvest and use.
5. Seasonal round data for other species is on file with the Subsistence Division, ADF&G.

Source: 1983 Field Interviews, Subsistence Division, Alaska Department of Fish and Game.

August through March, although some level of harvest occurs year-round. Marine mammals, other fish, and invertebrates are harvested year-round.

Old Harbor: Old Harbor residents consume an average of 463.9 pounds of subsistence foods per capita per year. Salmon are the most heavily harvested species (45 percent), followed by game (18 percent), marine mammals (16 percent), other fish (14 percent), and marine invertebrates (7 percent). Salmon are harvested from May through January, and halibut from May through September. Game resources are harvested primarily from August through March. Marine mammals, other fish, crabs and clams are harvested year-round.

Ouzinkie: Mean household consumption per capita per year of subsistence resources was 358.2 pounds in 1982-83. Ouzinkie residents harvest salmon most heavily (44 percent), followed by game (19 percent), other fish (15 percent), marine invertebrates (14 percent), and marine mammals (8 percent). Sockeye salmon are harvested during May and June; other salmon are harvested between July and November. Game is harvested primarily from August through May. Marine mammals, other fish, and marine invertebrates are harvested throughout the year.

Port Lions: Port Lions households harvested per capita an average of 262.4 pounds of subsistence foods. Halibut and other fish are the most heavily harvested on (34 percent), followed closely by salmon (33 percent), game (16 percent), marine invertebrates (14 percent) and marine mammals (3 percent). Salmon are harvested primarily from mid-April through November; other fish and marine invertebrates are harvested year around. Various types of game are harvested throughout the year, although activities are concentrated between August and February. Marine mammals are harvested from August through April.

Kodiak Road System: Residents of the City of Kodiak and its road system areas also utilize subsistence resources. Per capita consumption by weight of harvest averaged 143.1 pounds over the 1982-83 survey period, with the Chiniak area showing a slightly higher rate of consumption. Harvest of resources varied by survey groups (Coast Guard, Chiniak, Filipino, and

Native). Salmon (28 percent) and other fish (45 percent) are the most heavily harvested subsistence resources, followed by game, marine invertebrates and marine mammals. While no data on seasonal harvest characteristics are available, they are likely to be similar to the village seasonal patterns.

7.3.3 Economic and Sociocultural Contributions

Subsistence resources contribute to both the economic and sociocultural characteristics of the Borough. Subsistence functions in close relationship with the cash economy, especially commercial fishing. Households often combine these activities. Subsistence is the most reliable and consistence economic activity that takes place in the community. It is particularly important in the rural and village areas, where employment and other opportunities for cash income are limited. During poor commercial fishing seasons and other times of uncertain income, subsistence resources became even more important to local food and cash needs. The wide distribution of resources throughout the community spreads the economic benefits. For example, 85 percent of the households in Karluk gave game harvested to other households in their community. Pursuit of subsistence activities costs money; cash outlays may be major expenses in household budgets. However, there appears to be little correlation between income level and utilization of subsistence resources.

Subsistence resource distribution illustrates the sociocultural importance. Traditional village societies center on subsistence. Personal identity, family, and social status is tied to the harvest and sharing of subsistence resources. Parents take pride in providing for their families, and children grow up learning subsistence skills and the values of coopertion and sharing. Distribution and exchange provides social support and assistance to certain segments of the community, particularly the elderly and needy. Impacts to subsistence activities can also impact these values. Disruptions in hunting and fishing is likely to have profound psychological consequences for people who measure worth by their ability to provide their families and community with subsistence foods.

7.3.4 Sensitivity to Oil Pollution

Subsistence resources and harvest activities are sensitive to oil pollution in several ways. The fish and game harvested are sensitive to oil pollution during certain stages of their life history; these sensitivities are discussed in Chapter 6. An oil spill can interfere with or prevent subsistence harvest activities by scaring off resources (through the spill or cleanup and containment activities) or injury to resources, and by preventing access. The severity of such impacts depend on how widely the oil and the resource is distributed, the seasonal availability of the resource, and how heavily a village relies on a particular resource. Fouling of gear is another area of sensitivity. Oil pollution can foul nets, longlines, crab pots, and equipment used for transportation to harvest sites, such as boats and three-wheelers. The potential for gear fouling may impede subsistence harvests. Resources harvested during or after a spill can be tainted, making them inedible or undesirable.

Economic and cultural sensitivity are important considerations. Loss of subsistence harvests, particularly those that are heavily relied upon or are relatively inexpensive to harvest, require replacement by other resources or by cash. Cash diversion for subsistence relacement is a concern, particularly during poor fishing years. Given the high rate of subsistence distribution within the communities, a loss in resources can impact large segments of the community, particularly the elderly. Culturally, the loss of subsistence foods and activities can lead to depression or frustration by disrupting social roles and sharing patterns.

7.4 RECREATION

Recreation activities are important to Borough residents and visitors from outside the Borough. Recreation contributes to the local economy, benefitting merchants, lodge owners, guides and air taxi operators. The majority of activities closely follow sport hunting and fishing seasons, which occur from May through December. However, activities such as boating,

hiking, photography, and viewing fish and wildlife resources are also important. In addition to fish and wildlife and scenery, recreation resources include state and local parks, and cabin facilities on the Kodiak National Wildlife Refuge.

7.4.1 Fish and Wildlife Resources

There are five major categories of fish and wildlife resources important to coastal recreation: fish, brown bear, deer, elk, and waterfowl.

Fish: Sportfishing is one of the most important recreation resource in the Kodiak Island Borough. Five species of salmon are harvested by rod and reel, primarily along the road system and in adjacent nearshore waters. Some fishing occurs at other locations, often in conjunction with deer and elk hunting. Fishing occurs from May through November. Steelhead are also popular sportfish. Steelhead are fished primarily in the spring and fall, depending on the timing of fish runs. The Karluk, Ayakulik, and Buskin Rivers are important rivers; the Uganik River and other west side streams are also fished. Access to fishing areas is by road, boat, and plane.

Brown Bear: Brown bear are the most famous of Kodiak Island recreational hunting resources. Bears are hunted during April and May and in the fall from late October through November. Access to bear hunting areas is by road, boat, and plane.

Deer: In recent years, deer have been increasing in popularity as a recreation resource. Deer are hunted intensively along the road system along the west side of Kodiak Island, and on Afognak Island, between August 1st and December 31st. However, snow fall at higher elevations drives deer down to coastal areas, starting in late October, where hunting occurs along the shoreline and adjacent inland areas. Access to deer hunting areas is by road, boat and plane.

Elk: Afognak Island is the site of the only elk herd in Alaska. Hunting occurs during the fall months of September, October, and November.

Much of the hunting is conducted from recreation cabins on federal and Native lands; access to hunting areas is by boat and plane.

Waterfowl: More than any other fish and wildlife resources, waterfowl are hunted recreationally primarily by local residents. Hunting occurs along the shoreline, heads of bays and in coastal wetlands, during the fall months (September, October and November). Access to hunting areas is primarily by road and boat.

7.4.2 Parks and Facilities:

There are four state parks in Kodiak, all adjacent to the shoreline: Ft. Abercrombie, Pasagshak Bay, Shuyak Island and Buskin River State Parks. Ft. Abercrombie is a historical park located due north of the City of Kodiak. Camping, picnics, and sightseeing are the primary activities. Pasagshak Bay State Park is also located along the Kodiak road system, southwest of the City of Kodiak on Ugak Bay. This park is extremely popular with local residents for salmon fishing, waterfowl hunting, camping, and picnicking. Deer hunting also occurs in the State Park. Shuyak Bay State Park is a wilderness park that encompasses much of Shuyak Island. It is used primarily for wilderness boating and deer hunting.

The Kodiak National Wildlife Refuge is a major recreational resource and includes large portions of Afognak and Kodiak Islands. The U.S. Fish and Wildlife Service maintains 9 cabins for public use within the refuge on Kodiak Island. These facilities are intensively utilized during deer and bear hunting seasons and or for fishing. Access is by float plane and boat.

Other recreation facilities are located on private and Native lands. Private cabins and camps are maintained by hunting guides and air taxi operators. Lodges are located at Port Lions, Karluk Lagoon, and Seal Bay. The Karluk River and other popular recreation areas are located on Native lands. The Karluk River Lagoon is an extrememely popular steelhead and salmon fishing area.

7.4.3 Sensitivity to Oil Spills

Recreation Resources: The fish and wildlife resources important to recreation are sensitive to oil pollution (Chapter 5). Activities such as fishing and hunting can also be affected by spills and cleanup activities. Finally, the presence of oil and cleanup equipment can diminish the quality of recreation resources.

Of all the fish and wildlife resources harvested for recreation, fish are the most sensitive. Salmon fishing takes place in bays, estuaries, lagoons and outer coastal waters in relatively shallow water. These are areas where oil may be retained for long periods of time. The presence of oil may cause salmon and steelhead to avoid the spill area, or it may deter fishing efforts and foul fishing gear.

Bears whose coats have been oiled may be less desirable to hunt; the same may be true of elk and deer. In addition to their biological sensitivity, waterfowl may avoid oiled shoreline areas, decreasing their availability for hunting. Because most of the hunting takes place in tide flats and coastal wetlands, this impact could be significant. Also, oiled waterfowl are not desirable for hunting. Spill containment and clean up activities can interfere with hunting and fishing by driving off fish and wildlife and preventing access to use areas.

Recreation Use Areas: Table 7-5 presents the coastal recreation use areas of major importance to Borough residents. These areas are reflected on the sensitivity maps (Chapter 3). Recreation use areas are sensitive to oil contamination in three ways: damage to fish and wildlife resources, prevention of access and recreation uses, and aesthetic impacts. The severity of sensitivity of recreation areas to oil spill contamination is also influenced by how long oil can persist in the environment.

7.5 COMMUNITY INFRASTRUCTURE

All of the Kodiak Island Borough communities are coastally oriented. Residences, commercial facilities, boat harbors, docks, and other important

Table 7-5: Major Coastal Recreation Areas in the Kodiak Island Borough

AREA	RECREATION VALUE	PRIMARY USERS
Monashka Creek	Fishing, Picnics, Scenic Value	Road System Residents
Pillar Creek	Fishing, Picnics, Scenic Value	Road System Residents
Fort Abercrombie	State Park, Historical Resources, Camping, Hiking Picnics, Scenic Value	Road System Residents, Visitors
Gibson Cove	Scenic Value	Road System Residents, Visitors
Buskin River and Beach	State Park, Fishing, Picnics, Boating	Road System Residents, Visitors
Woody/Long Islands	Boating, Scenic Value	Road System Residents
Middle/Kalsin/ Isthmus Bays	Fishing, Clamming, Waterfowl Hunting, Scenic Value	Road System Residents, Visitors
Cape Chiniak/Narrow Cape	Hunting, Fishing, Picnics, Scenic Value	Road System Residents
Pasagshak Bay	State Park, Fishing, Hunting, Picnics, Scenic Value	Road System Residents Visitors
Saltery Cove	Fishing, Hunting, Scenic Value	Road System Residents
Hidden Basin	Hunting, Boating, Scenic Value	Road System Residents
Dry Spruce Bay	Boating, Fishing, Camping	Road System Residents, Port Lions Residents
Barbara Cove	Fishing, Boating	Road System Residents, Port Lions Residents
Kizhuyak Bay	Boating, Hunting, Fishing, Scenic Value	Road System Residents, Port Lions Residents
Anton Larsen Bay	Boating, Fishing, Hunting, Scenic Value	Road System Residents
Icon Bay	Fishing, Boating, Picnics	Ouzinkie Residents

Table 7-5: Major Coastal Recreation Areas in the Kodiak Island Borough (Continued)

AREA	RECREATION VALUE	PRIMARY USERS
Boulder Bay	Boating, Fishing, Picnics Beachcombing	Old Harbor Residents
Shearwater Bay	Hunting, Clamming, Beach-combing, Recreation Cabin	Old Harbor Residents
Midway Bay	Fishing, Clamming, Hunting, Berry Picking	Old Harbor Residents
Barling Bay	Hunting, Fishing, Boating Camping	Old Harbor Residents, Visitors
Three Saints Bay	Hunting, Fishing, Boating Camping	Old Harbor Residents, Visitors
Ocean/Rolling Bays	Fishing, Clamming, Hunting, Camping, Beachcombing, Scenic Value	Old Harbor Residents, Visitors
Kiavik Bay	Fishing, Hunting (Guide Camp), Scenic Value	Old Harbor Residents, Visitors
Russian Harbor	Hunting, Fishing, Camping	Old Harbor, Akhiok Residents
Drake Head	Hunting, Fishing, Picnics, Camping	Akhiok Residents
Halibut Bay	Hunting, Fishing	Karluk Residents, Visitors
Karluk Lagoon	Fishing, Boating	Karluk Residents, Visitors
Uyak Bay	Hunting (Guide Camp), Fishing	Visitors
Chief Point and Cove	Hunting, Camping	Larsen Bay Residents Visitors
Tonki Bay/ Pillar Cape	Fishing, Hunting, Camping (Public Cabin)	Visitors
Kitoi Bay	Boating, Fishing, Picnics, Hunting	Visitors
Duck Bay	Boating, Fishing, Hunting	Road System Residents, Visitors

Table 7-5: Major Coastal Recreation Areas in the Kodiak Island Borough (Continued)

AREA	RECREATION VALUE	PRIMARY USERS
Kazakof Bay	Hunting, Fishing, Boating	Port Lions, Road System Residents
Afognak Bay	Hunting, Fishing, Boating Camping, Scenic Value	Port Lions Residents, Visitors
The Slough	Boating, Hunting, Scenic Value, Picnics	Port Lions Residents, Road System Residents
Onion Bay	Hunting, Boating, Camping, Clamming, Scenic Value	Port Lions Residents, Ouzinkie Residents
Paramanof Bay	Hunting, Camping	Borough Residents, Visitors
Devils Inlet	Hunting, Scenic Value	Borough Residents
Shuyak Island	State Park, Hunting, Boating, Camping	Borough Residents, Visitors
Little Waterfowl Bay	Hunting, Scenic Value	Borough Residents, Visitors
Seal Bay	Fishing, Hunting (Commercial Lodge) Scenic Value	Borough Residents, Visitors
Tonki Cape	Hunting, Scenic Value	Borough Residents, Visitors

infrastructure are located on the shoreline and can be exposed to, or be the source of, oil spills. An oil spill can damage equipment and property. The presence of a spill can also prevent use of facilities and create safety hazards.

7.5.1 Transportation Facilities

Boat Harbors: As center of the community, boat harbors support fishing and other economic activities. Boats and gear are valuable pieces of property. Access to harbors is particulary important during commercial fishing openings. Boat harbors are occasionally the source of the spills; spilled petroleum products can be hazardous in a closed harbor. Kodiak, Old Harbor, Port Lions, Larsen Bay, and Ouzinkie have boat harbors; boats are beached or moored offshore in Karluk and Akhiok.

Docks: Municipality or privately owned docks are used for loading or unloading supplies, fuel, water, fish and passengers. Docks can be rendered unusable during oil spills, decreasing their availability. Damage to the structure itself may occur as a result of the spill and cleanup efforts. Major dock facilities are located in Kodiak (City Dock, SeaLand Service Dock, Ferry Terminal, Chevron Dock and various cannery docks), Womens Bay (Coast Guard and National Marine Fisheries Service), Old Harbor (State-owned pier), Larsen Bay (KISI Dock), Ouzinkie (Ouzinkie Village Corporation), and Port Lions (City Dock).

Other Transportation: Coastal waters and shorelines are relied on as transportation routes to a certain extent. For example, float planes flying into Ouzinkie, Karluk, and Port Lions use coastal waters. Residents of Karluk and Akhiok use the shoreline to travel to and from subsistence use areas via "three-wheelers."

7.5.2 Residential and Commercial Property

Many of the communities have residences and commercial facilities located on the shoreline. Kodiak, Karluk, Port Lions and Ouzinkie have

property that is particularly susceptible to oiling during high tide. Canneries and their importance are discussed in subsection 6.2.

7.5.3 Sensitivity to Oil Spills

Community infrastructure is sensitive primarily due to property damage, interference with access and safety hazards. Oiling from a petroleum product spill can cause damage to real property (i.e. land and facilities) and personal property (boats, fishing gear). Although oil can be removed, there are costs and potential damage often associated with removal. In the case of boats and gear, oiling can represent lost economic opportunity if it prevents fishing activities during open periods. Interference with access to boat harbors, and docks can occur from the presence of a petroleum spill or from cleanup activities. Interference can mean loss of revenues (i.e. lost fishing opportunities, docking fees) and disruption of supply or fish delivery. Finally, a petroleum spill can represent a safety hazard, particularly to boat harbors and docks. The degree of hazard depends on the nature of the spilled product and how volatile it is. A fresh spill of refined products can be highly flammable and easily ignited (Chapter 3).

7.6 ARCHAEOLOGICAL, HISTORICAL, AND CULTURAL RESOURCES

7.6.1 Introduction

The Kodiak Island Borough is rich in archaeological, historical, and cultural resources. Prehistoric and historic residents of Kodiak lived along the coastline, using the abundant fish and wildlife resources. Prior to Russian discovery and occupation, Native settlements were transitory, moving in response to the availability of resources. As a result, archaeological and traditional use resource sites are fairly well distributed along the coastline, but are concentrated along major bays and fish streams. The study area contains numerous historical sites, associated with Russian occupation, pre-transition under American governance, and defense facilities built during World War II. Nearly all of these are located within or adjacent to the City of Kodiak. A map showing the general location of cultural resources can be found in the Kodiak Coastal Management Program.

7.6.2 Cultural Resource Status

Cultural resources have varying degrees of protection under state and federal laws. There are three designations of cultural resources: sites on or eligible for inclusion on the National Register of Historic Places, sites selected under Section 14(h)(1) of the Alaska Native Claims Settlement Act (ANCSA) of 1971, and sites listed on the Alaska Heritage Resource Survey (AHRS). All of the National Register and Section 14(h)(1) sites are included within the AHRS files.

National Register of Historic Places: National Register sites are protected under federal law, which prohibits disturbance of these sites. Of the seven National Register sites within the study area, four are located on the immediate coastline: the Russian Kiln site on Long Island, Fort Abercrombie State Historic site, Three Saints Bay, and the Middle Bay Russian Kiln site. The characteristics of these sites are shown in Table 7-6.

ANCSA 14(h)(1) Sites: Under Section 14(h)(1) of the ANCSA, each regional Native Corporation can apply for the conveyance of historic and cemetary sites. Koniag Inc. has applied for several sites, some of which may be considered eligible for inclusion on the National Register of Historic Places. Sites are often traditional use sites of importance to village residents.

Alaska Heritage Resource Survey Sites: Alaska Heritage Resource Survey files are maintained by the State Historic Preservation Officer in the Alaska Department of Natural Resources. Each site is assigned a identifier number, and files contain specific information on location and site characteristics. Under State law, any disturbance of an AHRS site requires a permit, and must be supervised by an approved archaeologist.

Table 7-6: Sites On or Eligible for Inclusion on the National Register of Historic Places

AHRS Site Kod 207

The Russian Kiln Site is located on Long Island off the east shore of Kodiak Island. This is one of the few historic sites associated with brickmaking, which was a subsidiary industry of the Russian American Company. The 3,000 to 6,000 bricks that were produced annually were used as ballast in the company's ships, in the construction of stoves to heat employee quarters, and in bathhouses. The quantity of bricks produced would have been considerably larger if more lime had been available; as it was, the industry relied on burned sea shells as its source for this necessary ingredient. This site is considered to be signficant for its contribution to the industrial history of Alaska.

AHRS Site Kod 137

Fort Abercrombie State Historic Site is located on Kodiak Island approximately five miles north of the City of Kodiak. The site is strategically located atop a high headland, and commands a view of the surrounding straits and bays. A natural camouflage is provided by the dense, mature spruce stands in which the site is located. It is representative of north Pacific coast defense installations of the type operative during World War II. The area was withdrawn as a military reservation in 1941 but remained operational until 1945. The fort was named in honor of Lieutenant William H. Abercrombie, who was a noted explorer in Alaska in the late nineteenth century.

AHRS Site Kod 011

This site, located on the southeastern shoreline of Middle Bay, may be the site of a colonial Russian brick kiln. Test excavations have uncovered a portion of a brick platform, remnants of two brick walls, and a small standing brick arch. The site has been affected by erosion, and by people who have collected the bricks.

The structural remains uncovered at the KOD-011 site may represent an important subsidiary industry of Russian America. These features currently suggest that the site may have been the location of a type of kiln in general use for thousands of years, a type that might have been feasible for use by Russian colonists in America. The Kodiak-011 Site may have enormous potential for increasing our understanding of Russian colonial brickmaking operations in the Western Hemisphere.

AHRS Site Kod 124

The Three Saints Site is located on the southeastern shore of Kodiak Island on the western shore of Three Saints Bay. It is a multi-component site, consisting of a prehistoric occupation dating from 0-900 A.D., followed by a historic occupation beginning in the 1700s. Excavation and analysis of the prehistoric site provided the basis for the definition of the Three Saints Bay Phase of the Kachemak Bay Tradition in Kodiak prehistory. In 1784, the first Russian colony in America was established at Three Saints Bay and for eight years the colony served as the headquarters of the Shelikhof-Golikof Fur Company.

7.6.3 Sensitivity to Oil Spill

Oil spills can affect cultural resources in two ways: oil damage to the site and specific artifacts, and damage to the site or artifacts from clean-up activities.

Oil Contamination: Actual oil contamination of a cultural resource site can cause several problems. Oiling of specific artifacts can lessen their interpretive and real value. Contamination of a site could also hinder future investigations to determine the significance of the site. Other impacts include reduction of the aesthetic value of a site and desecration of a site of cultural importance to Native residents.

Cleanup Activities: Activities associated with cleanup of an oil spill can cause severe damage to cultural resource sites and artifacts. The three sources of damage are traffic on the shoreline in support of spill cleanup, removal of oil and oiled sediments, and vandalism from cleanup areas. Much of the value of a cultural resource site is the undisturbed distribution of artifacts, which allow interpretation of the cultural significance of the site. Vehicle traffic through a site can damage both artifacts and their distribution. The impact of oil or sediment removal is similar but potentially more severe, since it removes a greater amount of material. This could damage artifacts lying beneath the surface, in addition to those on the surface. Finally, vandalism and pilfering could result from a cleanup operation that is not properly supervised. Removal of artifacts without a permit is prohibited by state law.

If a petroleum product spill occurs in the vicinity of a cultural resource site, it is essential to coordinate response actions with the State Historic Preservation Office and affected landowners and managers. This will assist in selecting actions that will result in the least damage. In some cases, allowing oil to be removed by natural wave and tidal action may be preferable to manual or mechanical cleanup.

7.7 REFERENCES

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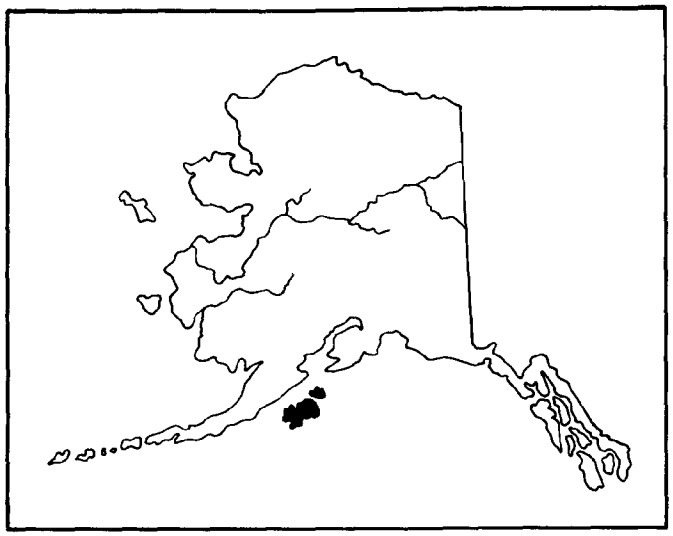


MAP INDEX AND SYMBOLS

10	11	12
17	18	19
25	26	27

SHADED BLOCK SHOWS MAP NUMBER; ADJACENT MAP NUMBERS ARE PROVIDED FOR REFERENCE

SPILL SENSITIVITY[1]

- High Sensitivity to Oil Spills
- Medium Sensitivity to Oil Spills
- Low Sensitivity to Oil Spills

CANNERY/SET NET SITES[2]

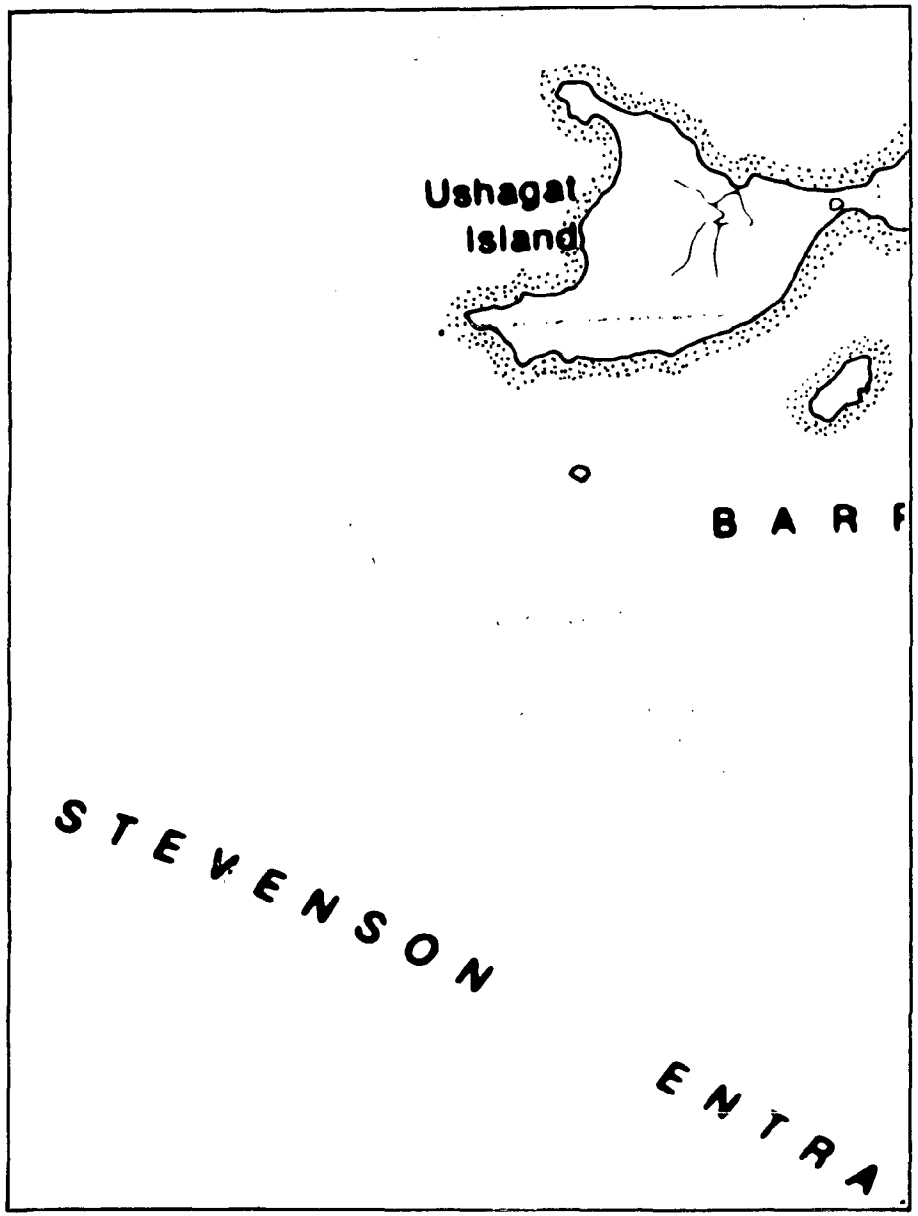
Can-H-1	Cannery
Set-H1	Salmon Set Net Sites

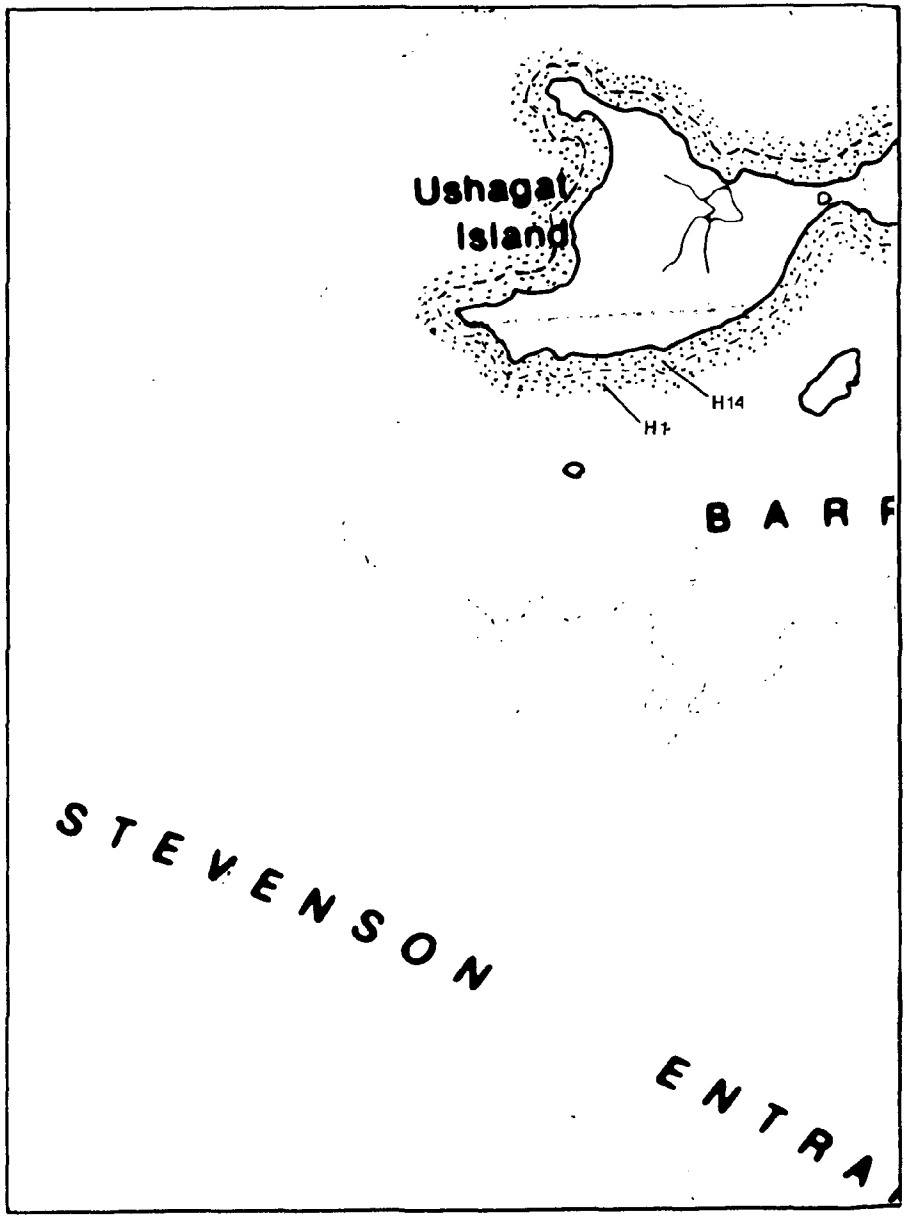
SCALE: 1:100,000

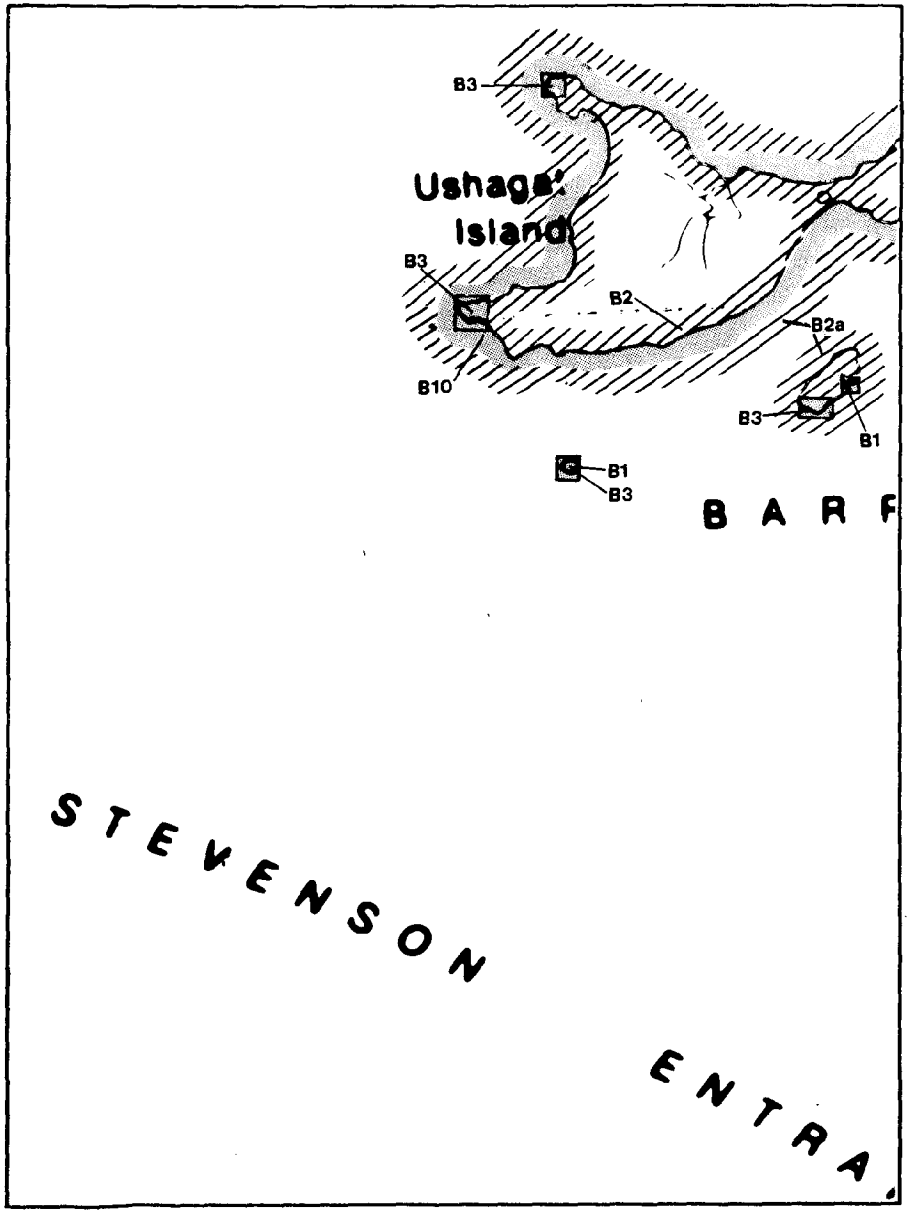
1. Coastal sensitivity rating only applies to oil spills and does not reflect resource value or sensitivity to other disturbance.

2. Seasonal sensitivity is similar to H-1 sensitivity seasonal table.

HIGH MEDIUM LOW

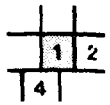


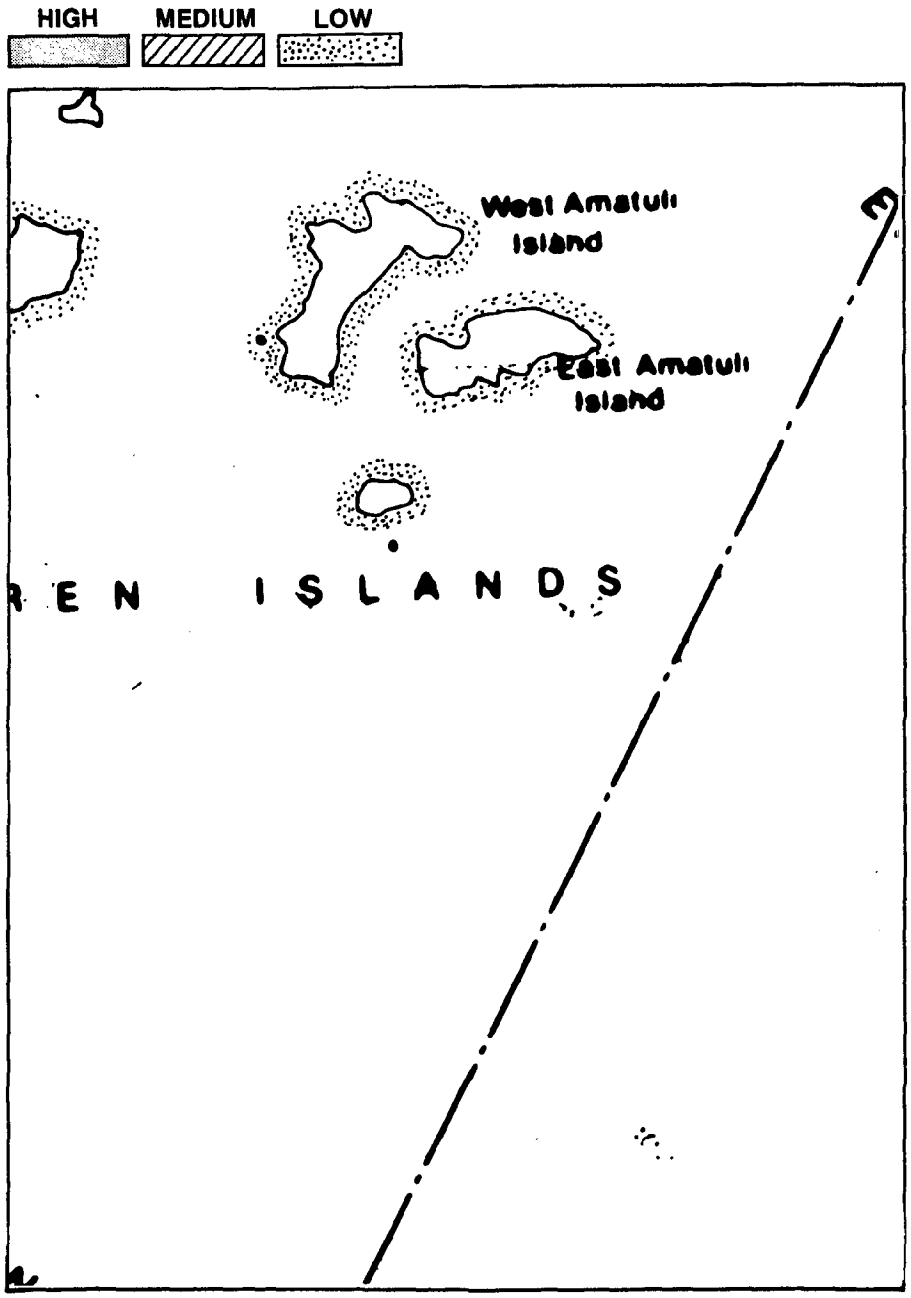


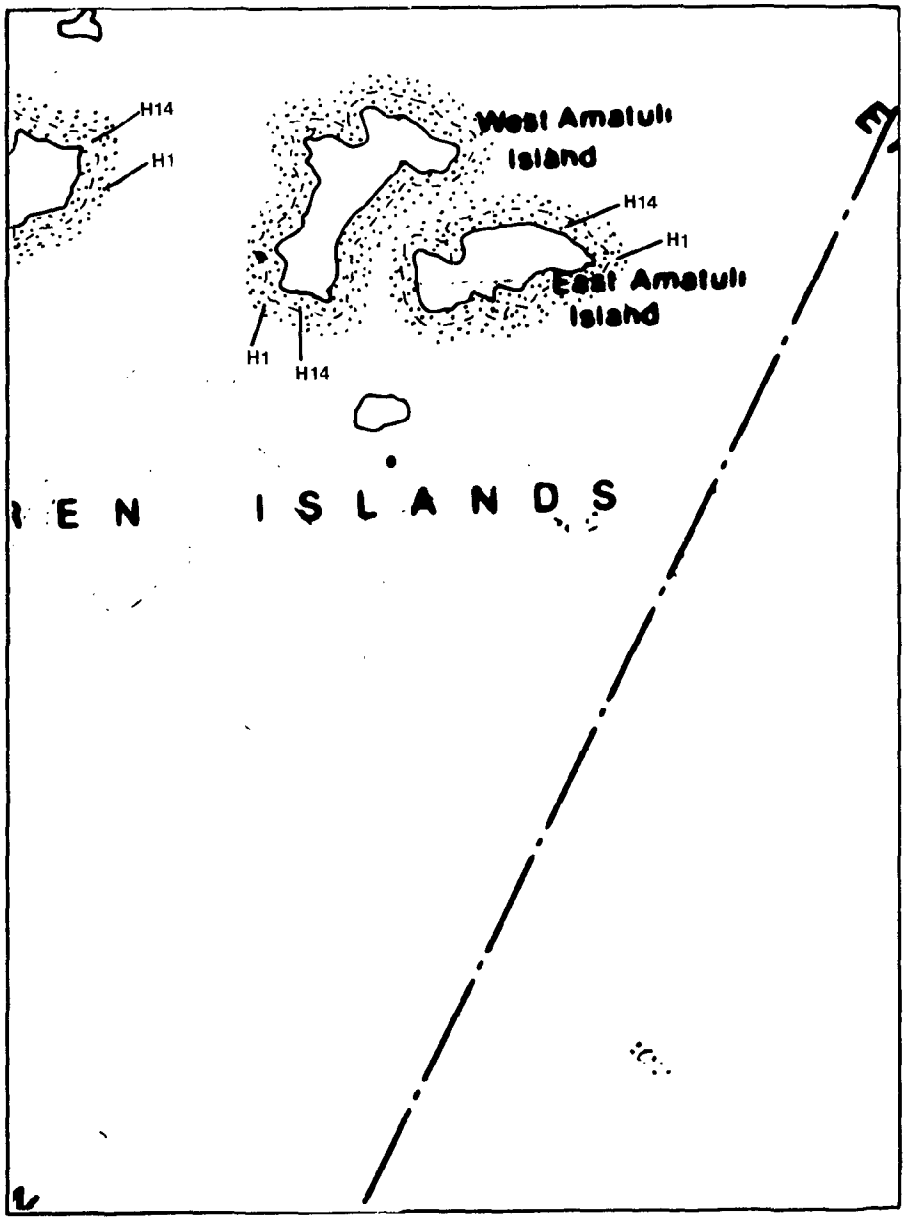


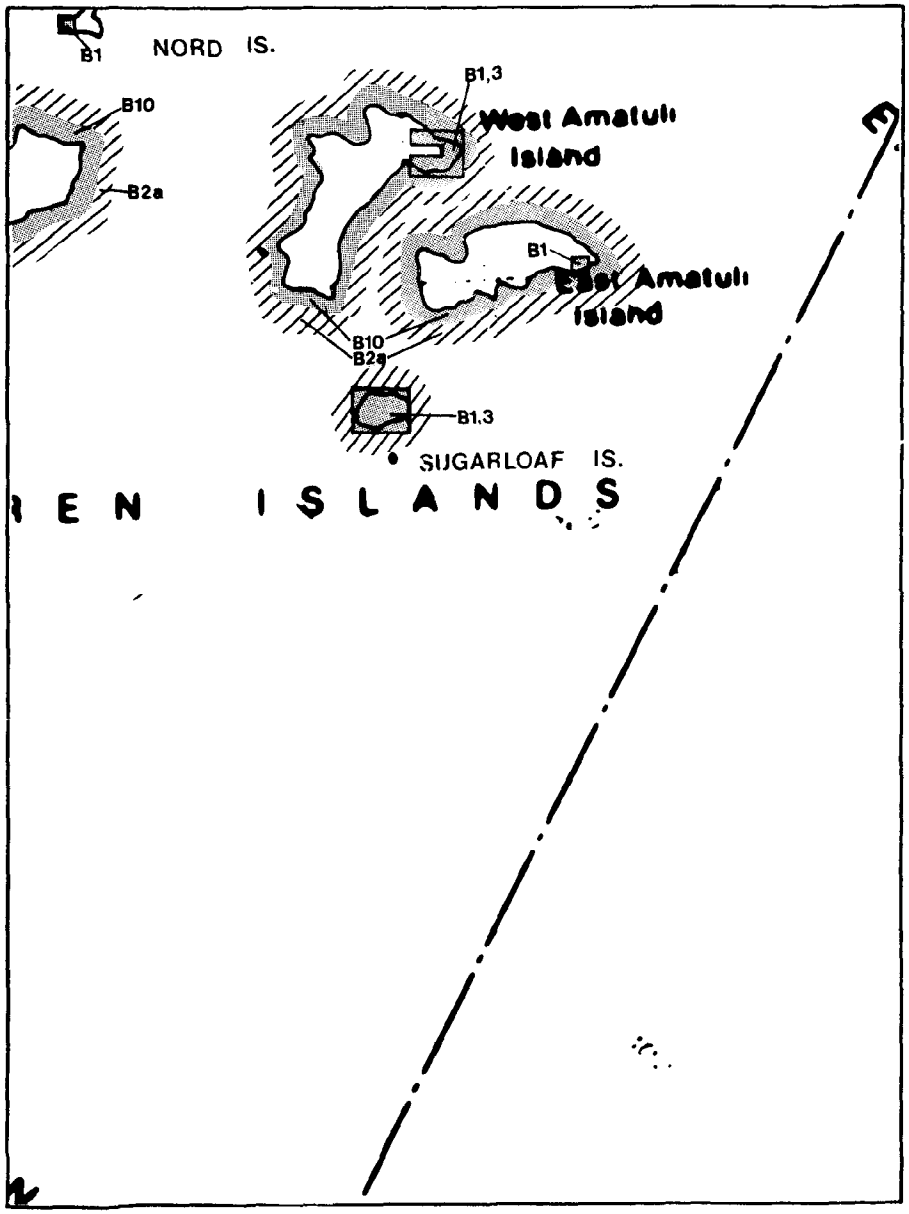
MAP NUMBER 1

RESOURCE	Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE												
R-1 Rocky Headlands	—	—	—	—	—	—	—	—	—	—	—	—
R-2 Wave-Cut Platforms	—	—	—	—	—	—	—	—	—	—	—	—
R-3 Sand Beaches/Exposed Tidal Flats	—	—	—	—	—	—	—	—	—	—	—	—
R-4 Mixed Sand and Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-5 Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-6 Sheltered Rocky and Gravel Shores	—	—	—	—	—	—	—	—	—	—	—	—
R-7 Protected Estuarine Tidal Flats and Marshes	—	—	—	—	—	—	—	—	—	—	—	—
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon												
H-2 Roe Herring												
H-3 Crab	—	—	—	—	—					—	—	—
H-4 Shrimp												
H-5 Halibut												
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer												
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon												
Recreation												
H-14 Recreation Use Area							—	—	—	—		
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony						—	—	—	—			
B-2a Waterfowl (overwintering)	—	—	—	—							—	—
B-2b Waterfowl (summer use)												
B-3 Sea Lion Haul-out	—	—	—	—	—	—	—	—	—	—	—	—
B-4 Black Tail Deer												
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)	—	—	—	—							—	—
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults												
Salmon - Juveniles												
Char/Dolly Varden - Adults												
Char/Dolly Varden - Juveniles												
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area												
B-9 Razor Clam Beach												
B-10 Sea Otters	—	—	—	—	—	—	—	—	—	—	—	—




HIGH
MEDIUM
LOW
West Amatuli Island
East Amatuli Island
EN ISLANDS

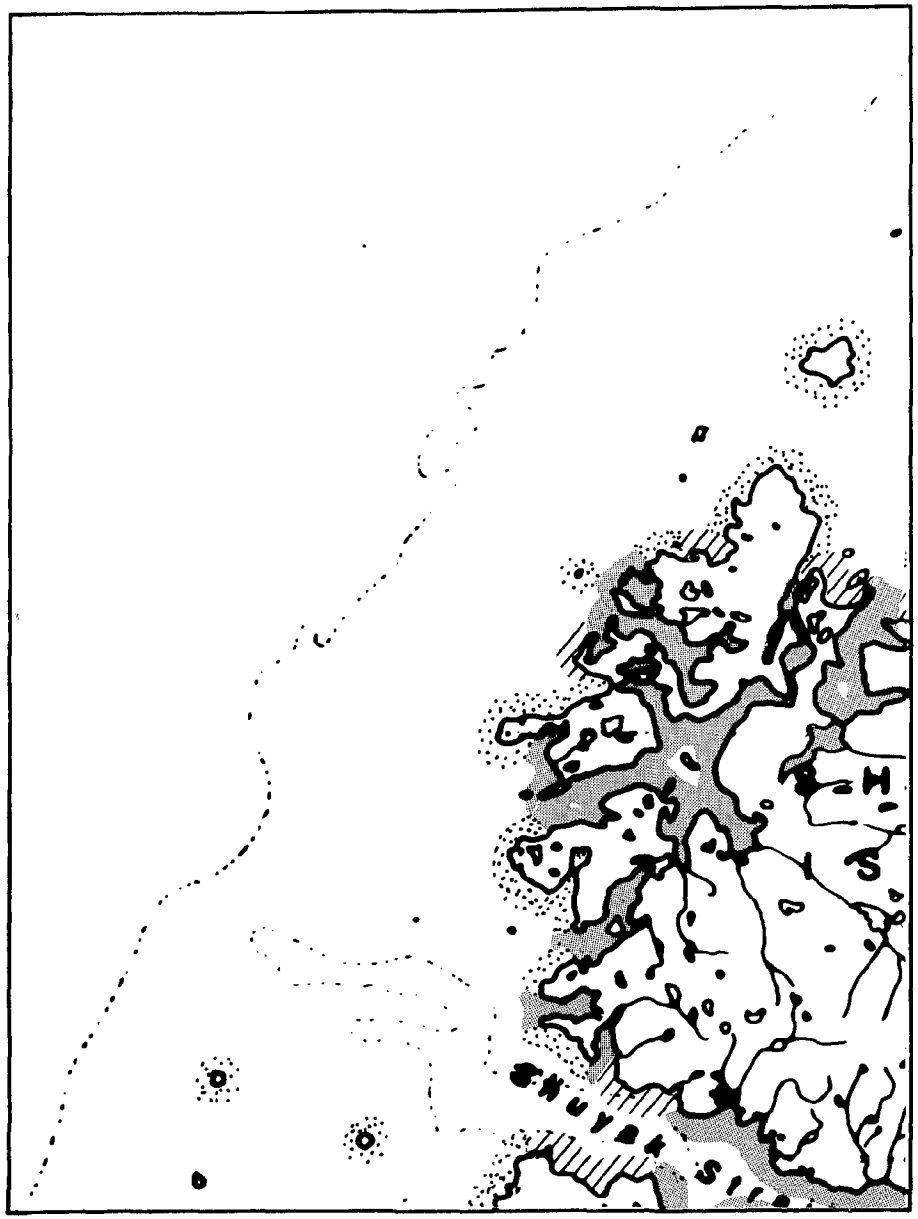

H14
H1
West Amatuli Island
H14
H1
East Amatuli Island
H1
H14
EN ISLANDS

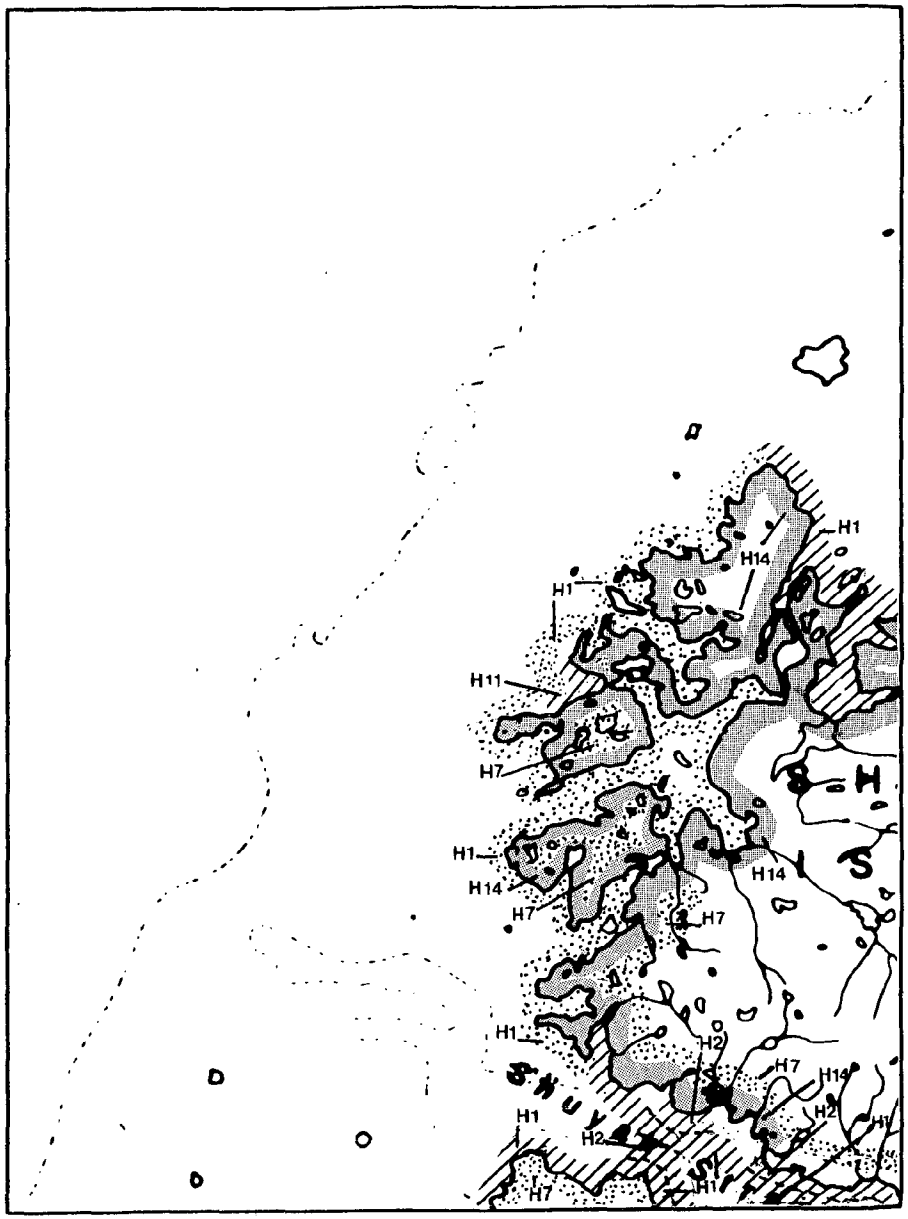


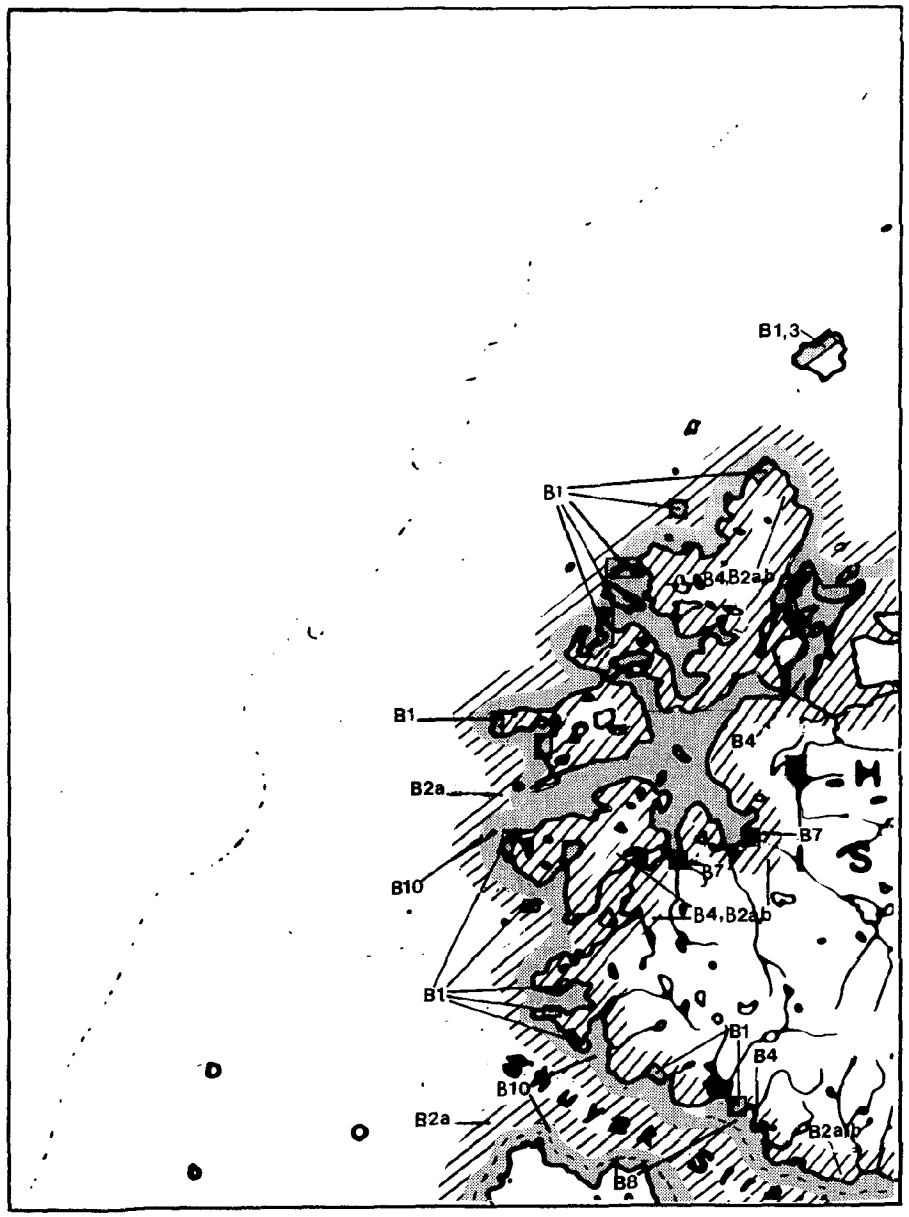
MAP NUMBER 2

RESOURCE		Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE													
R-1	Rocky Headlands	—	—	—	—	—	—	—	—	—	—	—	—
R-2	Wave-Cut Platforms	—	—	—	—	—	—	—	—	—	—	—	—
R-3	Sand Beaches/Exposed Tidal Flats	—	—	—	—	—	—	—	—	—	—	—	—
R-4	Mixed Sand and Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-5	Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-6	Sheltered Rocky and Gravel Shores	—	—	—	—	—	—	—	—	—	—	—	—
R-7	Protected Estuarine Tidal Flats and Marshes	—	—	—	—	—	—	—	—	—	—	—	—
HUMAN USE INDEX													
Commercial Fisheries													
H-1	Salmon												
H-2	Roe Herring												
H-3	Crab	—	—	—	—	—					—	—	—
H-4	Shrimp												
H-5	Halibut												
H-6	Whitefish												
Subsistence													
H-7	Deer/Elk/Reindeer												
H-8	Marine Mammal												
H-9	Crab												
H-10	Waterfowl												
H-11	Clams												
H-12	Halibut/Marine Fish												
H-13	Salmon												
Recreation													
H-14	Recreation Use Area							—	—	—	—		
H-15	Recreation Facility												
Infrastructure													
H-16	Boat Harbor												
H-17	Dock												
H-18	Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX													
Onshore													
B-1	Seabird Colony						—	—	—	—	—		
B-2a	Waterfowl (overwintering)												
B-2b	Waterfowl (summer use)												
B-3	Sea Lion Haul-out	—	—	—	—	—	—	—	—	—	—	—	—
B-4	Black Tail Deer												
B-5	Elk												
B-6	Brown Bear												
Offshore													
B-2a	Waterfowl (overwintering)	—	—	—	—							—	—
B-2b	Waterfowl (summer use)												
B-7	Anadromous Fish Streams												
	Salmon - Adults												
	Salmon - Juveniles												
	Char/Dolly Varden - Adults												
	Char/Dolly Varden - Juveniles												
	Steelhead - Adults												
	Steelhead - Juveniles												
B-8	Herring Spawning Area												
B-9	Razor Clam Beach												
B-10	Sea Otters	—	—	—	—	—	—	—	—	—	—	—	—

HIGH MEDIUM LOW



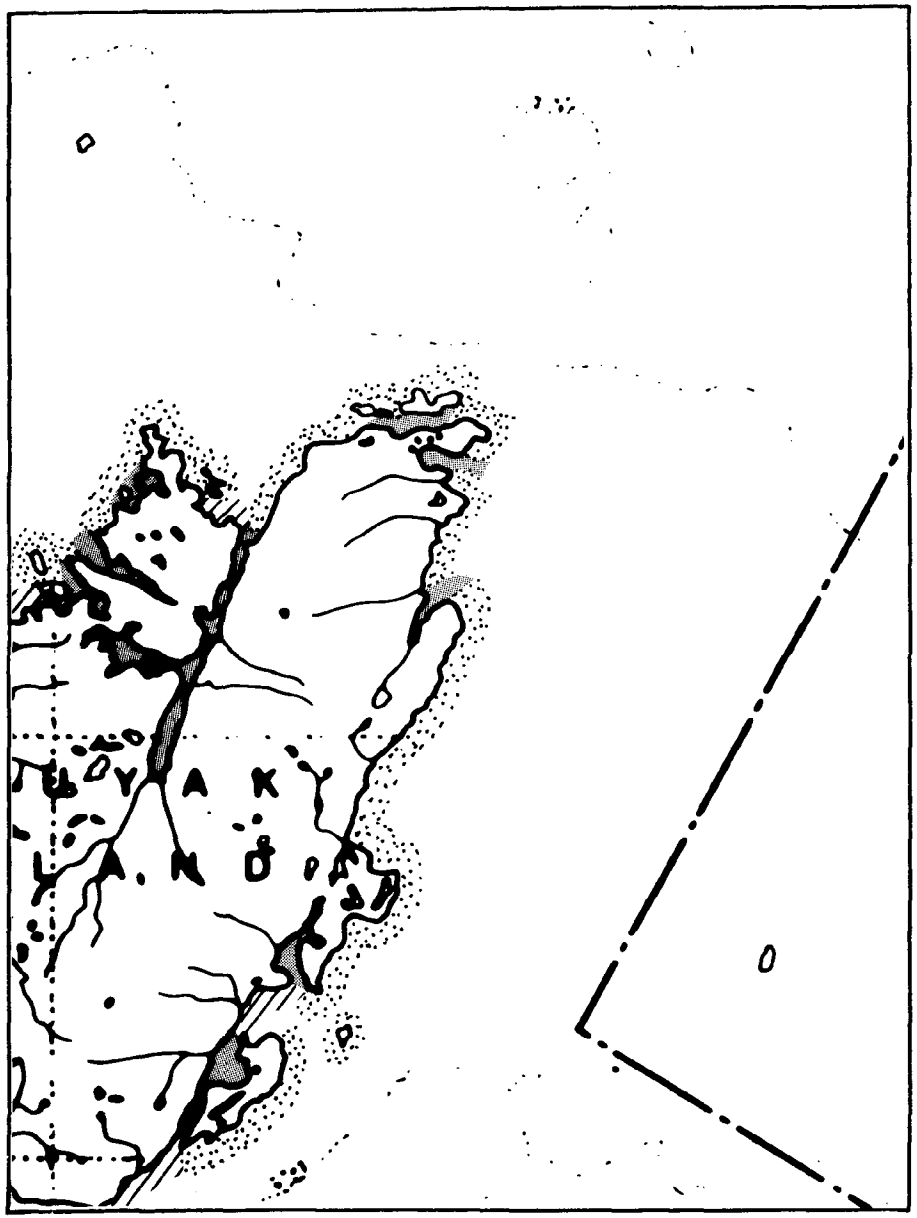


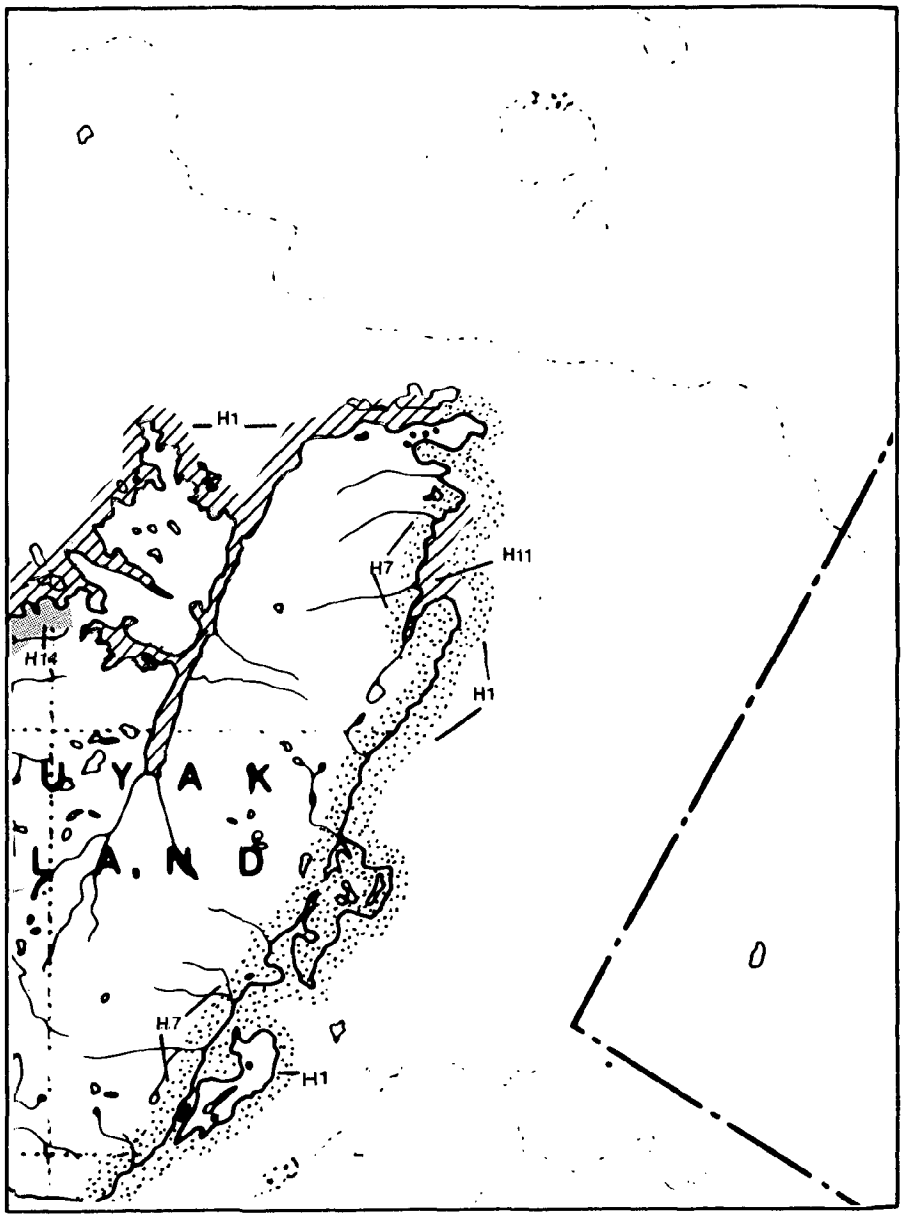


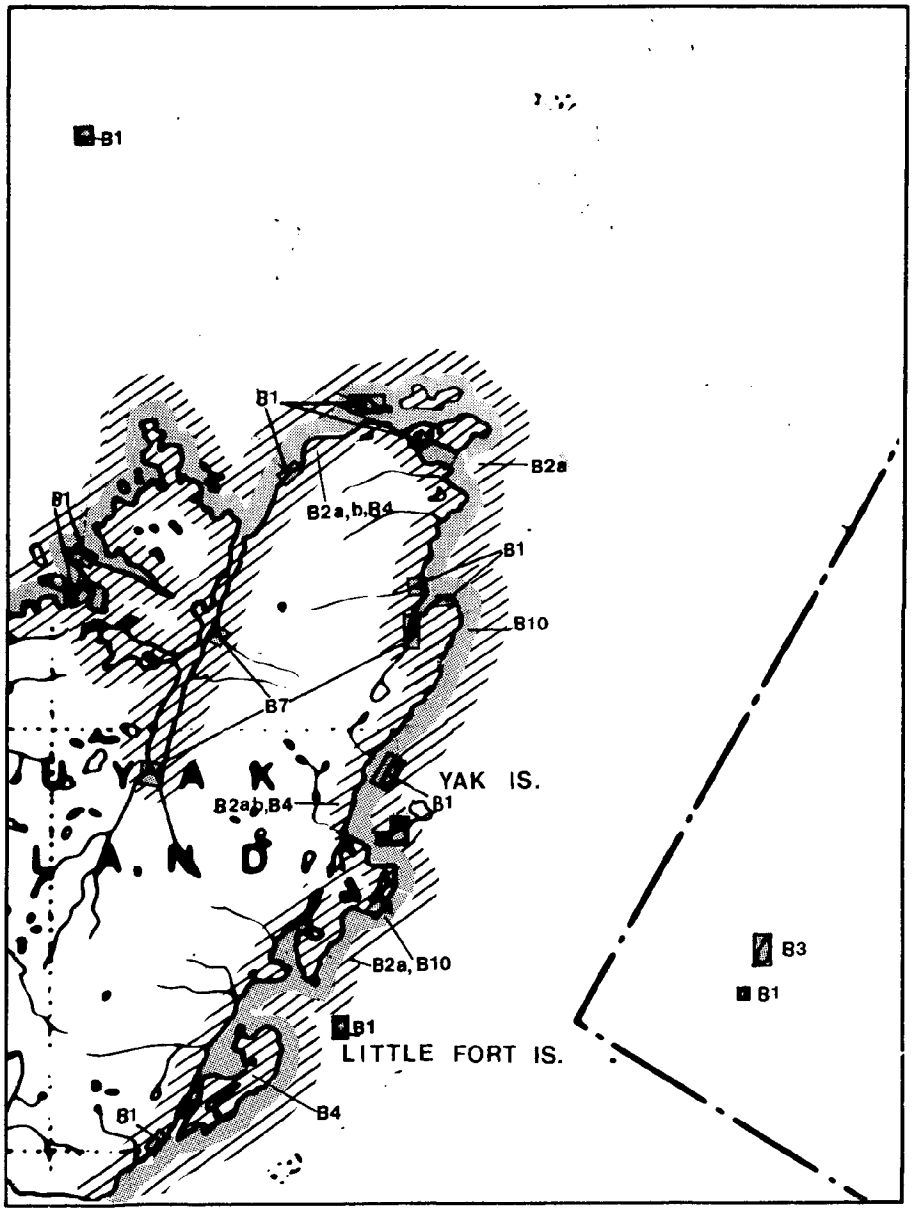
MAP NUMBER 3

RESOURCE	Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE												
R-1 Rocky Headlands	—	—	—	—	—	—	—	—	—	—	—	—
R-2 Wave-Cut Platforms	—	—	—	—	—	—	—	—	—	—	—	—
R-3 Sand Beaches/Exposed Tidal Flats	—	—	—	—	—	—	—	—	—	—	—	—
R-4 Mixed Sand and Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-5 Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-6 Sheltered Rocky and Gravel Shores	—	—	—	—	—	—	—	—	—	—	—	—
R-7 Protected Estuarine Tidal Flats and Marshes	—	—	—	—	—	—	—	—	—	—	—	—
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon							—	—	—	—		
H-2 Roe Herring					—	—	—					
H-3 Crab		—	—	—	—	—	—	—	—	—	—	—
H-4 Shrimp												
H-5 Halibut							—	—				
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer	—											—
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon												
Recreation												
H-14 Recreation Use Area							—	—	—	—		
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony						—	—	—	—			
B-2a Waterfowl (overwintering)	—	—	—	—								—
B-2b Waterfowl (summer use)						—	—	—	—			
B-3 Sea Lion Haul-out	—	—	—	—	—	—	—	—	—	—	—	—
B-4 Black Tail Deer	—	—	—	—								—
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)	—	—	—	—								—
B-2b Waterfowl (summer use)						—	—	—	—			
B-7 Anadromous Fish Streams												
Salmon - Adults						—	—	—	—	—	—	
Salmon - Juveniles		—	—	—	—	—	—	—	—	—	—	—
Char/Dolly Varden - Adults	—							—	—	—	—	—
Char/Dolly Varden - Juveniles							—	—	—	—		
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area					—	—	—					
B-9 Razor Clam Beach												
B-10 Sea Otters	—	—	—	—	—	—	—	—	—	—	—	—

HIGH MEDIUM LOW

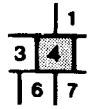




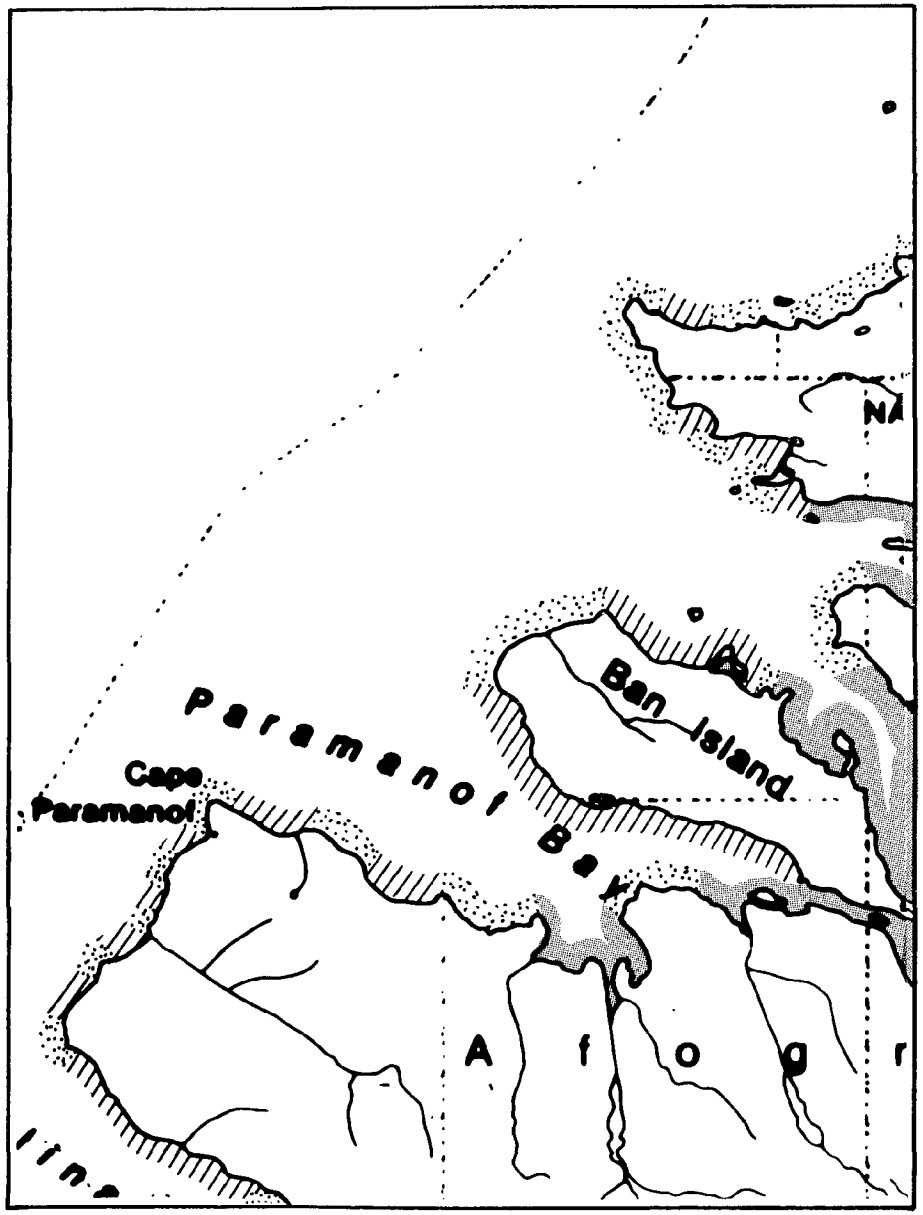


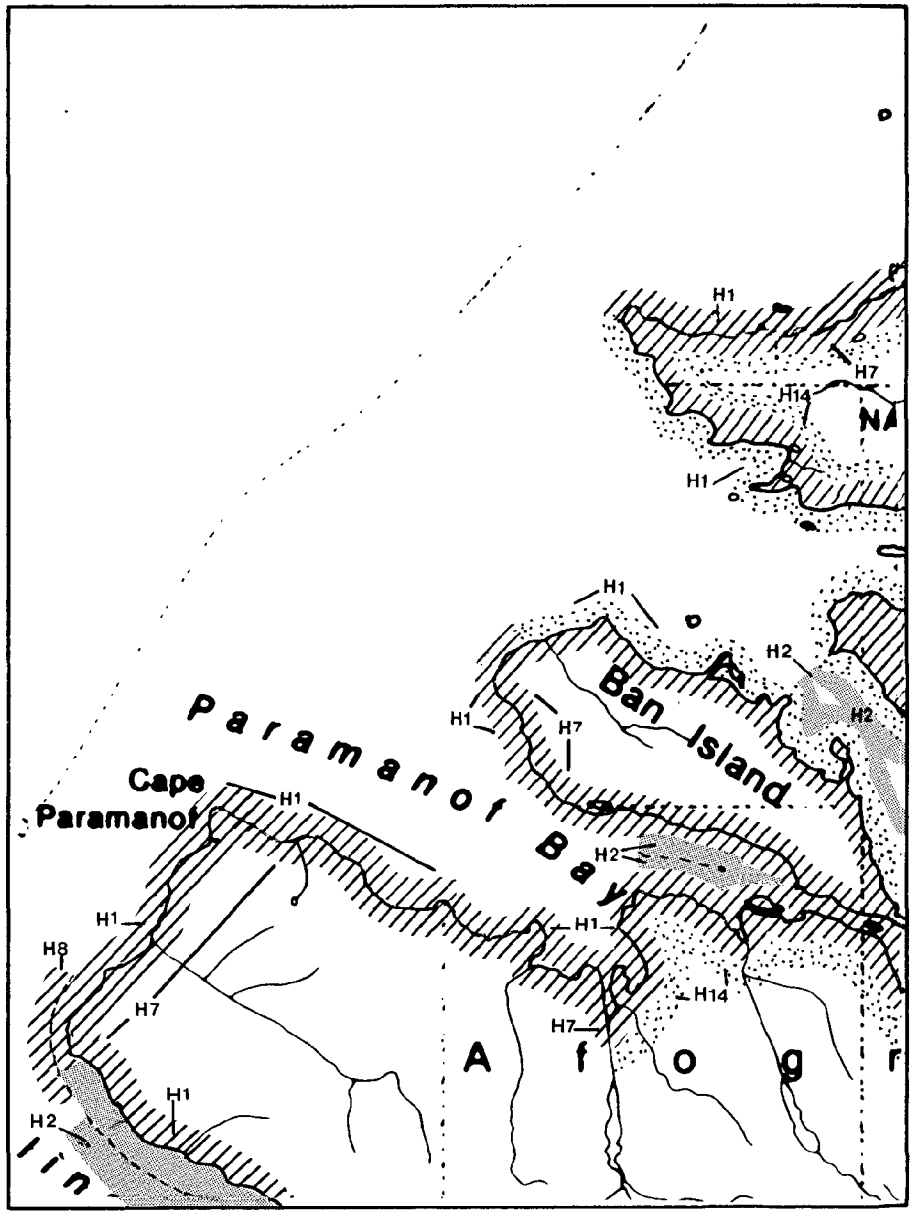
MAP NUMBER 4

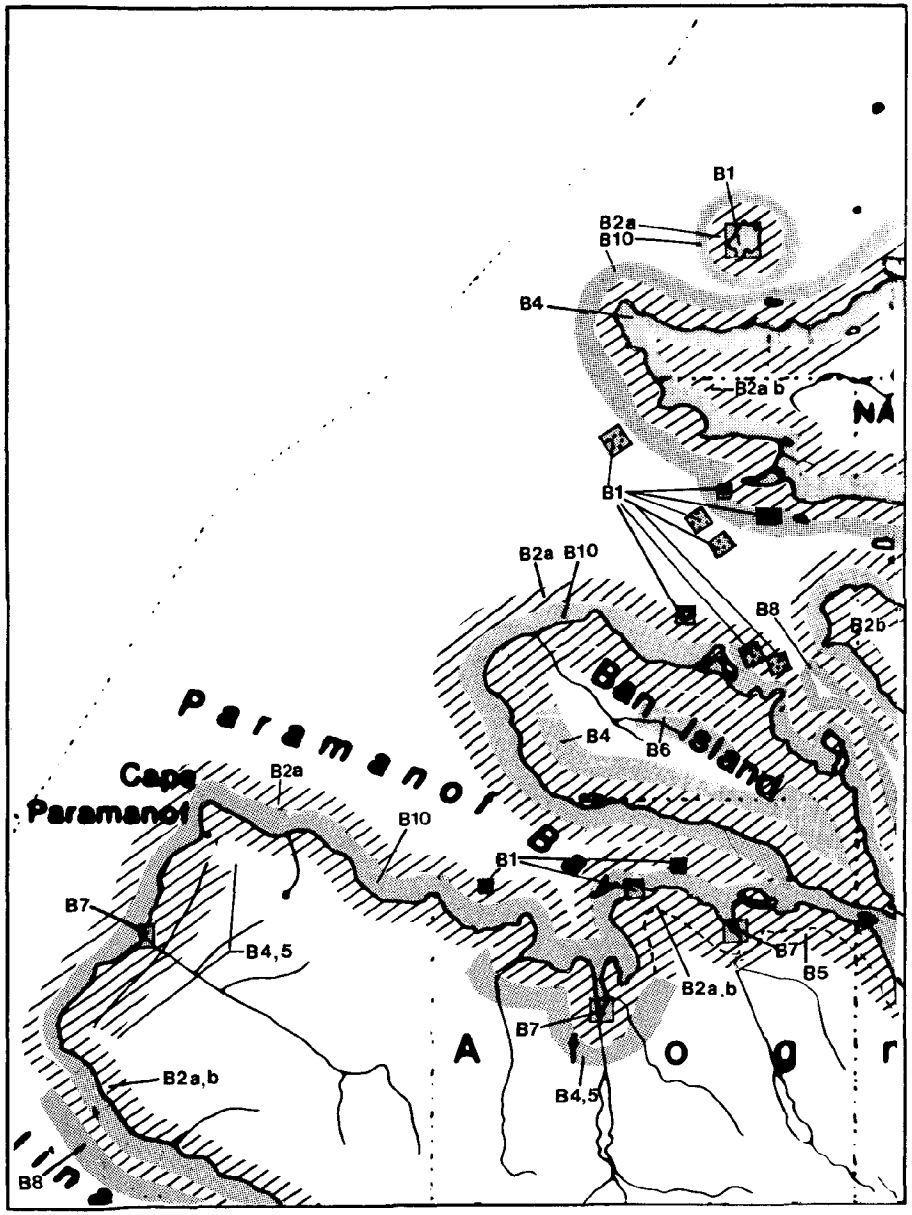
RESOURCE	Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE												
R-1 Rocky Headlands	—	—	—	—	—	—	—	—	—	—	—	—
R-2 Wave-Cut Platforms	—	—	—	—	—	—	—	—	—	—	—	—
R-3 Sand Beaches/Exposed Tidal Flats	—	—	—	—	—	—	—	—	—	—	—	—
R-4 Mixed Sand and Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-5 Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-6 Sheltered Rocky and Gravel Shores	—	—	—	—	—	—	—	—	—	—	—	—
R-7 Protected Estuarine Tidal Flats and Marshes	—	—	—	—	—	—	—	—	—	—	—	—
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon							—	—	—	—		
H-2 Roe Herring					—	—	—					
H-3 Crab			—	—	—	—	—	—	—	—	—	—
H-4 Shrimp												
H-5 Halibut							—	—				
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer	—											—
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon												
Recreation												
H-14 Recreation Use Area							—	—	—	—		
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony						—	—	—	—	—		
B-2a Waterfowl (overwintering)	—	—	—	—							—	—
B-2b Waterfowl (summer use)						—	—	—	—	—		
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer	—	—	—	—								—
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)	—	—	—	—							—	—
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults						—	—	—	—	—	—	—
Salmon - Juveniles	—	—	—	—	—	—	—	—	—	—	—	—
Char/Dolly Varden - Adults	—							—	—	—	—	—
Char/Dolly Varden - Juveniles				—	—	—	—					
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area												
B-9 Razor Clam Beach												
B-10 Sea Otters	—	—	—	—	—	—	—	—	—	—	—	—



HIGH MEDIUM LOW

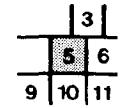


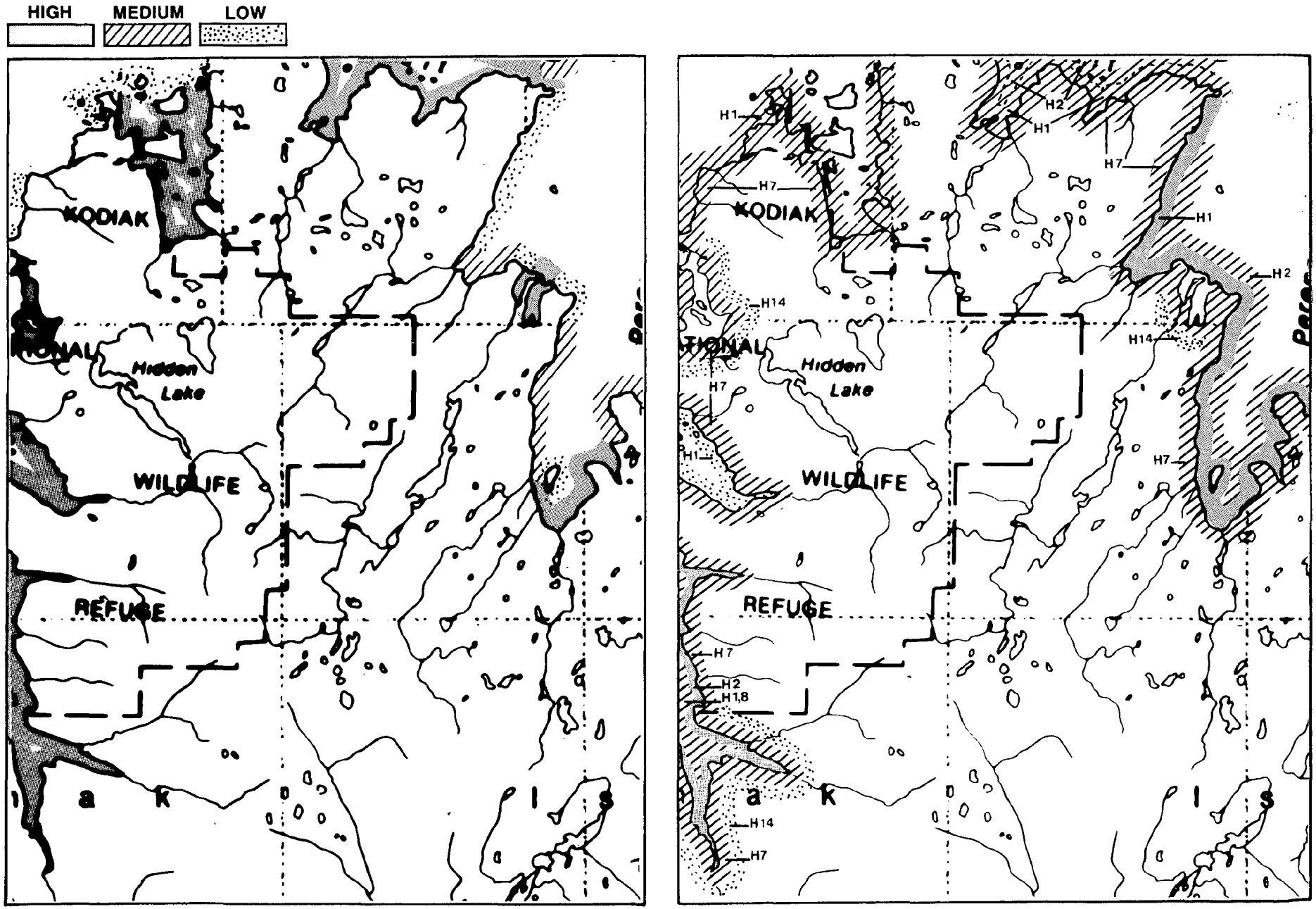


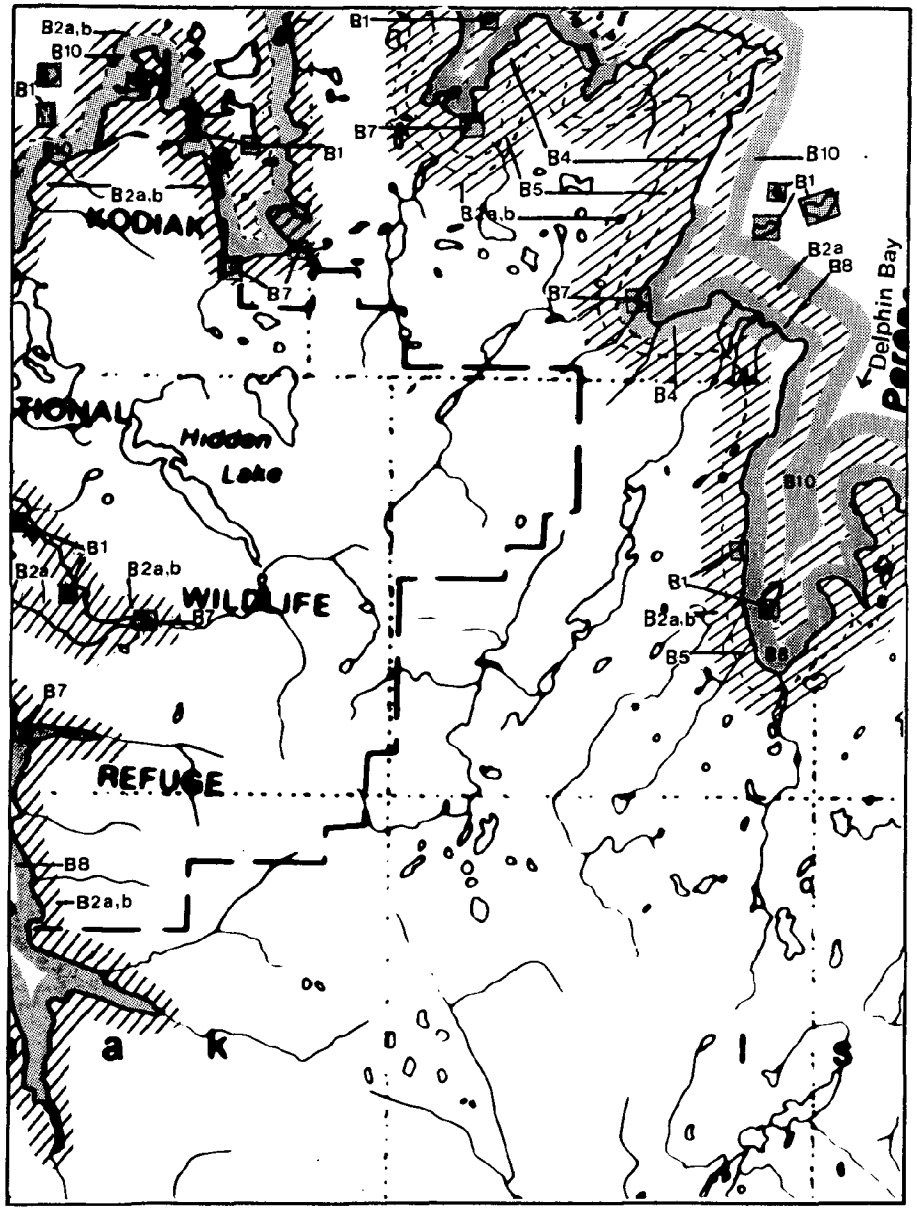


MAP NUMBER 5

RESOURCE	Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE												
R-1 Rocky Headlands												
R-2 Wave-Cut Platforms												
R-3 Sand Beaches/Exposed Tidal Flats												
R-4 Mixed Sand and Gravel Beaches												
R-5 Gravel Beaches												
R-6 Sheltered Rocky and Gravel Shores												
R-7 Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon												
H-2 Roe Herring												
H-3 Crab												
H-4 Shrimp												
H-5 Halibut												
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer												
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon												
Recreation												
H-14 Recreation Use Area												
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer												
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults												
Salmon - Juveniles												
Char/Dolly Varden - Adults												
Char/Dolly Varden - Juveniles												
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area												
B-9 Razor Clam Beach												
B-10 Sea Otters												




HIGH
MEDIUM
LOW
KODIAK
Hidden Lake
WILDLIFE
REFUGE
a k
H1
H2
H7
H14
H1,8

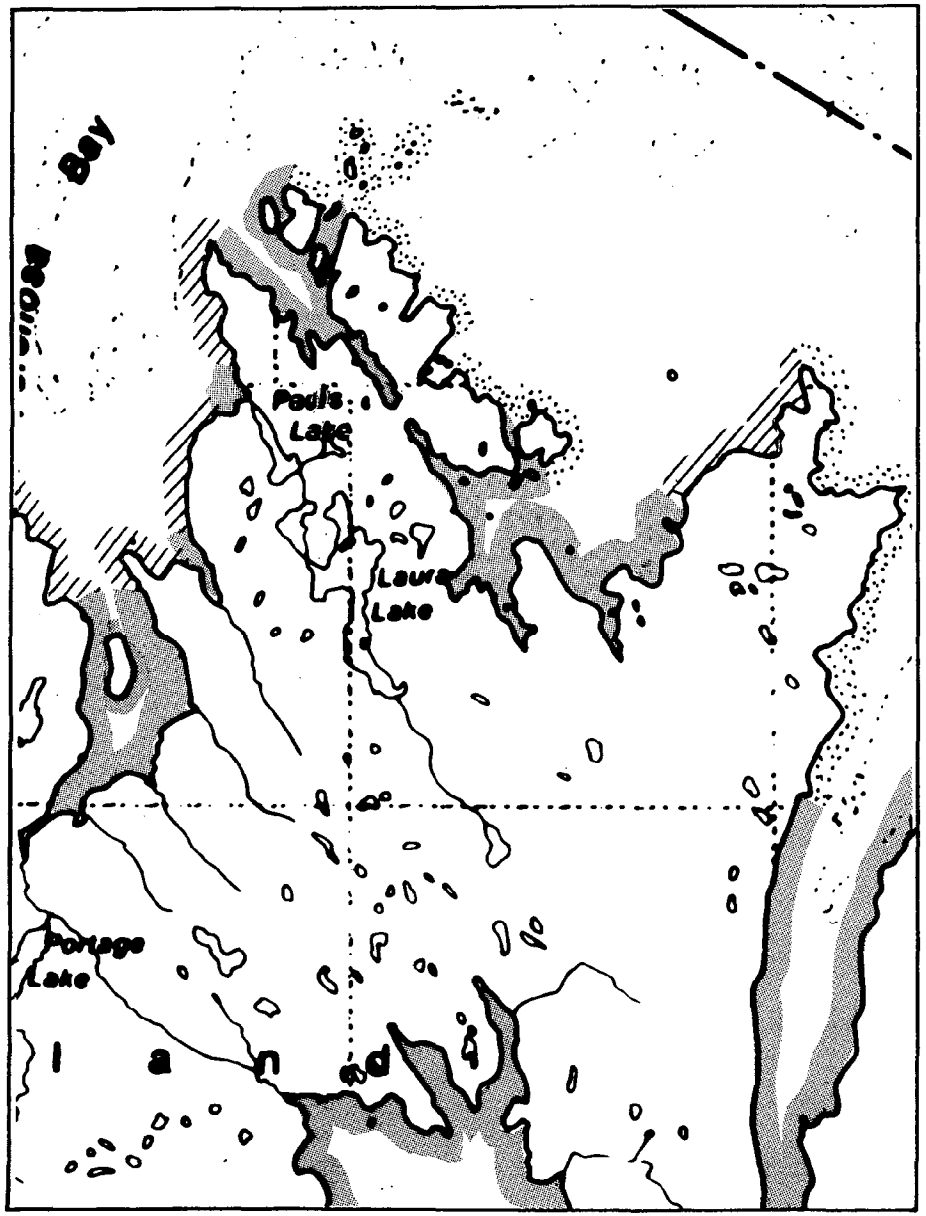


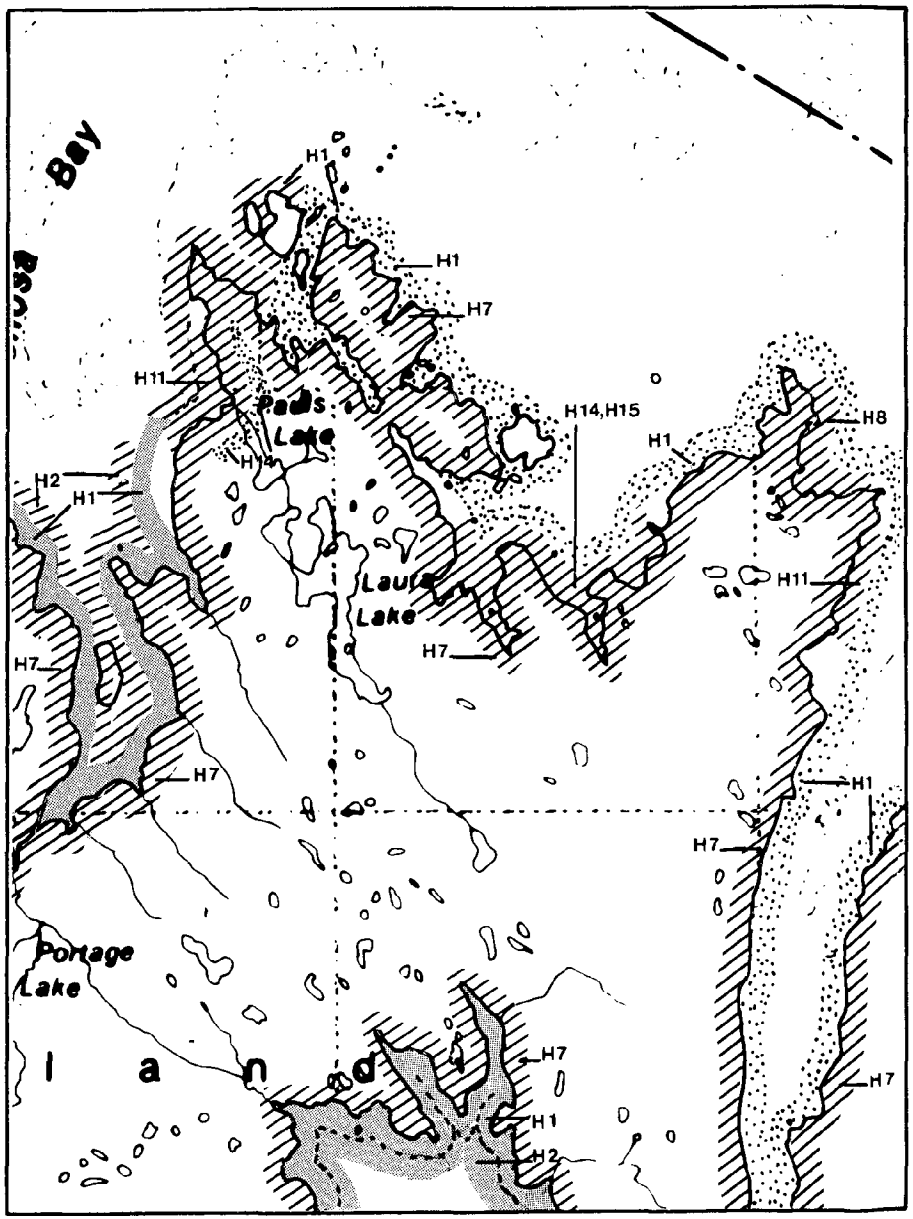
MAP NUMBER 6

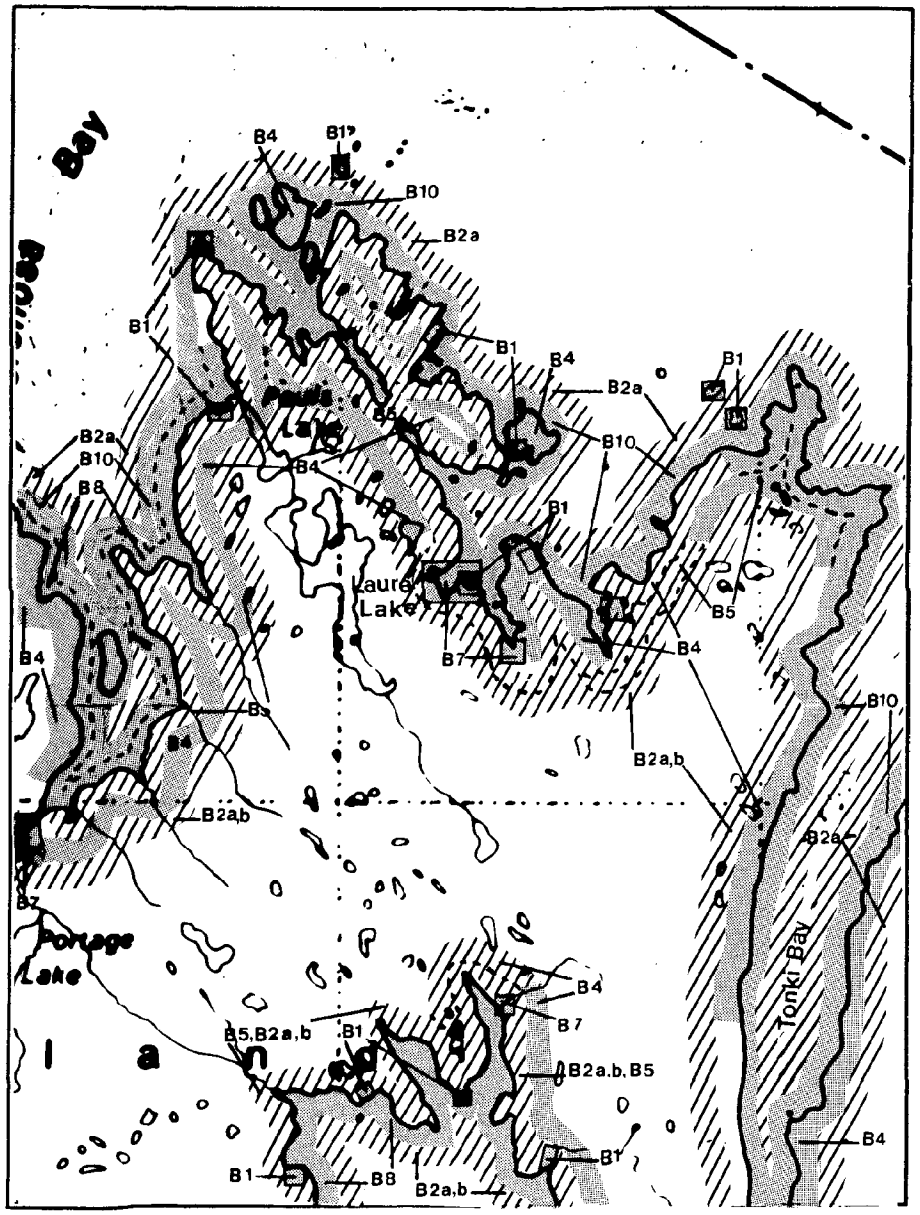
RESOURCE	Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE												
R-1 Rocky Headlands												
R-2 Wave-Cut Platforms												
R-3 Sand Beaches/Exposed Tidal Flats												
R-4 Mixed Sand and Gravel Beaches												
R-5 Gravel Beaches												
R-6 Sheltered Rocky and Gravel Shores												
R-7 Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon												
H-2 Roe Herring												
H-3 Crab												
H-4 Shrimp												
H-5 Halibut												
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer												
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon												
Recreation												
H-14 Recreation Use Area												
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer												
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults												
Salmon - Juveniles												
Char/Dolly Varden - Adults												
Char/Dolly Varden - Juveniles												
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area												
B-9 Razor Clam Beach												
B-10 Sea Otters												

	3	4
5	6	7
10	11	12

HIGH MEDIUM LOW

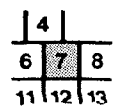


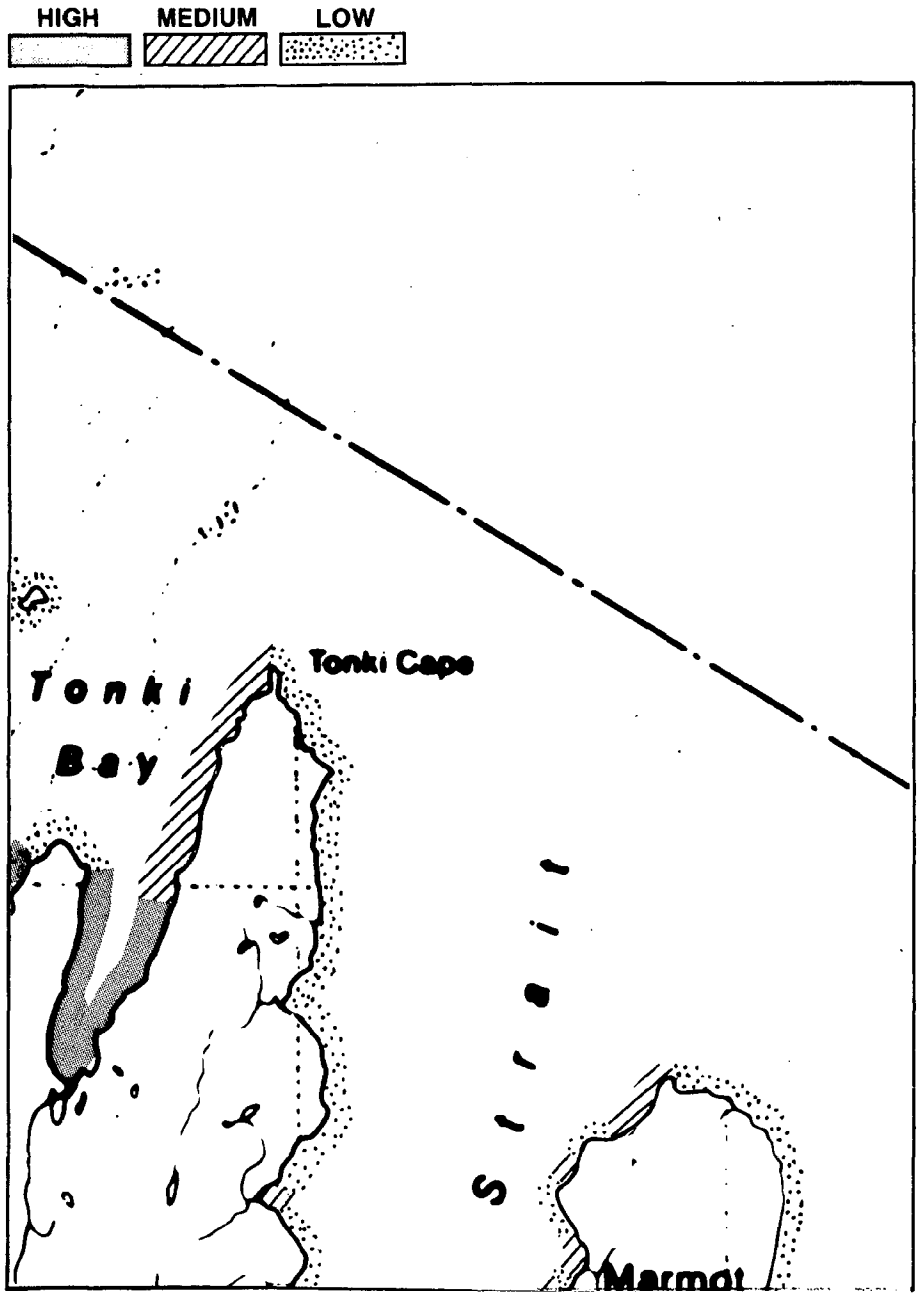


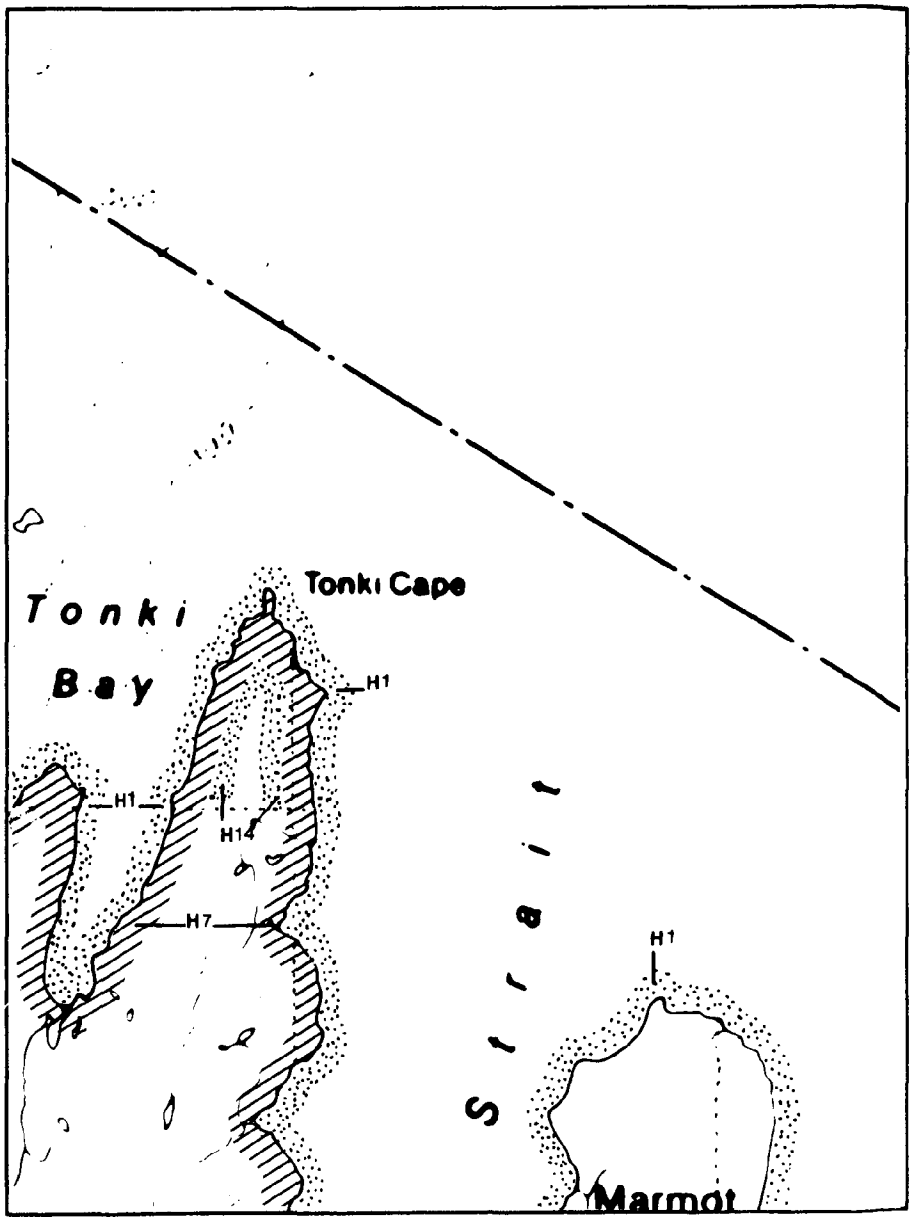


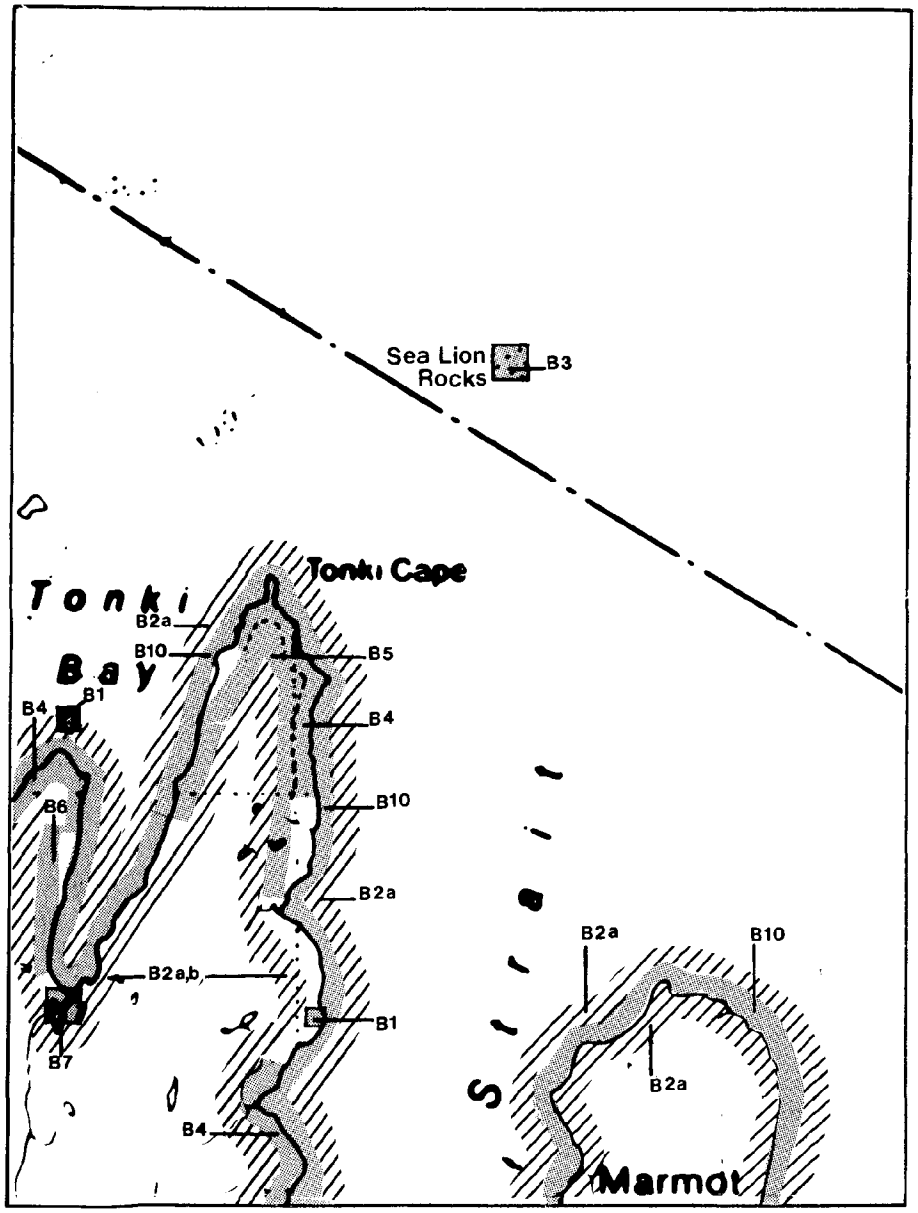
MAP NUMBER 7

RESOURCE		Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE													
R-1	Rocky Headlands												
R-2	Wave-Cut Platforms												
R-3	Sand Beaches/Exposed Tidal Flats												
R-4	Mixed Sand and Gravel Beaches												
R-5	Gravel Beaches												
R-6	Sheltered Rocky and Gravel Shores												
R-7	Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX													
Commercial Fisheries													
H-1	Salmon												
H-2	Roe Herring												
H-3	Crab												
H-4	Shrimp												
H-5	Halibut												
H-6	Whitefish												
Subsistence													
H-7	Deer/Elk/Reindeer												
H-8	Marine Mammal												
H-9	Crab												
H-10	Waterfowl												
H-11	Clams												
H-12	Halibut/Marine Fish												
H-13	Salmon												
Recreation													
H-14	Recreation Use Area												
H-15	Recreation Facility												
Infrastructure													
H-16	Boat Harbor												
H-17	Dock												
H-18	Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX													
Onshore													
B-1	Seabird Colony												
B-2a	Waterfowl (overwintering)												
B-2b	Waterfowl (summer use)												
B-3	Sea Lion Haul-out												
B-4	Black Tail Deer												
B-5	Elk												
B-6	Brown Bear												
Offshore													
B-2a	Waterfowl (overwintering)												
B-2b	Waterfowl (summer use)												
B-7	Anadromous Fish Streams												
	Salmon - Adults												
	Salmon - Juveniles												
	Char/Dolly Varden - Adults												
	Char/Dolly Varden - Juveniles												
	Steelhead - Adults												
	Steelhead - Juveniles												
B-8	Herring Spawning Area												
B-9	Razor Clam Beach												
B-10	Sea Otters												




HIGH
MEDIUM
LOW
Tonki Bay
Tonki Cape
Strait
Marmot

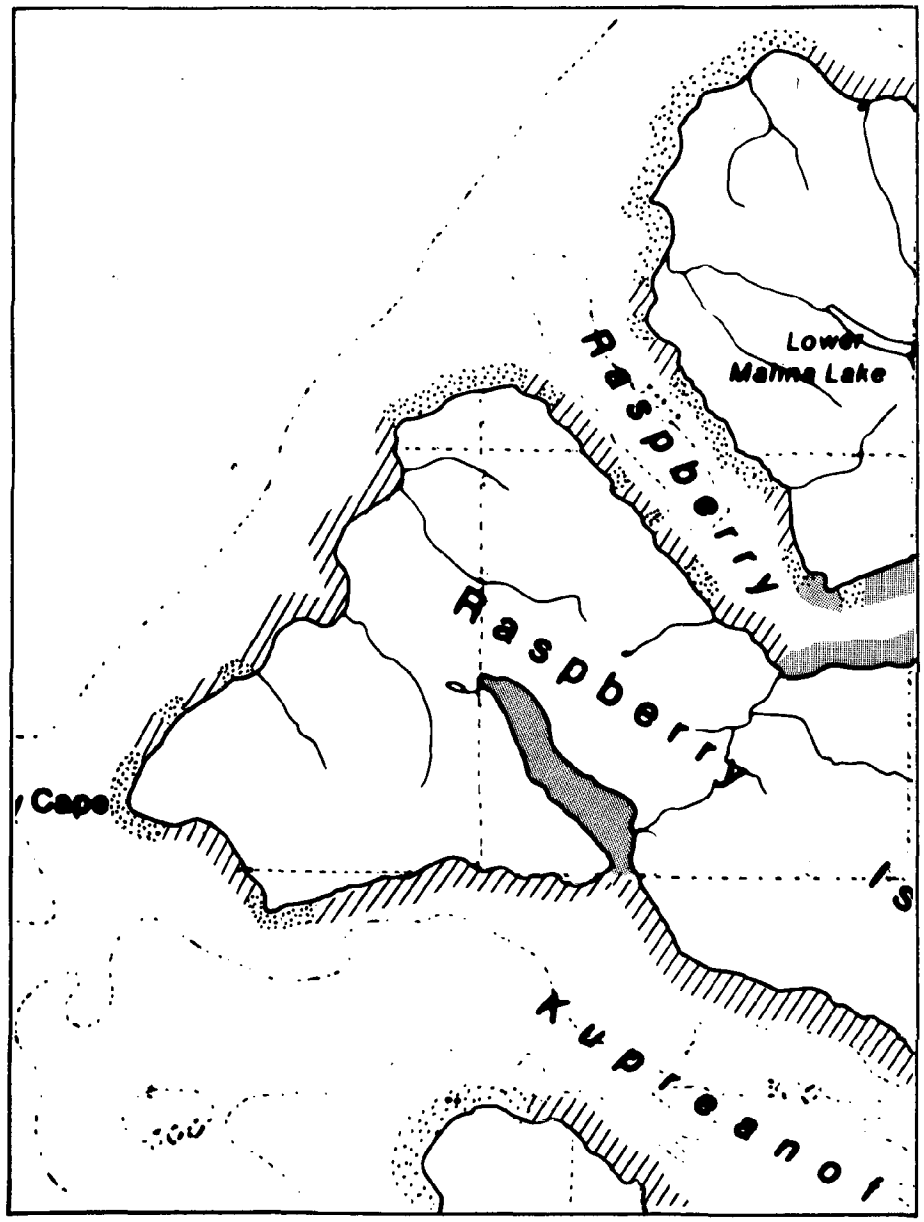

Tonki Bay
Tonki Cape
H1
H1
H14
H7
H1
Strait
Marmot

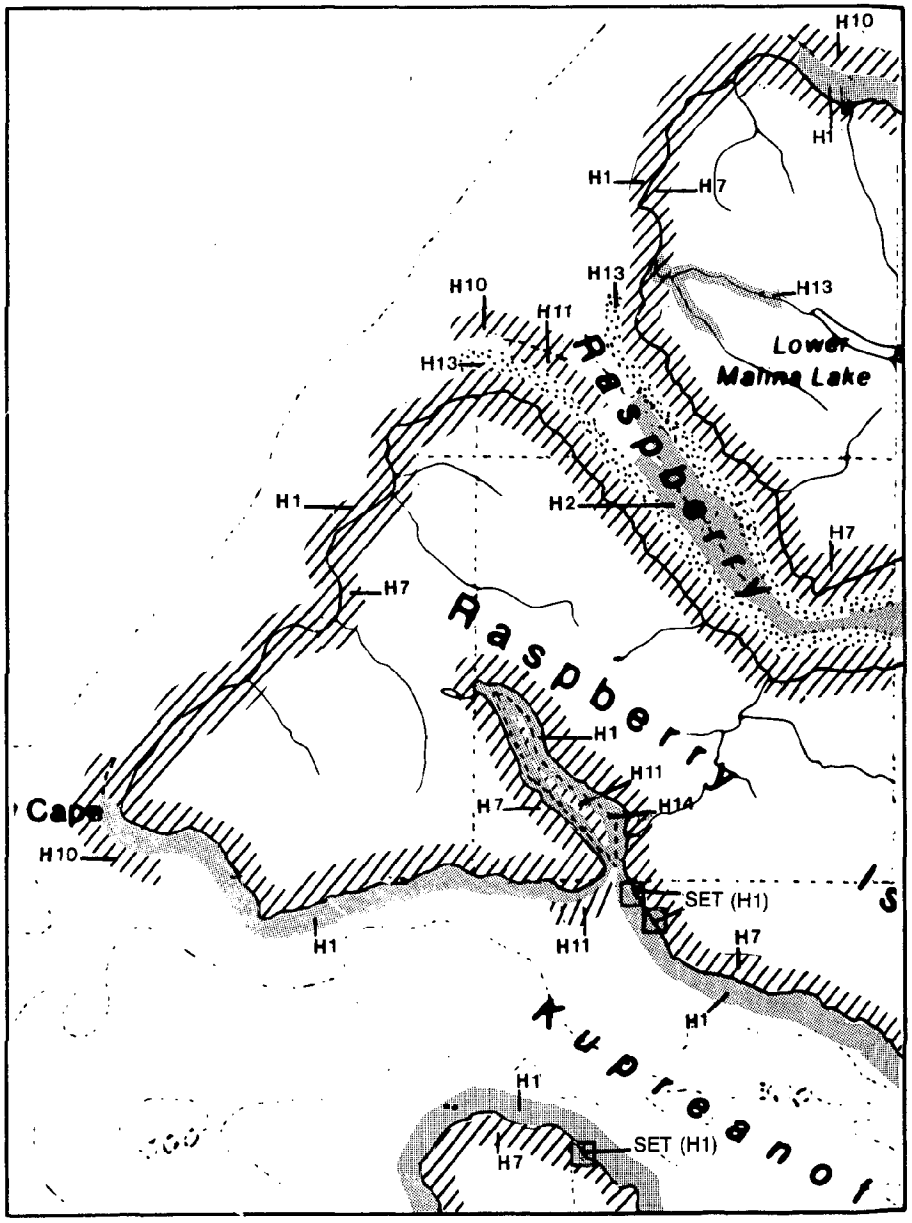


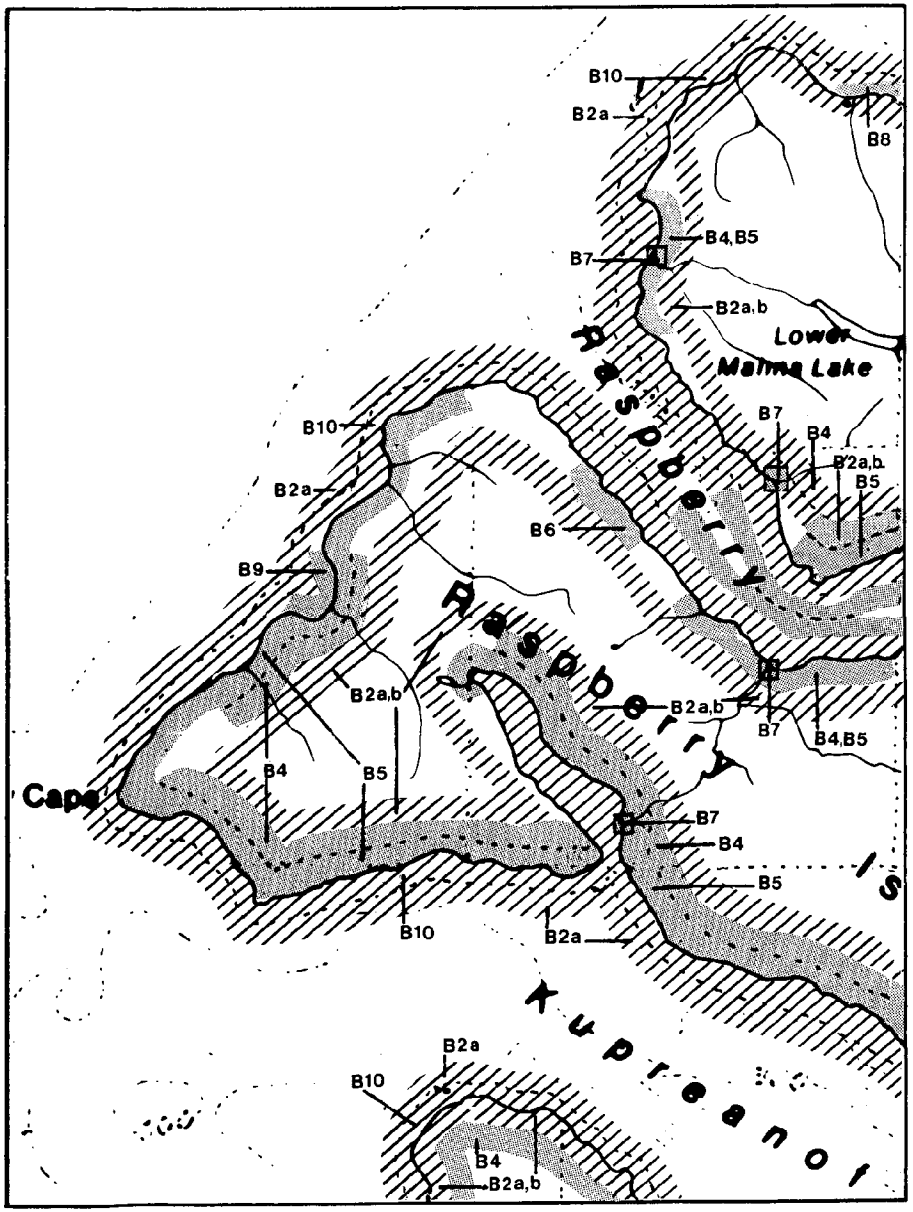
MAP NUMBER 8

RESOURCE	Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE												
R-1 Rocky Headlands	—	—	—	—	—	—	—	—	—	—	—	—
R-2 Wave-Cut Platforms	—	—	—	—	—	—	—	—	—	—	—	—
R-3 Sand Beaches/Exposed Tidal Flats	—	—	—	—	—	—	—	—	—	—	—	—
R-4 Mixed Sand and Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-5 Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-6 Sheltered Rocky and Gravel Shores	—	—	—	—	—	—	—	—	—	—	—	—
R-7 Protected Estuarine Tidal Flats and Marshes	—	—	—	—	—	—	—	—	—	—	—	—
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon							—	—	—	—		
H-2 Roe Herring												
H-3 Crab						—	—	—	—	—		
H-4 Shrimp												
H-5 Halibut							—	—				
H-6 Whitefish	—	—	—	—	—	—	—	—	—	—	—	—
Subsistence												
H-7 Deer/Elk/Reindeer	—											—
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon												
Recreation												
H-14 Recreation Use Area	—						—	—	—	—	—	—
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony						—	—	—	—	—		
B-2a Waterfowl (overwintering)	—	—	—	—							—	—
B-2b Waterfowl (summer use)						—	—	—	—	—		
B-3 Sea Lion Haul-out	—	—	—	—	—	—	—	—	—	—	—	—
B-4 Black Tail Deer	—	—	—	—								—
B-5 Elk	—	—	—	—								—
B-6 Brown Bear					—	—				—	—	—
Offshore												
B-2a Waterfowl (overwintering)	—	—	—	—							—	—
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults						—	—	—	—	—	—	—
Salmon - Juveniles		—	—	—	—	—	—	—	—	—	—	—
Char/Dolly Varden - Adults								—	—	—	—	—
Char/Dolly Varden - Juveniles					—	—	—					
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area												
B-9 Razor Clam Beach												
B-10 Sea Otters	—	—	—	—	—	—	—	—	—	—	—	—

HIGH MEDIUM LOW





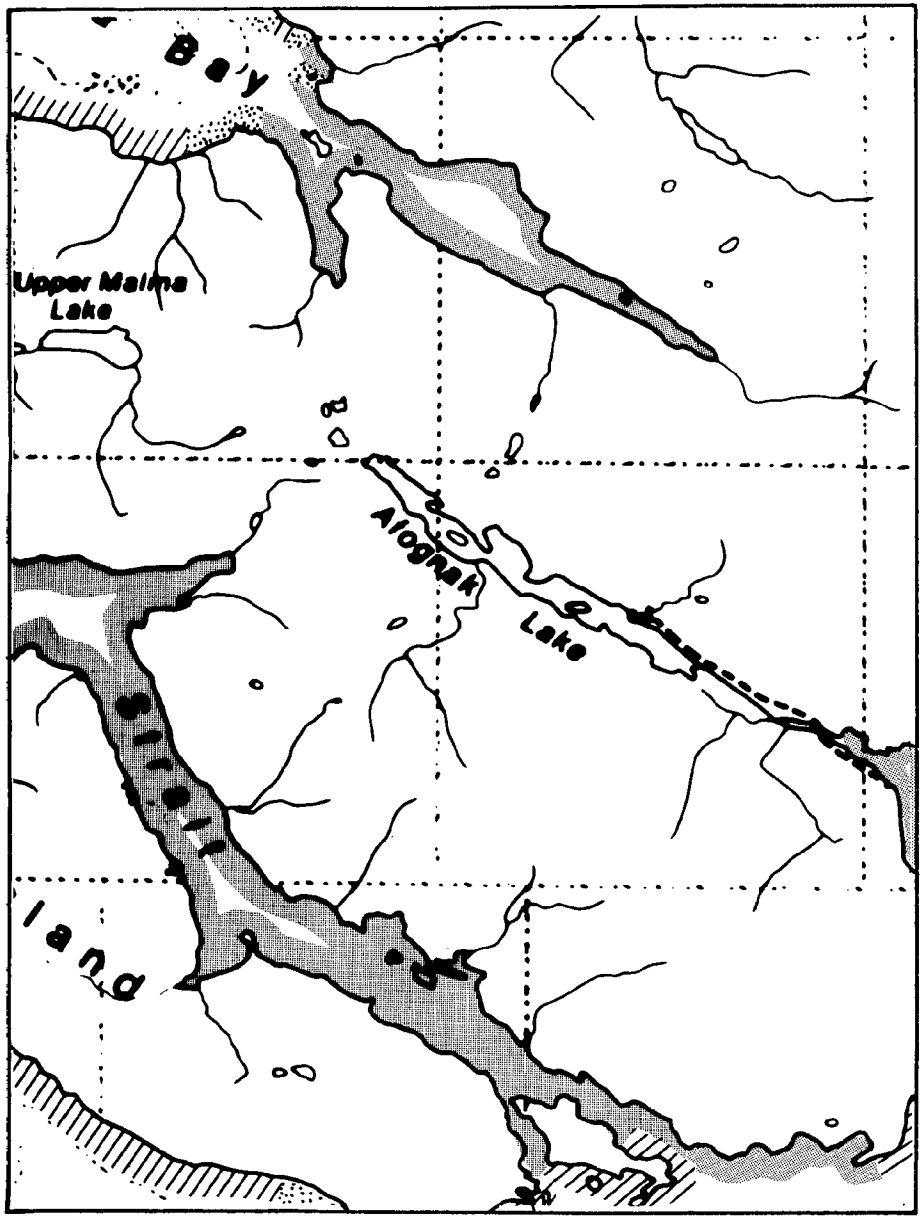


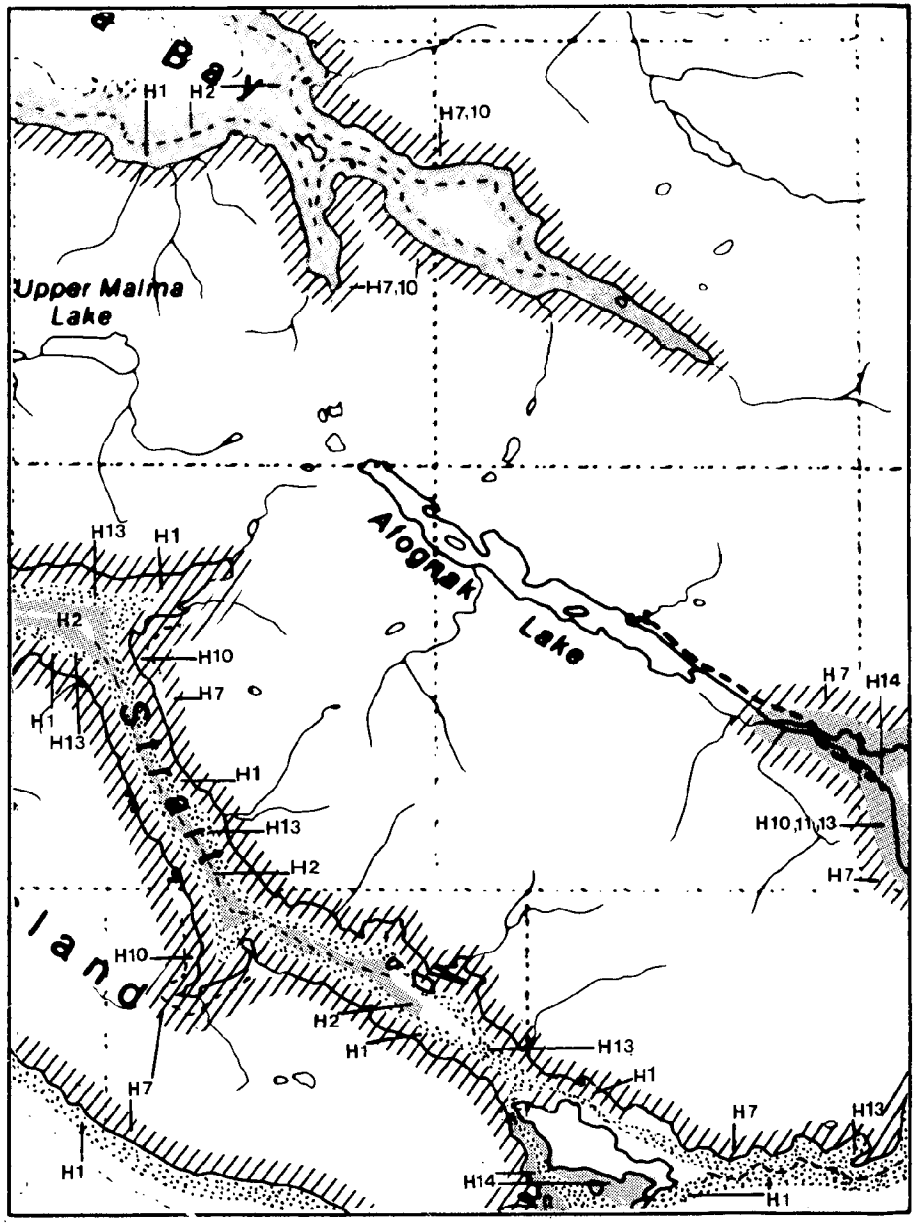
MAP NUMBER 9

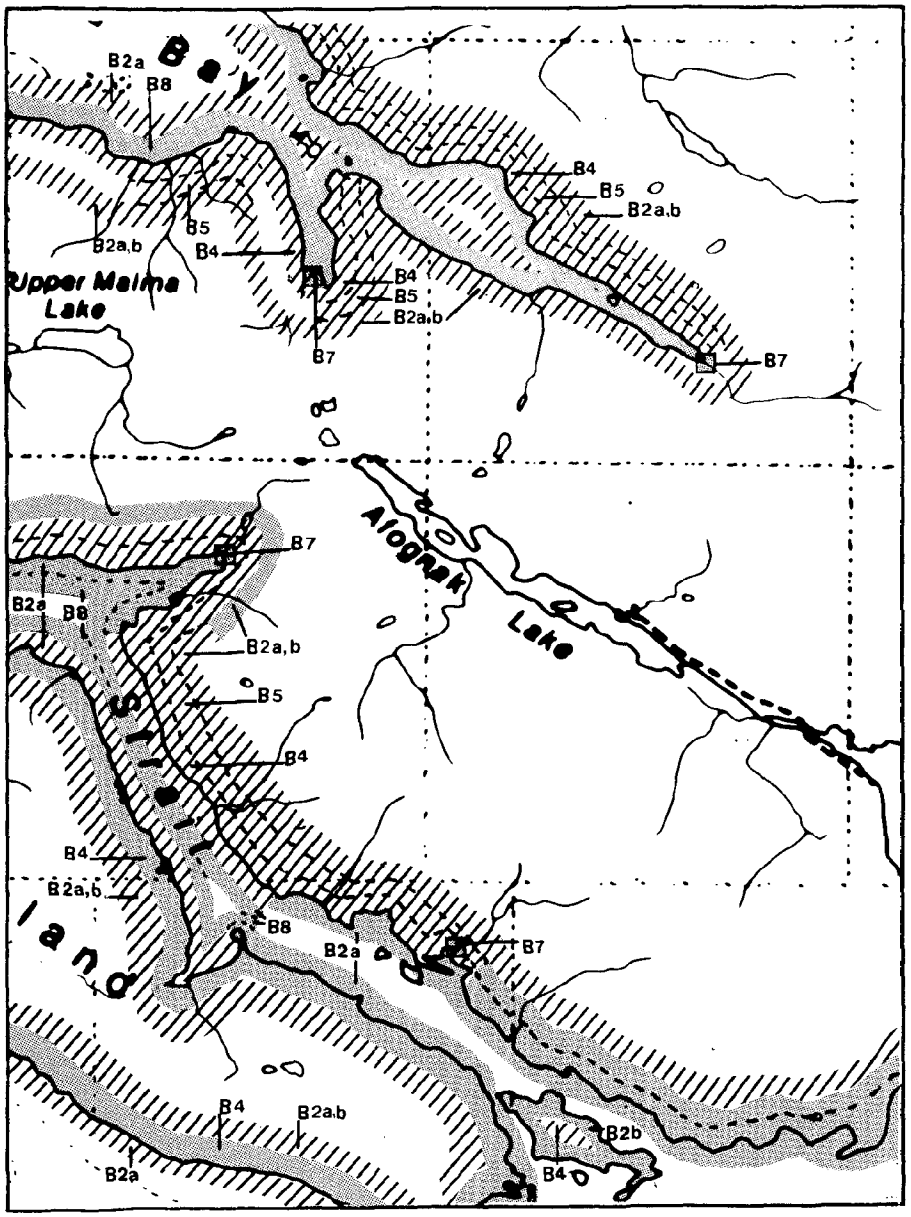
RESOURCE	Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE												
R-1 Rocky Headlands	—	—	—	—	—	—	—	—	—	—	—	—
R-2 Wave-Cut Platforms	—	—	—	—	—	—	—	—	—	—	—	—
R-3 Sand Beaches/Exposed Tidal Flats	—	—	—	—	—	—	—	—	—	—	—	—
R-4 Mixed Sand and Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-5 Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-6 Sheltered Rocky and Gravel Shores	—	—	—	—	—	—	—	—	—	—	—	—
R-7 Protected Estuarine Tidal Flats and Marshes	—	—	—	—	—	—	—	—	—	—	—	—
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon							—	—	—	—		
H-2 Roe Herring					—	—	—					
H-3 Crab		—	—	—	—	—	—	—	—	—	—	—
H-4 Shrimp												
H-5 Halibut												
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer	—											—
H-8 Marine Mammal	—	—	—	—	—				—	—	—	—
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon						—	—	—	—	—	—	—
Recreation												
H-14 Recreation Use Area	—						—	—	—	—	—	—
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony												
B-2a Waterfowl (overwintering)	—	—	—	—							—	—
B-2b Waterfowl (summer use)						—	—	—	—	—		
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer	—	—	—	—								—
B-5 Elk	—	—	—	—								—
B-6 Brown Bear					—	—				—	—	—
Offshore												
B-2a Waterfowl (overwintering)	—	—	—	—							—	—
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults						—	—	—	—	—	—	—
Salmon - Juveniles	—	—	—	—	—	—	—	—	—	—	—	—
Char/Dolly Varden - Adults	—									—	—	—
Char/Dolly Varden - Juveniles					—	—	—					
Steelhead - Adults	—	—	—	—	—	—	—			—		
Steelhead - Juveniles							—	—	—	—		
B-8 Herring Spawning Area						—	—					
B-9 Razor Clam Beach	—	—	—	—	—	—	—	—	—	—	—	—
B-10 Sea Otters	—	—	—	—	—	—	—	—	—	—	—	—

		5
	9	10
15	16	17

HIGH MEDIUM LOW





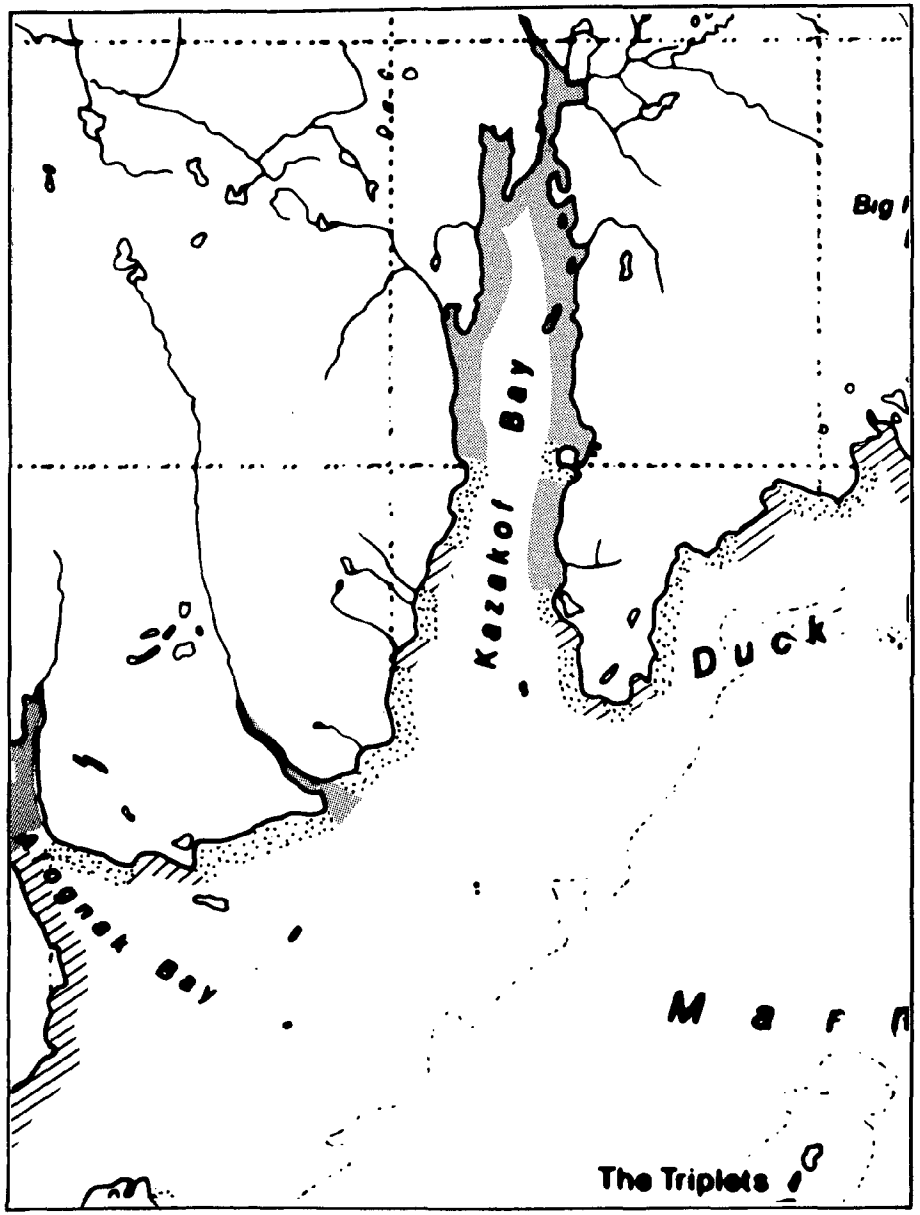


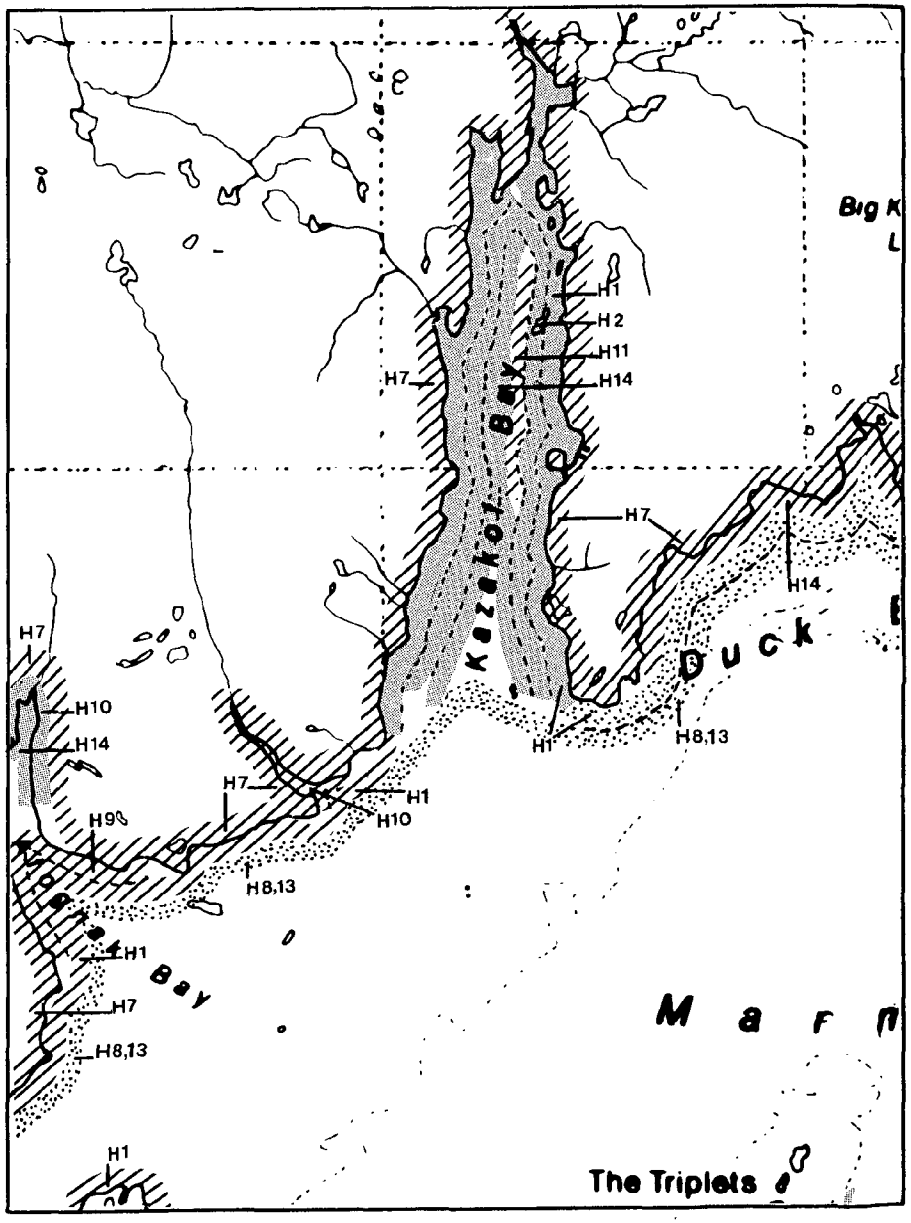
MAP NUMBER 10

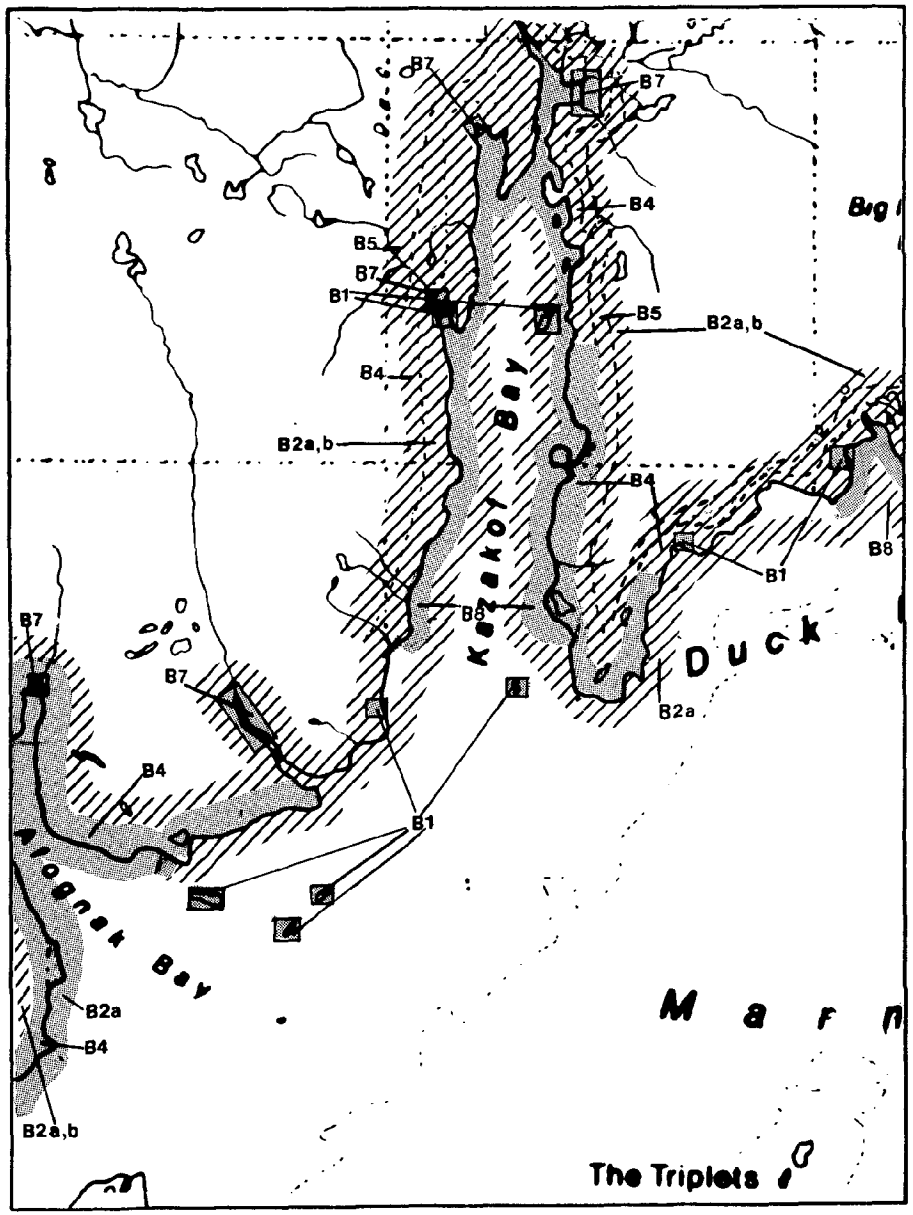
RESOURCE	Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE												
R-1 Rocky Headlands	—	—	—	—	—	—	—	—	—	—	—	—
R-2 Wave-Cut Platforms	—	—	—	—	—	—	—	—	—	—	—	—
R-3 Sand Beaches/Exposed Tidal Flats	—	—	—	—	—	—	—	—	—	—	—	—
R-4 Mixed Sand and Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-5 Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-6 Sheltered Rocky and Gravel Shores	—	—	—	—	—	—	—	—	—	—	—	—
R-7 Protected Estuarine Tidal Flats and Marshes	—	—	—	—	—	—	—	—	—	—	—	—
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon							—	—	—	—		
H-2 Roe Herring					—	—	—					
H-3 Crab						—	—	—	—	—	—	
H-4 Shrimp												
H-5 Halibut												
H-6 Whitefish	—	—	—	—	—	—	—	—	—	—	—	—
Subsistence												
H-7 Deer/Elk/Reindeer	—											—
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl	—	—	—	—	—	—				—	—	—
H-11 Clams	—	—	—	—	—	—	—	—	—	—	—	—
H-12 Halibut/Marine Fish												
H-13 Salmon						—	—	—	—	—	—	—
Recreation												
H-14 Recreation Use Area	—						—	—	—	—	—	—
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony												
B-2a Waterfowl (overwintering)	—	—	—	—							—	—
B-2b Waterfowl (summer use)						—	—	—	—	—		
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer	—	—	—	—								—
B-5 Elk	—	—	—	—								—
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)	—	—	—	—							—	—
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults						—	—	—	—	—	—	—
Salmon - Juveniles	—	—	—	—	—	—	—	—	—	—	—	—
Char/Dolly Varden - Adults	—							—	—	—	—	—
Char/Dolly Varden - Juveniles					—	—	—					
Steelhead - Adults	—	—	—	—	—	—			—	—	—	—
Steelhead - Juveniles							—	—	—			
B-8 Herring Spawning Area					—	—						
B-9 Razor Clam Beach												
B-10 Sea Otters												

	5	6
9	10	11
16	17	18

HIGH MEDIUM LOW



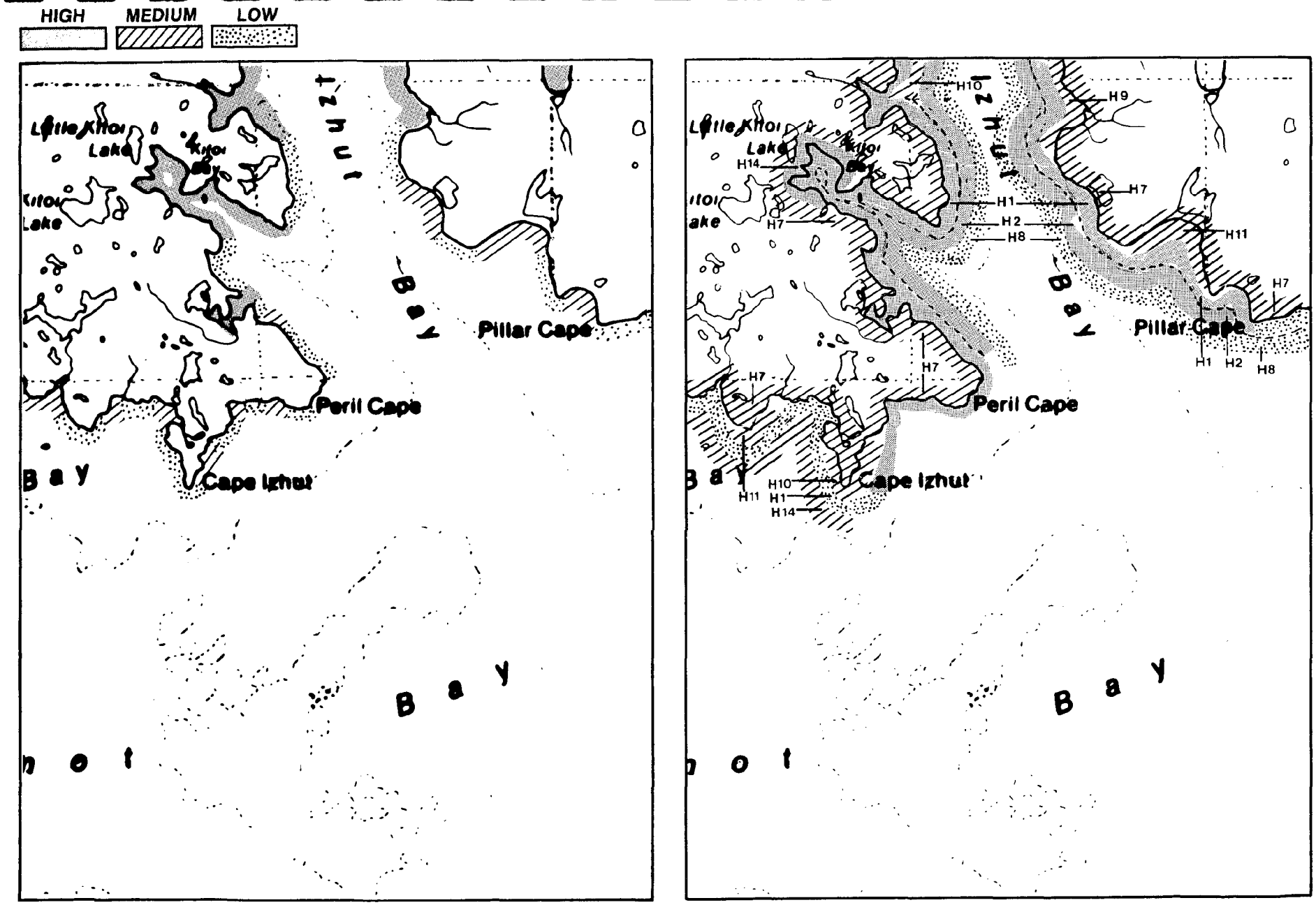


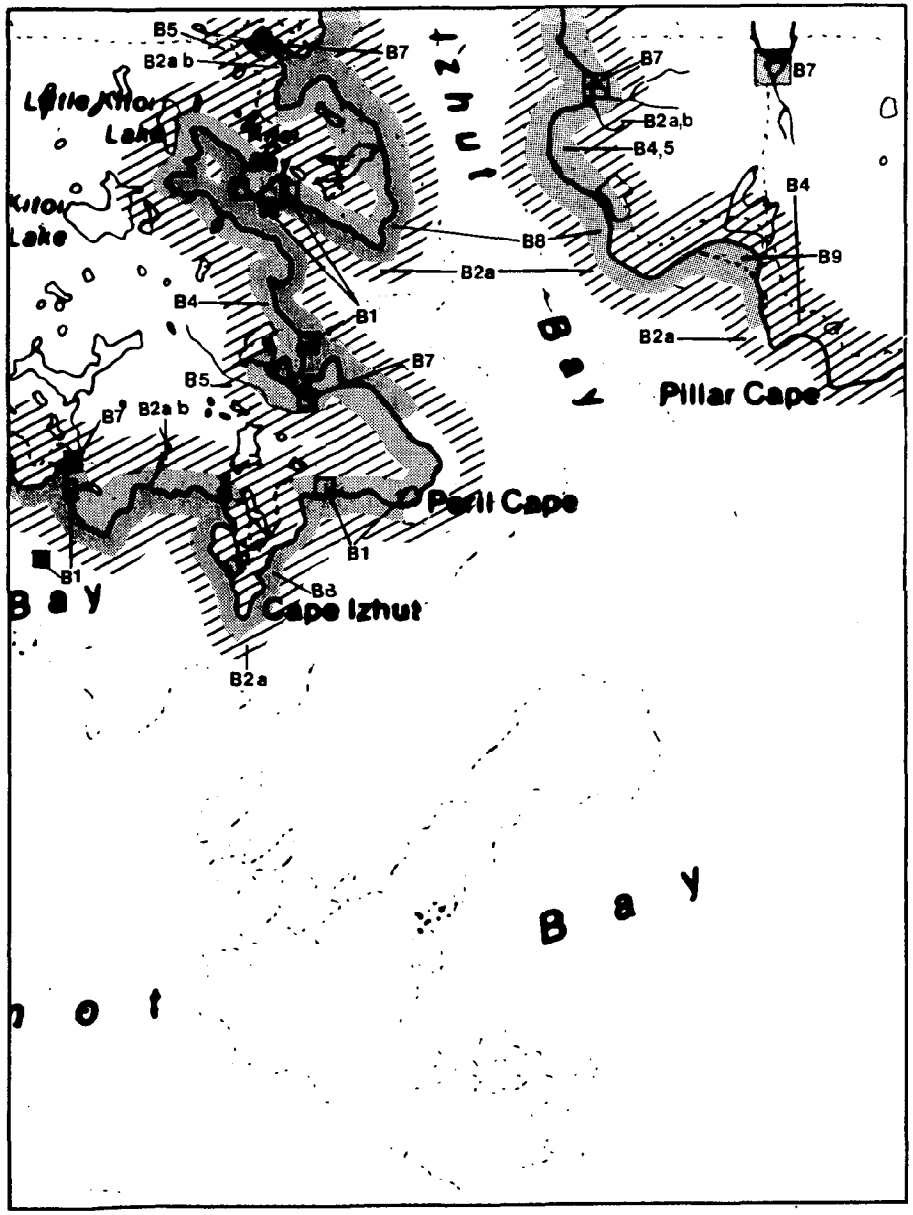


MAP NUMBER 11

RESOURCE	D	J	F	M	A	M	J	J	A	S	O	N
	Winter			Spring			Summer			Fall		
OIL RESIDENCE												
R-1 Rocky Headlands	—	—	—	—	—	—	—	—	—	—	—	—
R-2 Wave-Cut Platforms	—	—	—	—	—	—	—	—	—	—	—	—
R-3 Sand Beaches/Exposed Tidal Flats	—	—	—	—	—	—	—	—	—	—	—	—
R-4 Mixed Sand and Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-5 Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-6 Sheltered Rocky and Gravel Shores	—	—	—	—	—	—	—	—	—	—	—	—
R-7 Protected Estuarine Tidal Flats and Marshes	—	—	—	—	—	—	—	—	—	—	—	—
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon							—	—	—	—		
H-2 Roe Herring					—	—	—					
H-3 Crab							—	—	—	—		
H-4 Shrimp												
H-5 Halibut							—	—				
H-6 Whitefish	—	—	—	—	—	—	—	—	—	—	—	—
Subsistence												
H-7 Deer/Elk/Reindeer	—											—
H-8 Marine Mammal	—	—	—	—	—	—	—	—	—	—	—	—
H-9 Crab	—	—	—	—	—	—	—	—	—	—	—	—
H-10 Waterfowl	—	—	—	—	—	—	—	—	—	—	—	—
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon						—	—	—	—	—	—	—
Recreation												
H-14 Recreation Use Area	—						—	—	—	—	—	—
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony						—	—	—	—	—		
B-2a Waterfowl (overwintering)	—	—	—	—							—	—
B-2b Waterfowl (summer use)						—	—	—	—	—		
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer	—	—	—	—								—
B-5 Elk	—	—	—	—								—
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)	—	—	—	—							—	—
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults						—	—	—	—	—	—	—
Salmon - Juveniles	—	—	—	—	—	—	—	—	—	—	—	—
Char/Dolly Varden - Adults	—							—	—	—	—	—
Char/Dolly Varden - Juveniles					—	—	—					
Steelhead - Adults	—	—	—	—	—	—	—		—	—	—	—
Steelhead - Juveniles							—	—	—			
B-8 Herring Spawning Area					—	—	—					
B-9 Razor Clam Beach												
B-10 Sea Otters												

5	6	7
10	11	12
17	18	19

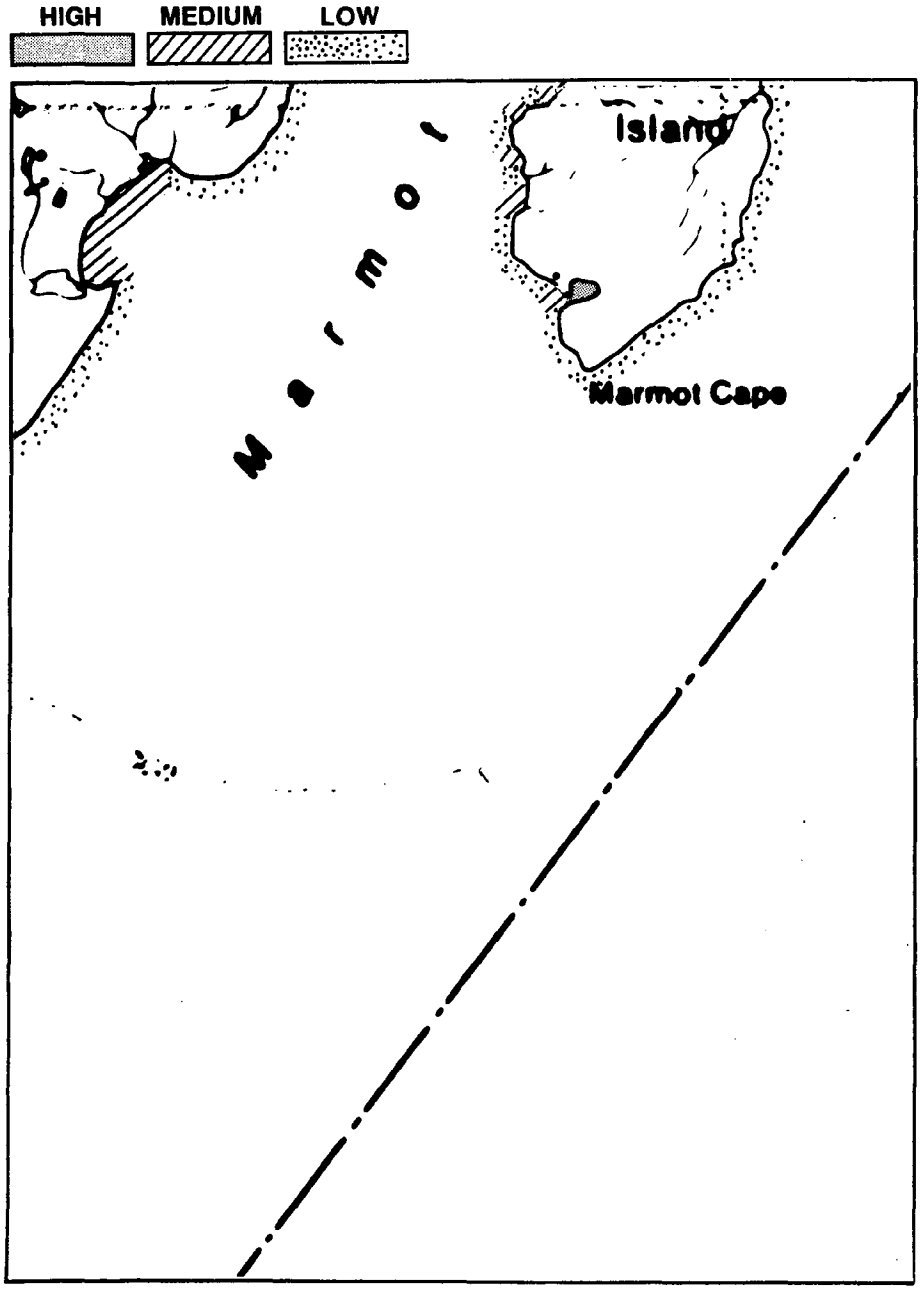

HIGH
MEDIUM
LOW
Little Khor Lake
Khor Lake
Izhut
Bay
Pillar Cape
Peril Cape
Cape Izhut
Bay
Bay
H10
H9
H14
H7
H1
H2
H8
H11
H7
H7
H7
H1
H2
H8
H11
H10
H1
H14

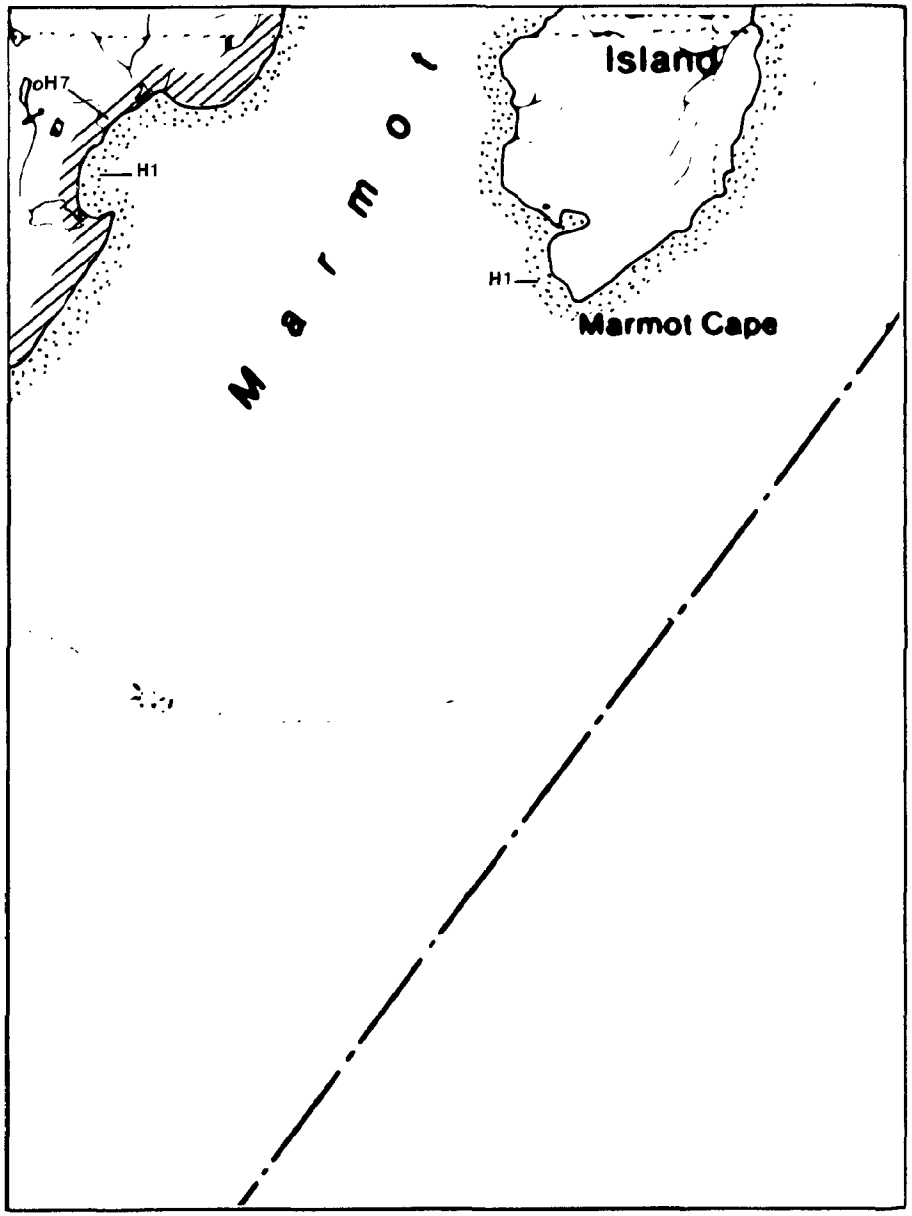


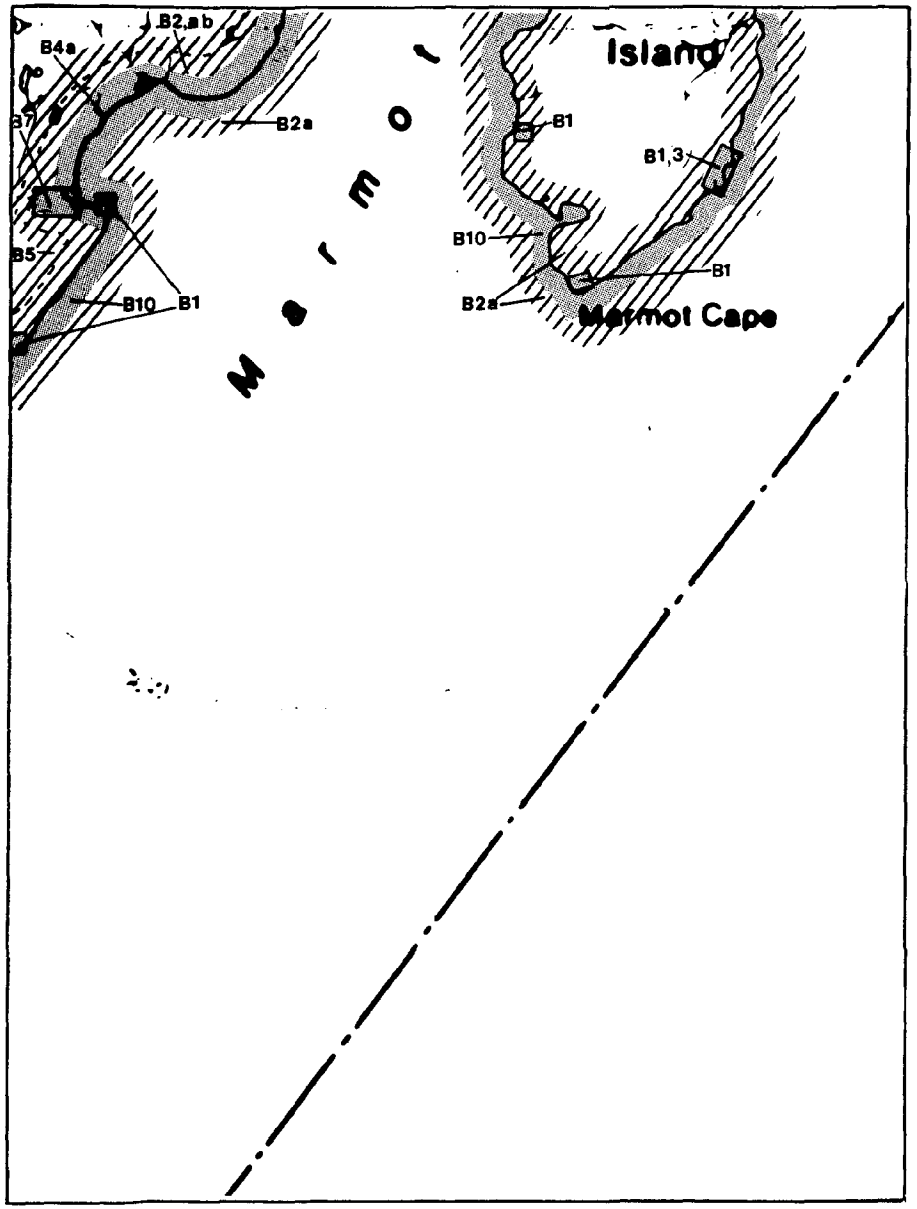
MAP NUMBER 12

RESOURCE		Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE													
R-1	Rocky Headlands	—	—	—	—	—	—	—	—	—	—	—	—
R-2	Wave-Cut Platforms	—	—	—	—	—	—	—	—	—	—	—	—
R-3	Sand Beaches/Exposed Tidal Flats	—	—	—	—	—	—	—	—	—	—	—	—
R-4	Mixed Sand and Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-5	Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-6	Sheltered Rocky and Gravel Shores	—	—	—	—	—	—	—	—	—	—	—	—
R-7	Protected Estuarine Tidal Flats and Marshes	—	—	—	—	—	—	—	—	—	—	—	—
HUMAN USE INDEX													
Commercial Fisheries													
H-1	Salmon							—	—	—	—		
H-2	Roe Herring					—	—	—					
H-3	Crab						—	—	—	—	—	—	
H-4	Shrimp												
H-5	Halibut							—	—				
H-6	Whitefish												
Subsistence													
H-7	Deer/Elk/Reindeer	—											—
H-8	Marine Mammal	—	—	—	—	—	—	—	—	—	—	—	—
H-9	Crab	—	—	—	—	—	—	—	—	—	—	—	—
H-10	Waterfowl	—	—	—	—	—	—	—	—	—	—	—	—
H-11	Clams	—	—	—	—	—	—	—	—	—	—	—	—
H-12	Halibut/Marine Fish	—	—	—	—	—	—	—	—	—	—	—	—
H-13	Salmon					—	—	—	—	—	—	—	—
Recreation													
H-14	Recreation Use Area	—						—	—	—	—	—	—
H-15	Recreation Facility												
Infrastructure													
H-16	Boat Harbor												
H-17	Dock												
H-18	Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX													
Onshore													
B-1	Seabird Colony						—	—	—	—	—		
B-2a	Waterfowl (overwintering)	—	—	—	—							—	—
B-2b	Waterfowl (summer use)						—	—	—	—			
B-3	Sea Lion Haul-out												
B-4	Black Tail Deer	—	—	—	—								—
B-5	Elk	—	—	—	—								—
B-6	Brown Bear												
Offshore													
B-2a	Waterfowl (overwintering)	—	—	—	—							—	—
B-2b	Waterfowl (summer use)												
B-7	Anadromous Fish Streams												
	Salmon - Adults						—	—	—	—	—	—	—
	Salmon - Juveniles	—	—	—	—	—	—	—	—	—	—	—	—
	Char/Dolly Varden - Adults	—								—	—	—	—
	Char/Dolly Varden - Juveniles					—	—	—					
	Steelhead - Adults												
	Steelhead - Juveniles												
B-8	Herring Spawning Area					—	—	—					
B-9	Razor Clam Beach	—	—	—	—	—	—	—	—	—	—	—	—
B-10	Sea Otters	—	—	—	—	—	—	—	—	—	—	—	—

6	7	8
11	12	13
18	19	


HIGH
MEDIUM
LOW
Marmot
Island
Marmot Cape

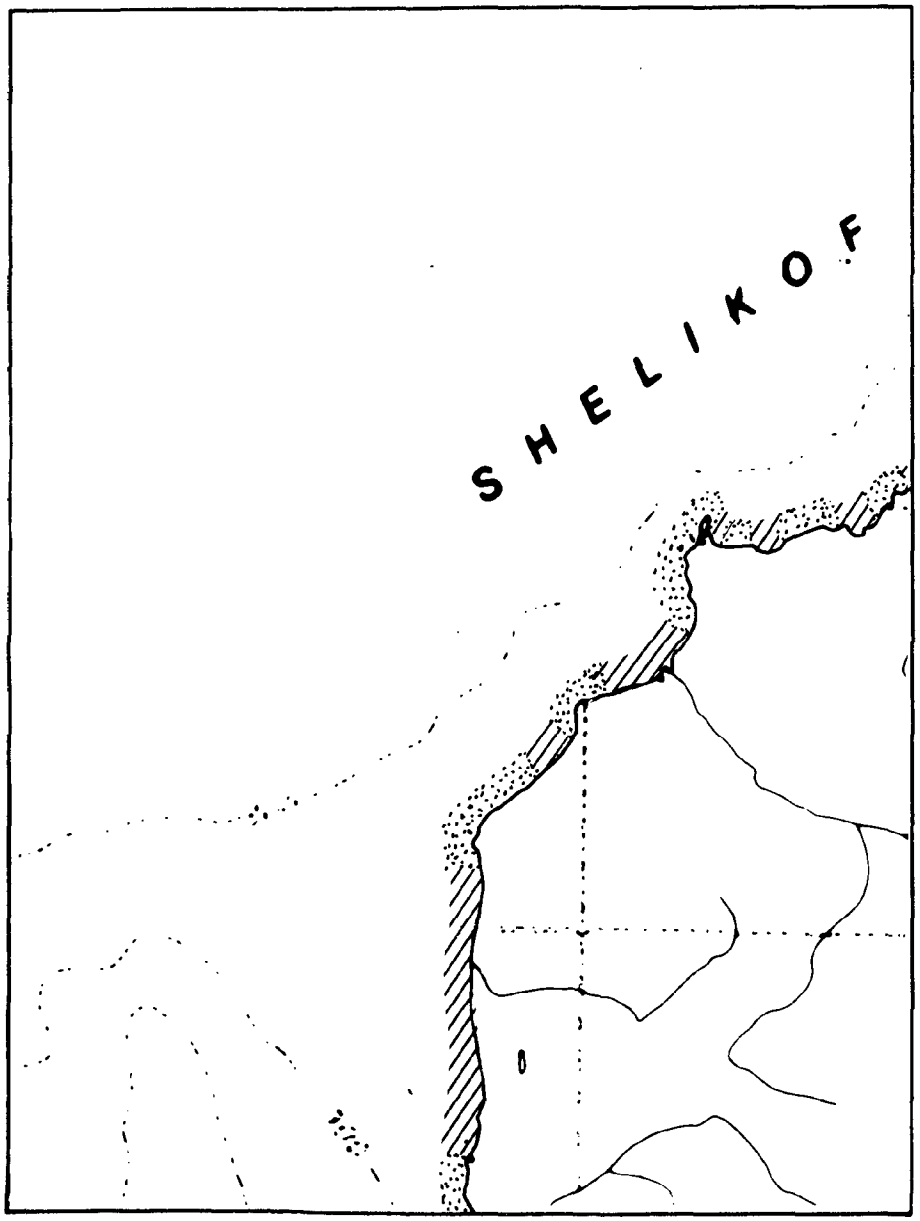

oH7
H1
H1
Marmot
Island
Marmot Cape

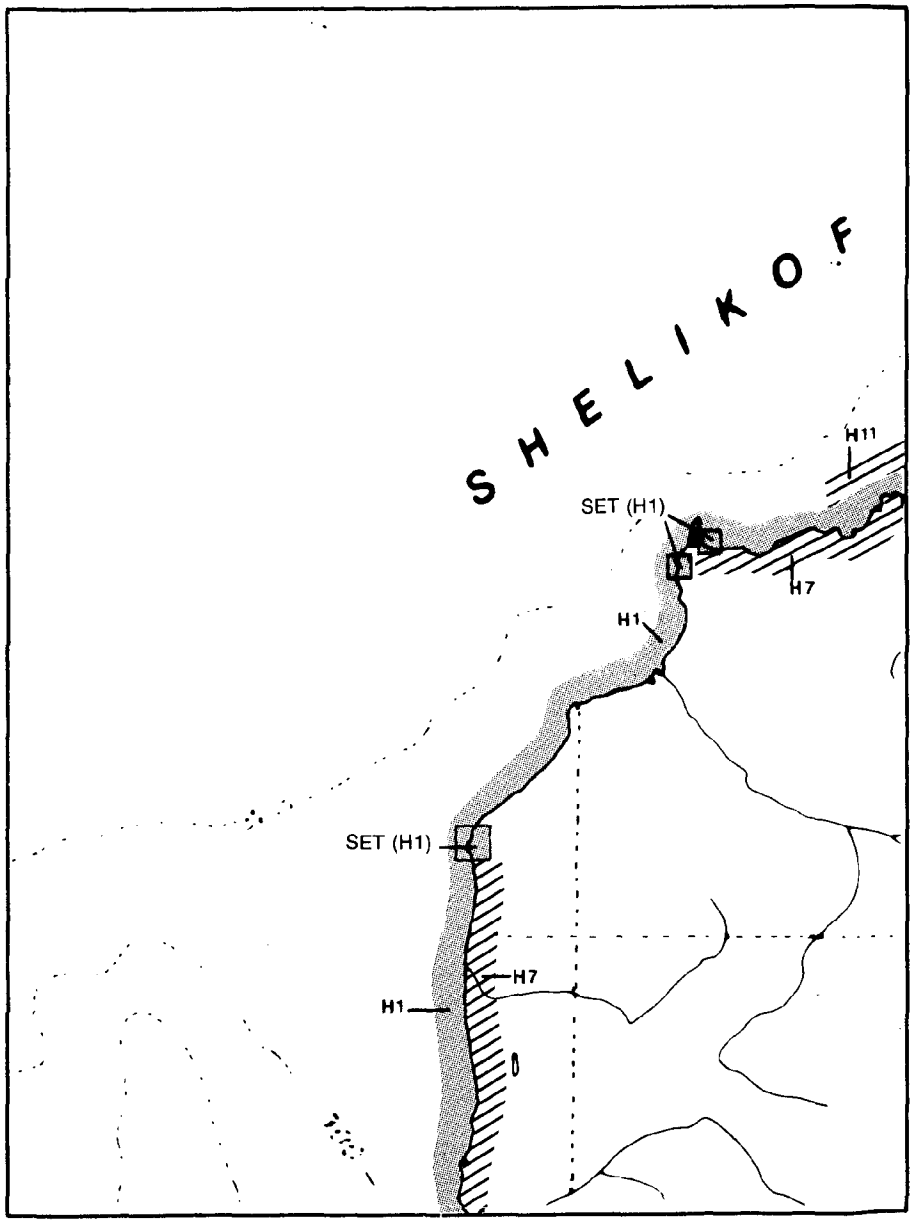


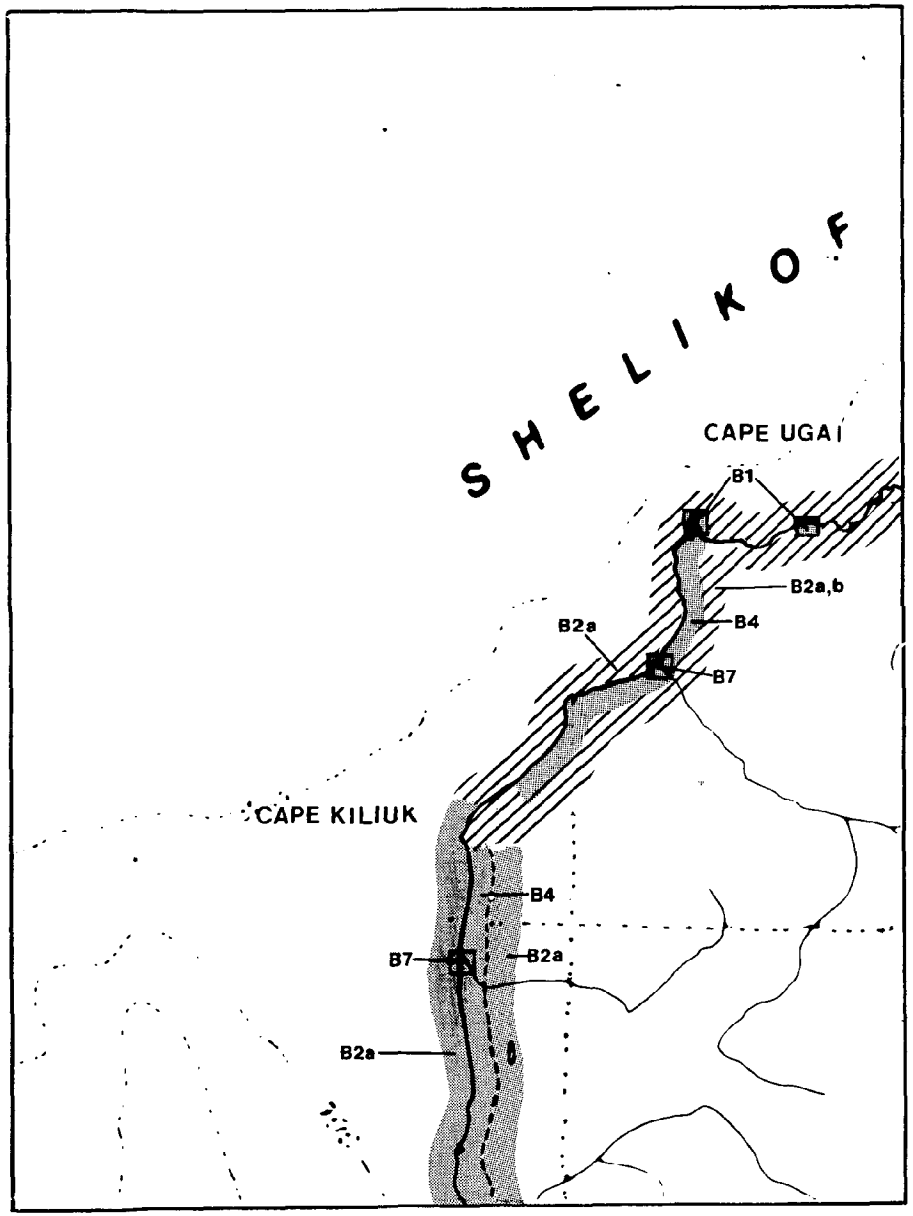
MAP NUMBER 13

RESOURCE		Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE													
R-1	Rocky Headlands	—	—	—	—	—	—	—	—	—	—	—	—
R-2	Wave-Cut Platforms	—	—	—	—	—	—	—	—	—	—	—	—
R-3	Sand Beaches/Exposed Tidal Flats	—	—	—	—	—	—	—	—	—	—	—	—
R-4	Mixed Sand and Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-5	Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-6	Sheltered Rocky and Gravel Shores	—	—	—	—	—	—	—	—	—	—	—	—
R-7	Protected Estuarine Tidal Flats and Marshes	—	—	—	—	—	—	—	—	—	—	—	—
HUMAN USE INDEX													
Commercial Fisheries													
H-1	Salmon							—	—	—	—		
H-2	Roe Herring					—	—	—					
H-3	Crab		—	—	—	—	—	—	—	—	—	—	—
H-4	Shrimp												
H-5	Halibut												
H-6	Whitefish												
Subsistence													
H-7	Deer/Elk/Reindeer	—											—
H-8	Marine Mammal												
H-9	Crab												
H-10	Waterfowl												
H-11	Clams												
H-12	Halibut/Marine Fish												
H-13	Salmon												
Recreation													
H-14	Recreation Use Area												
H-15	Recreation Facility												
Infrastructure													
H-16	Boat Harbor												
H-17	Dock												
H-18	Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX													
Onshore													
B-1	Seabird Colony						—	—	—	—			
B-2a	Waterfowl (overwintering)	—	—	—	—							—	—
B-2b	Waterfowl (summer use)						—	—	—	—			
B-3	Sea Lion Haul-out												
B-4	Black Tail Deer	—	—	—	—								—
B-5	Elk	—	—	—	—								—
B-6	Brown Bear												
Offshore													
B-2a	Waterfowl (overwintering)	—	—	—	—							—	—
B-2b	Waterfowl (summer use)												
B-7	Anadromous Fish Streams												
	Salmon - Adults						—	—	—	—			
	Salmon - Juveniles	—	—	—	—	—	—	—	—	—	—	—	—
	Char/Dolly Varden - Adults	—							—	—	—	—	—
	Char/Dolly Varden - Juveniles					—	—	—					
	Steelhead - Adults												
	Steelhead - Juveniles												
B-8	Herring Spawning Area												
B-9	Razor Clam Beach												
B-10	Sea Otters	—	—	—	—	—	—	—	—	—	—	—	—

HIGH MEDIUM LOW



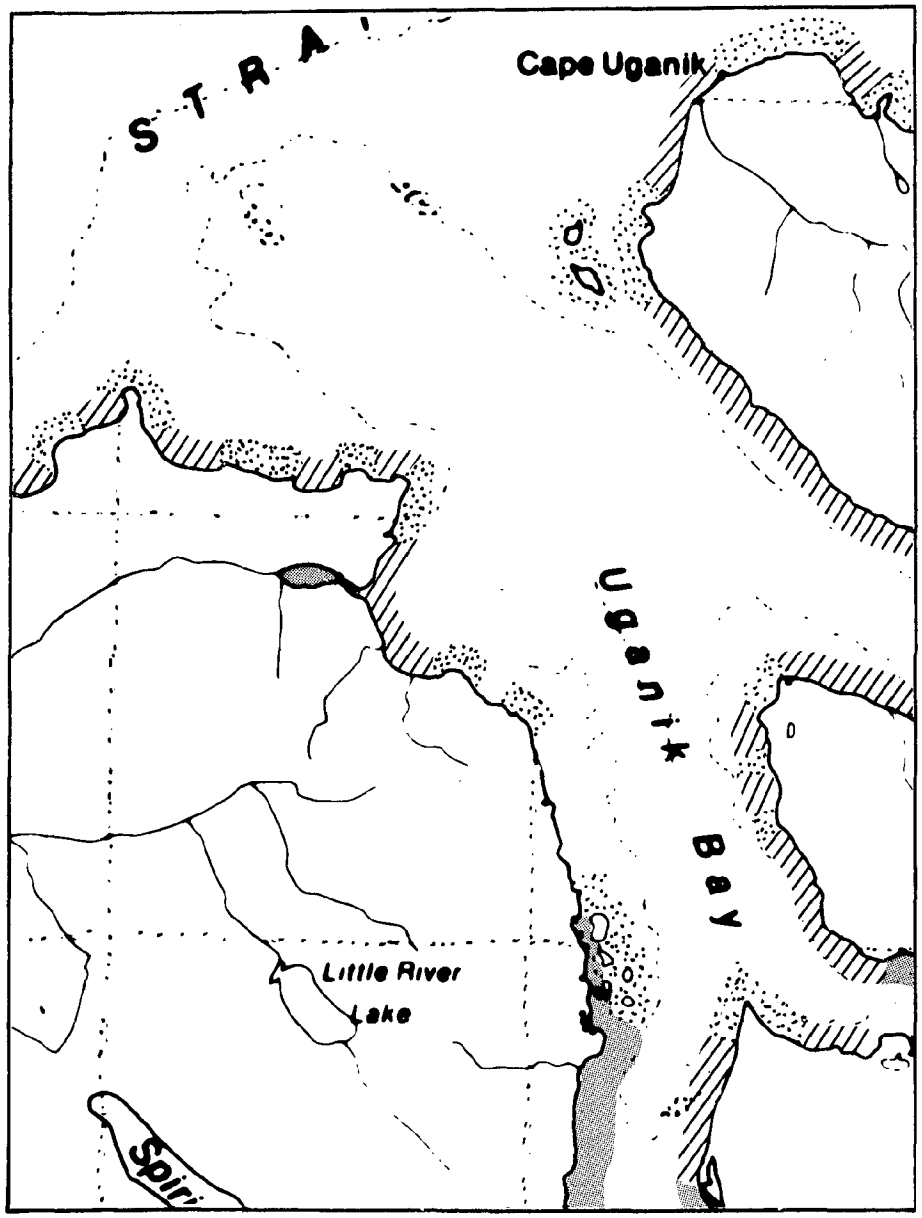


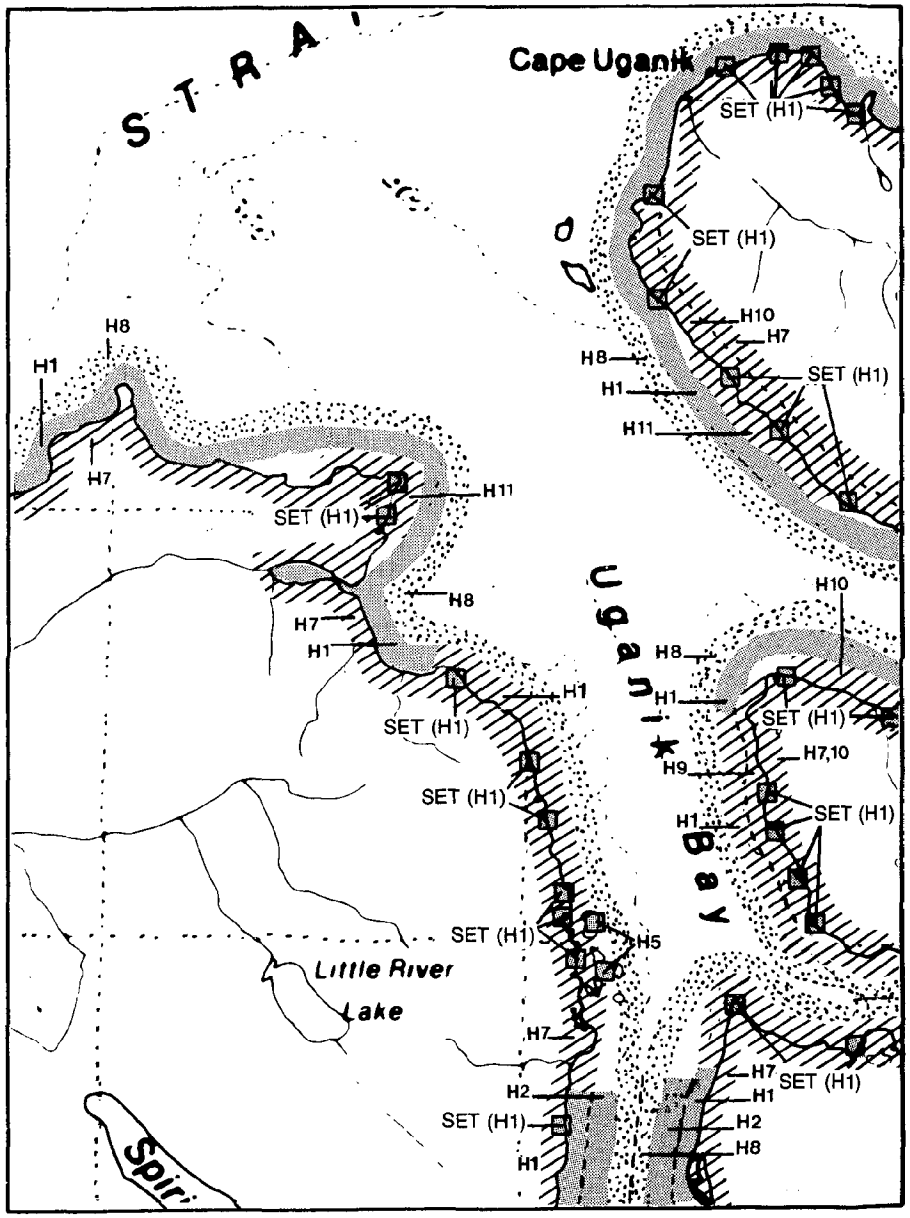


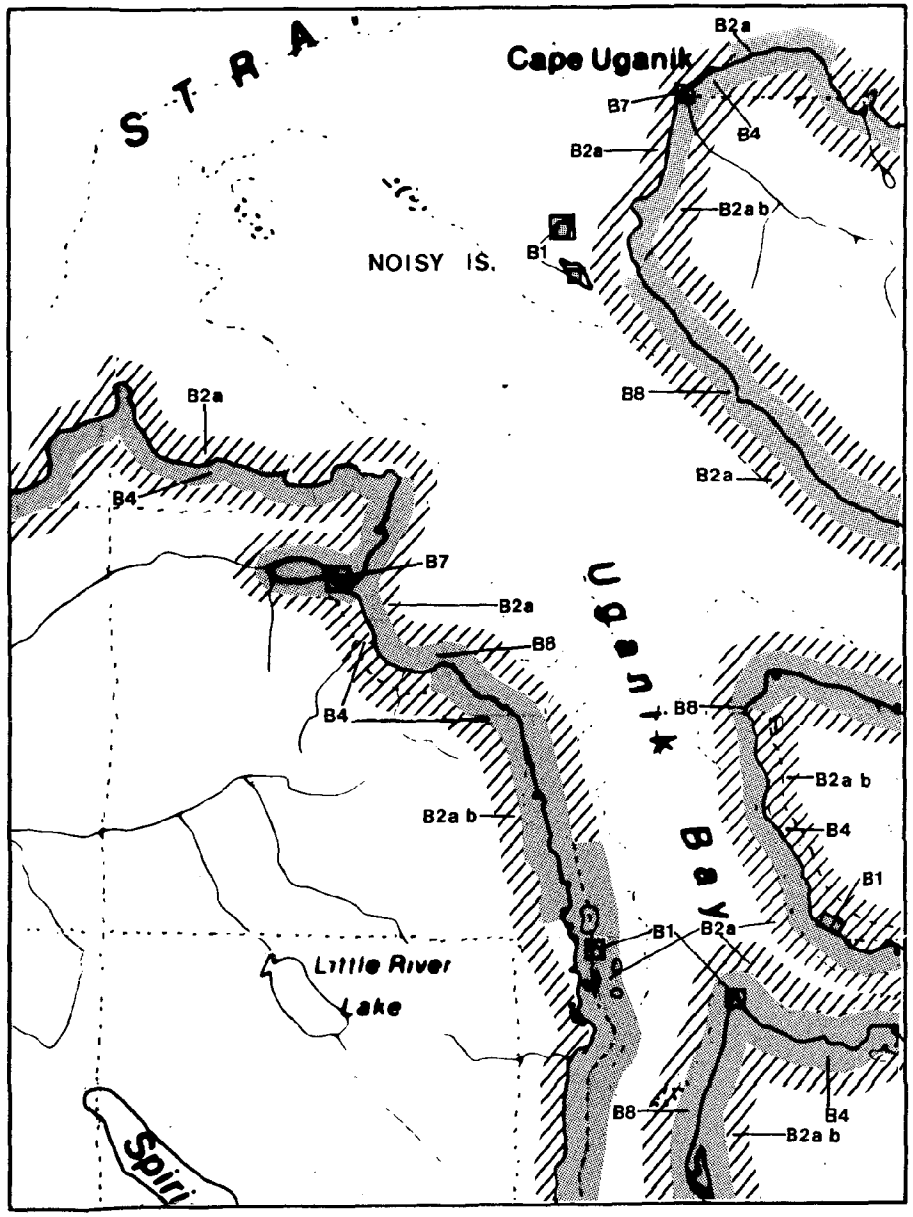
MAP NUMBER 14

RESOURCE	Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE												
R-1 Rocky Headlands	■	■	■	■	■	■	■	■	■	■	■	■
R-2 Wave-Cut Platforms	■	■	■	■	■	■	■	■	■	■	■	■
R-3 Sand Beaches/Exposed Tidal Flats	■	■	■	■	■	■	■	■	■	■	■	■
R-4 Mixed Sand and Gravel Beaches	■	■	■	■	■	■	■	■	■	■	■	■
R-5 Gravel Beaches	■	■	■	■	■	■	■	■	■	■	■	■
R-6 Sheltered Rocky and Gravel Shores	■	■	■	■	■	■	■	■	■	■	■	■
R-7 Protected Estuarine Tidal Flats and Marshes	■	■	■	■	■	■	■	■	■	■	■	■
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon							■	■	■	■		
H-2 Roe Herring					■	■	■					
H-3 Crab		■	■	■	■	■	■	■	■	■	■	■
H-4 Shrimp												
H-5 Halibut							■	■				
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer	■											■
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon												
Recreation												
H-14 Recreation Use Area												
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony							■	■	■	■		
B-2a Waterfowl (overwintering)	■	■	■	■							■	■
B-2b Waterfowl (summer use)							■	■	■	■		
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer	■	■	■	■								■
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)	■	■	■	■							■	■
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults							■	■	■	■	■	■
Salmon - Juveniles	■	■	■	■	■	■	■	■	■	■	■	■
Char/Dolly Varden - Adults												
Char/Dolly Varden - Juveniles												
Steelhead - Adults	■	■	■	■	■	■	■		■	■	■	■
Steelhead - Juveniles							■	■	■			
B-8 Herring Spawning Area												
B-9 Razor Clam Beach												
B-10 Sea Otters												

HIGH MEDIUM LOW





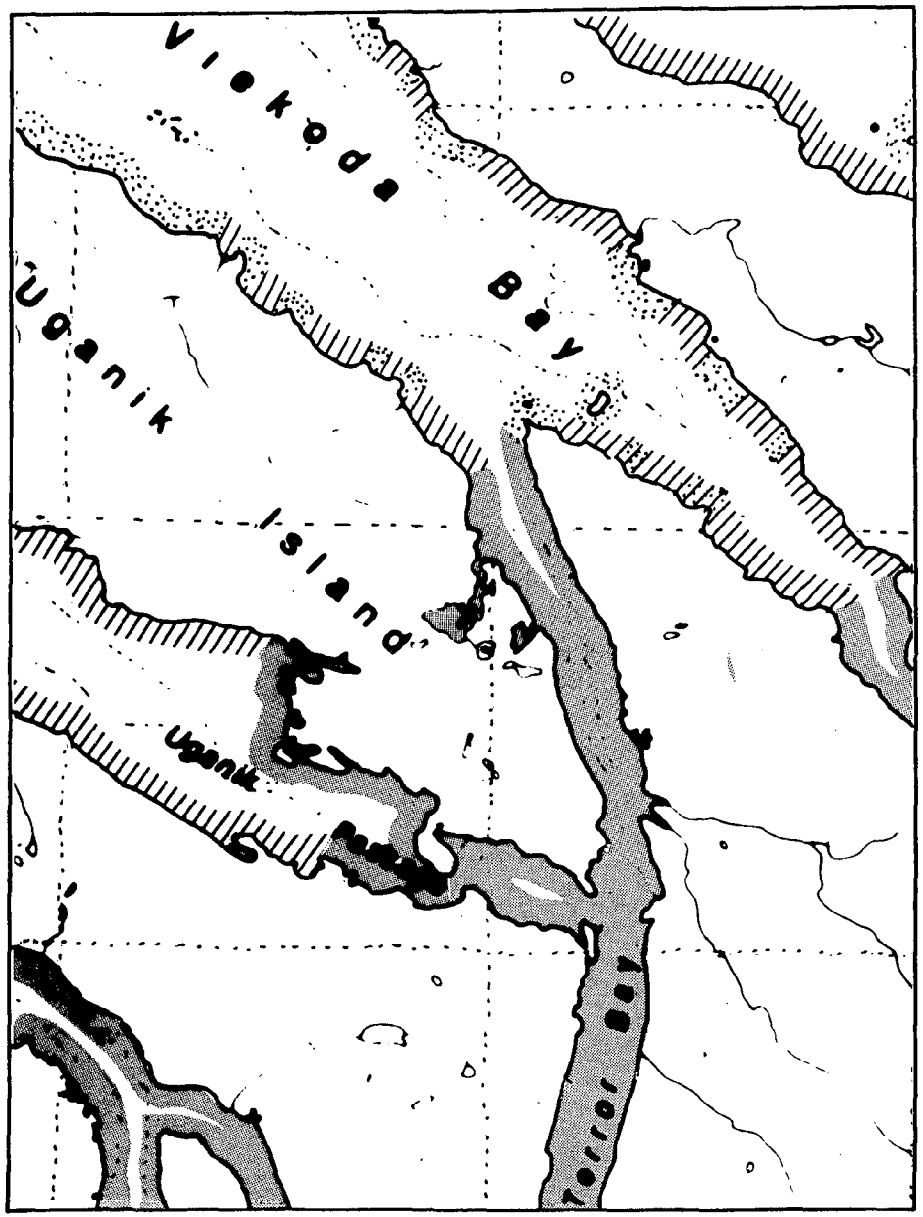


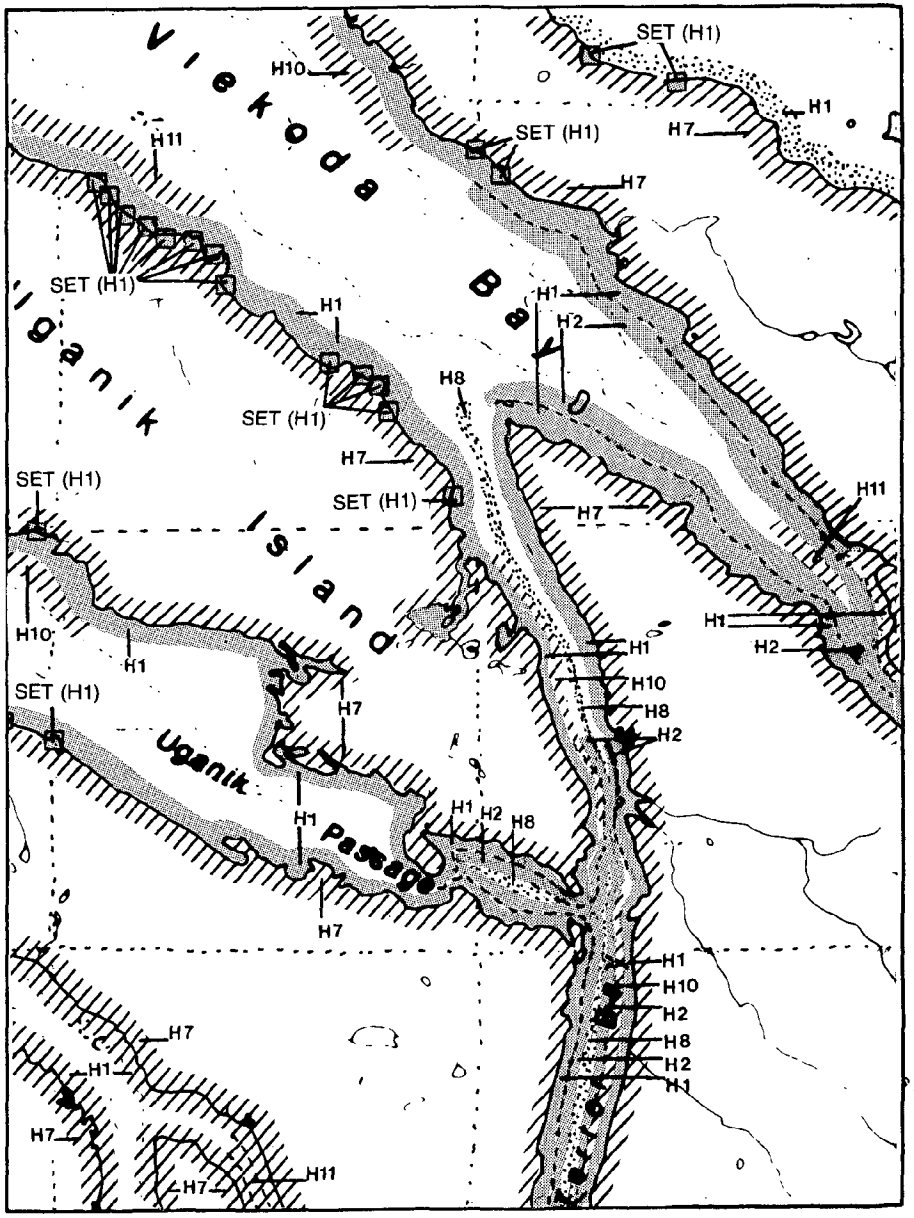
MAP NUMBER 15

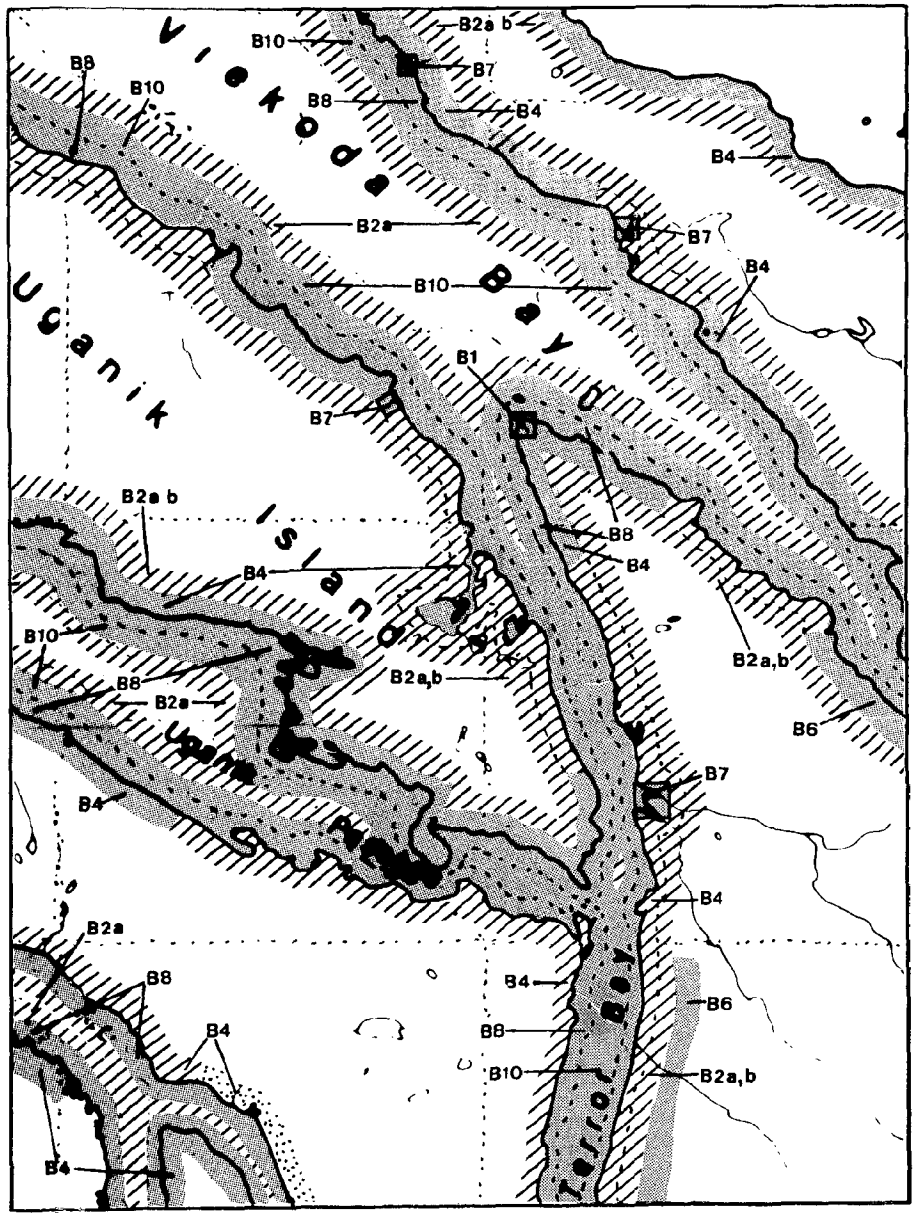
RESOURCE		Winter			Spring			Summer			Fall		
		D	J	F	M	A	M	J	J	A	S	O	N
OIL RESIDENCE													
R-1	Rocky Headlands	—	—	—	—	—	—	—	—	—	—	—	—
R-2	Wave-Cut Platforms	—	—	—	—	—	—	—	—	—	—	—	—
R-3	Sand Beaches/Exposed Tidal Flats	—	—	—	—	—	—	—	—	—	—	—	—
R-4	Mixed Sand and Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-5	Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-6	Sheltered Rocky and Gravel Shores	—	—	—	—	—	—	—	—	—	—	—	—
R-7	Protected Estuarine Tidal Flats and Marshes	—	—	—	—	—	—	—	—	—	—	—	—
HUMAN USE INDEX													
Commercial Fisheries													
H-1	Salmon							—	—	—	—		
H-2	Roe Herring					—	—	—					
H-3	Crab						—	—	—	—	—	—	
H-4	Shrimp												
H-5	Halibut							—	—				
H-6	Whitefish												
Subsistence													
H-7	Deer/Elk/Reindeer	—											—
H-8	Marine Mammal	—	—	—	—	—	—	—	—	—	—	—	—
H-9	Crab	—	—	—	—	—	—	—	—	—	—	—	—
H-10	Waterfowl	—								—	—	—	—
H-11	Clams												
H-12	Halibut/Marine Fish												
H-13	Salmon												
Recreation													
H-14	Recreation Use Area												
H-15	Recreation Facility												
Infrastructure													
H-16	Boat Harbor												
H-17	Dock												
H-18	Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX													
Onshore													
B-1	Seabird Colony						—	—	—	—	—		
B-2a	Waterfowl (overwintering)	—	—	—	—							—	—
B-2b	Waterfowl (summer use)						—	—	—	—	—		
B-3	Sea Lion Haul-out												
B-4	Black Tail Deer	—	—	—	—								—
B-5	Elk												
B-6	Brown Bear												
Offshore													
B-2a	Waterfowl (overwintering)	—	—	—	—							—	—
B-2b	Waterfowl (summer use)												
B-7	Anadromous Fish Streams												
	Salmon - Adults						—	—	—	—	—	—	—
	Salmon - Juveniles												
	Char/Dolly Varden - Adults												
	Char/Dolly Varden - Juveniles												
	Steelhead - Adults												
	Steelhead - Juveniles												
B-8	Herring Spawning Area					—	—						
B-9	Razor Clam Beach												
B-10	Sea Otters												

		9
14	15	16
22	23	24

HIGH MEDIUM LOW





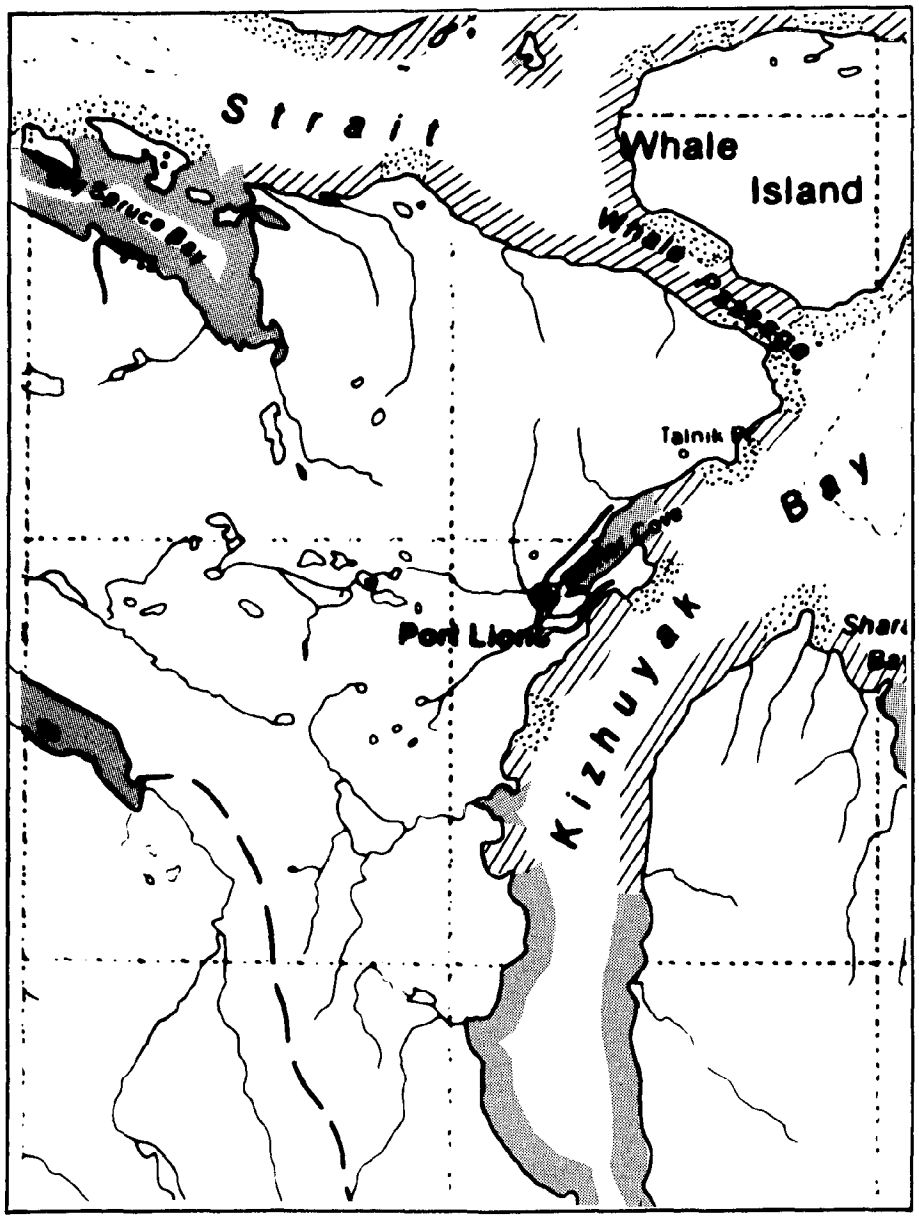


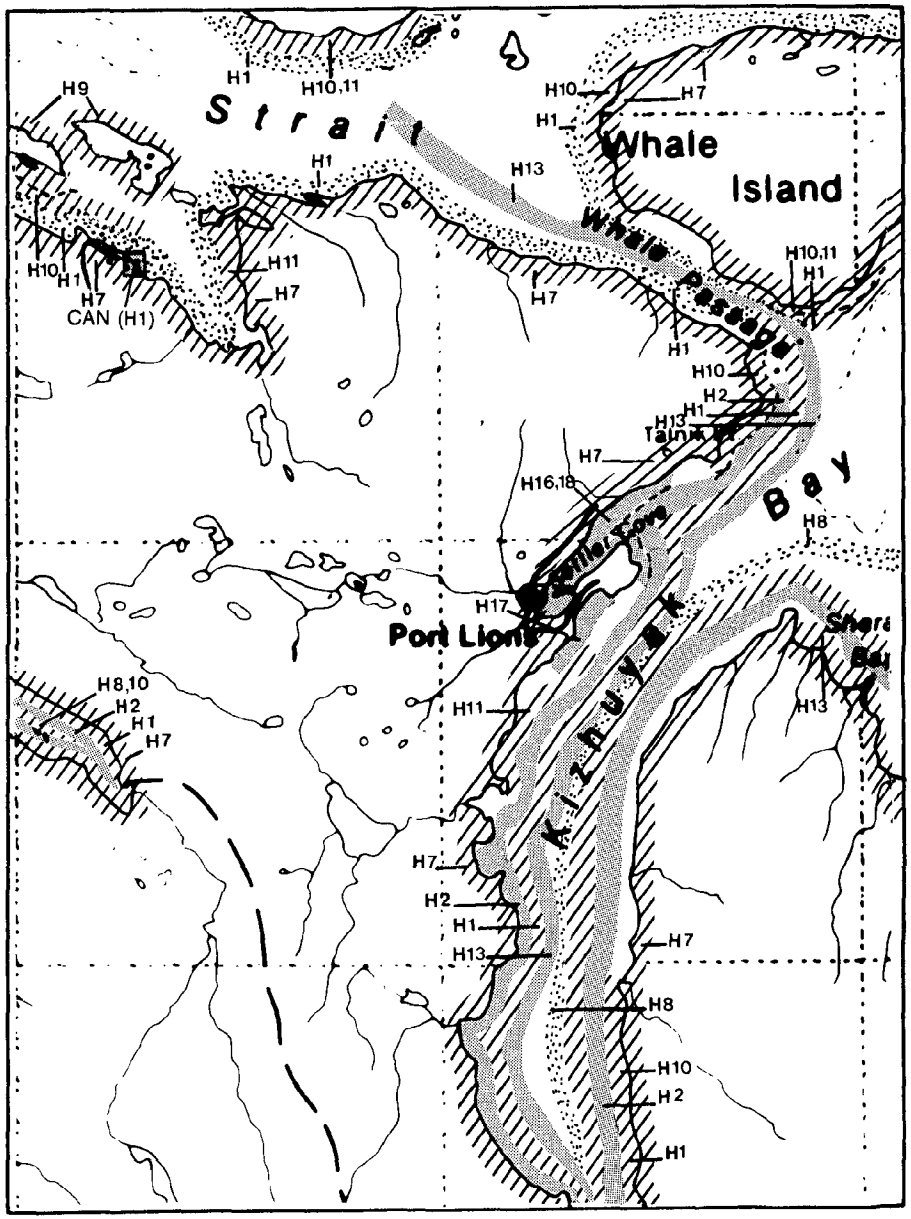
MAP NUMBER 16

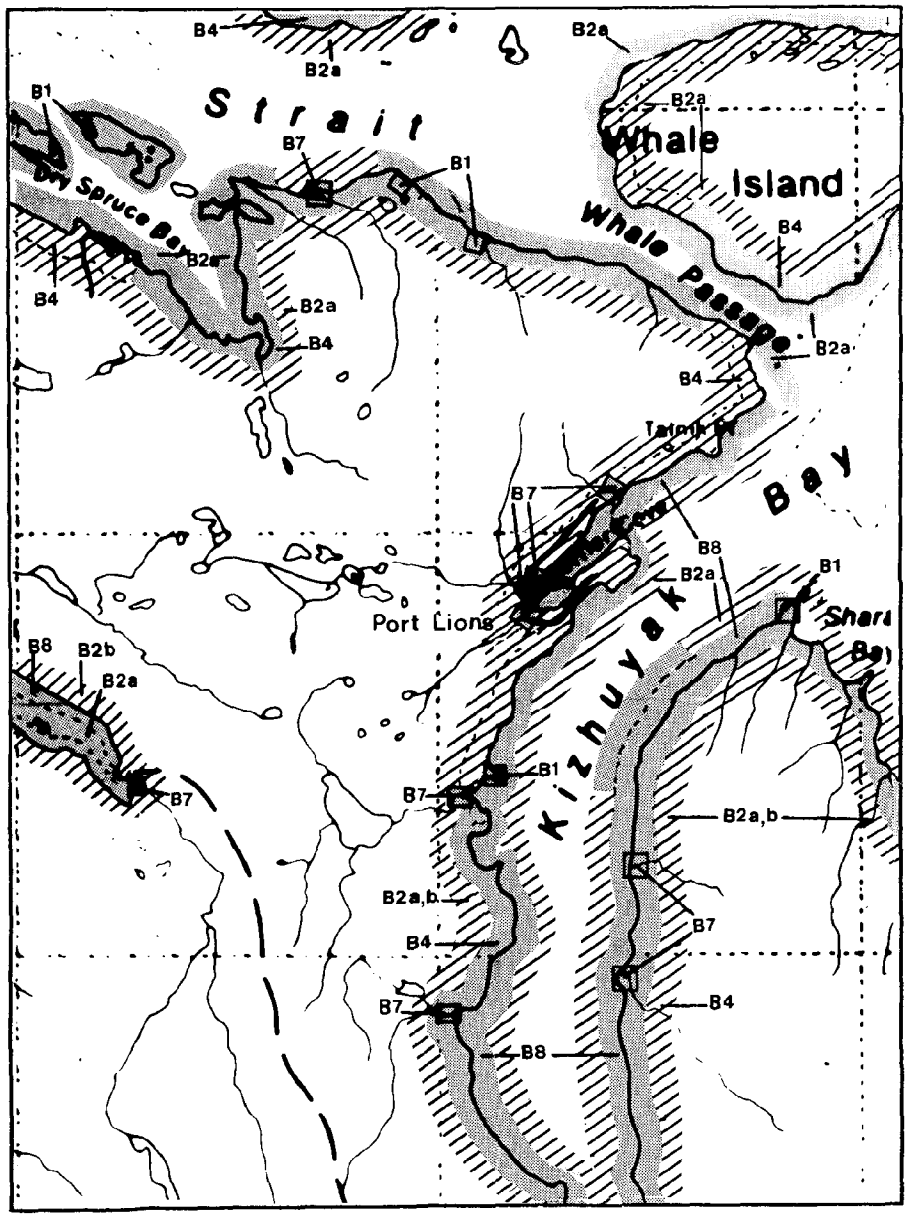
RESOURCE	Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE												
R-1 Rocky Headlands												
R-2 Wave-Cut Platforms												
R-3 Sand Beaches/Exposed Tidal Flats												
R-4 Mixed Sand and Gravel Beaches												
R-5 Gravel Beaches												
R-6 Sheltered Rocky and Gravel Shores												
R-7 Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon												
H-2 Roe Herring												
H-3 Crab												
H-4 Shrimp												
H-5 Halibut												
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer												
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon												
Recreation												
H-14 Recreation Use Area												
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer												
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults												
Salmon - Juveniles												
Char/Dolly Varden - Adults												
Char/Dolly Varden - Juveniles												
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area												
B-9 Razor Clam Beach												
B-10 Sea Otters												

	9	10
15	16	17
23	24	25

HIGH MEDIUM LOW





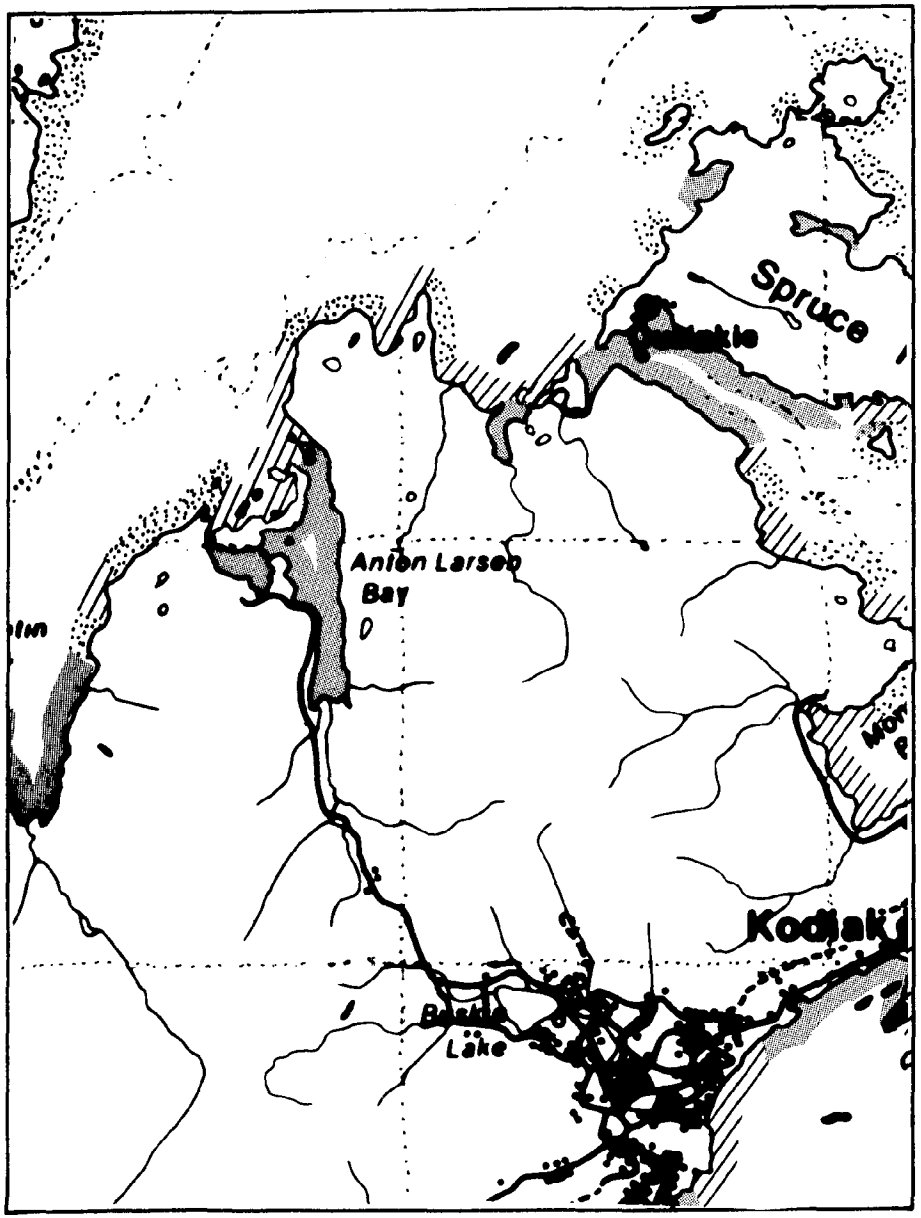


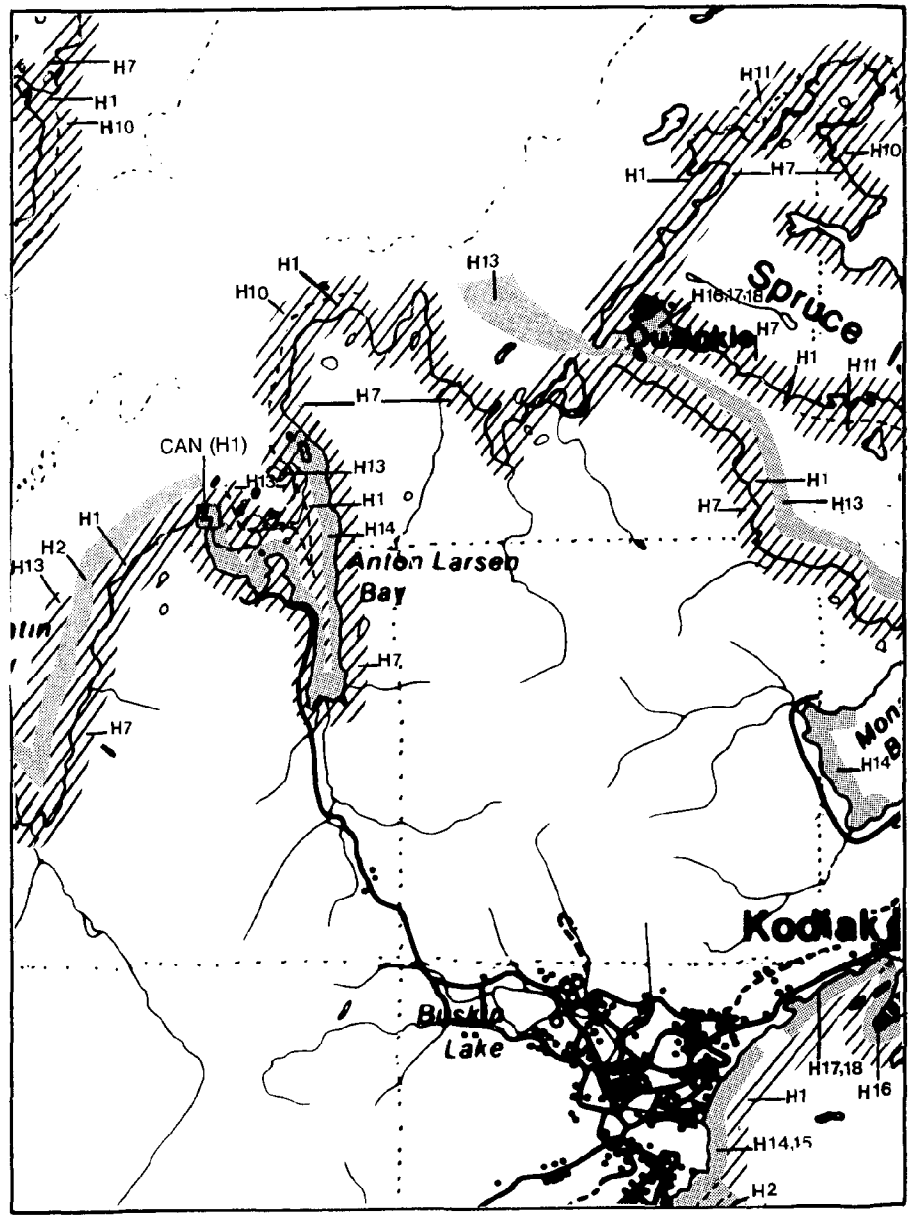
MAP NUMBER 17

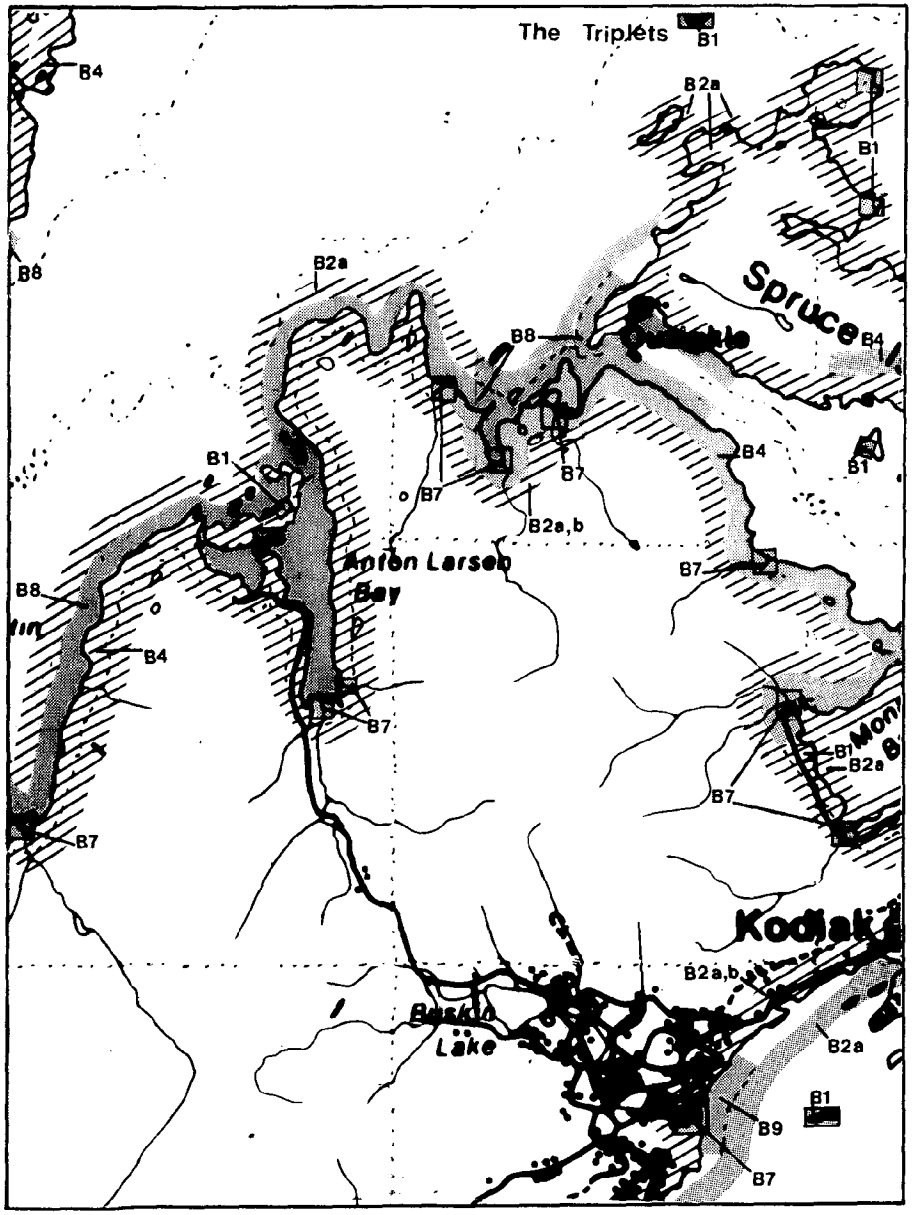
RESOURCE	Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE												
R-1 Rocky Headlands												
R-2 Wave-Cut Platforms												
R-3 Sand Beaches/Exposed Tidal Flats												
R-4 Mixed Sand and Gravel Beaches												
R-5 Gravel Beaches												
R-6 Sheltered Rocky and Gravel Shores												
R-7 Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon												
H-2 Roe Herring												
H-3 Crab												
H-4 Shrimp												
H-5 Halibut												
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer												
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon												
Recreation												
H-14 Recreation Use Area												
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer												
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults												
Salmon - Juveniles												
Char/Dolly Varden - Adults												
Char/Dolly Varden - Juveniles												
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area												
B-9 Razor Clam Beach												
B-10 Sea Otters												

9	10	11
16	17	18
24	25	26

HIGH MEDIUM LOW





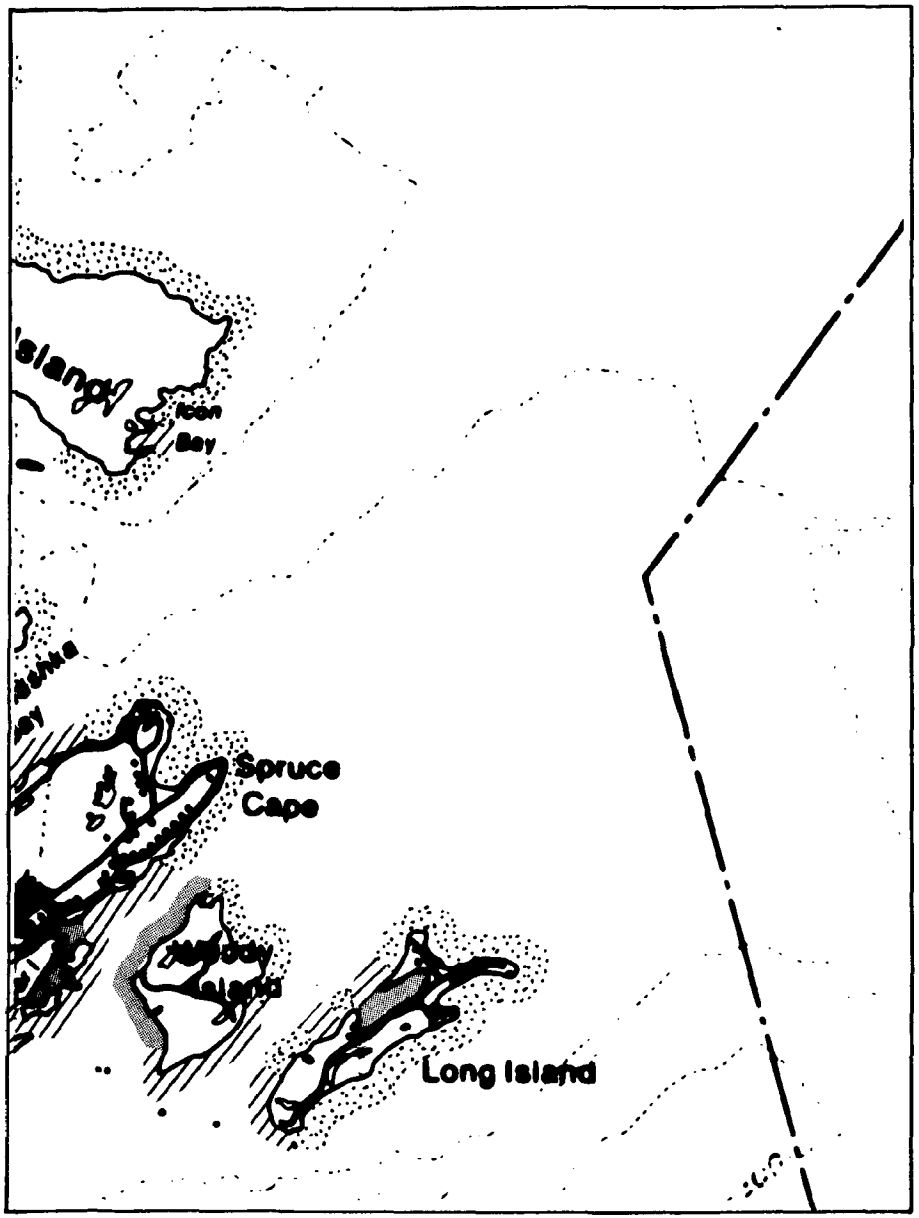


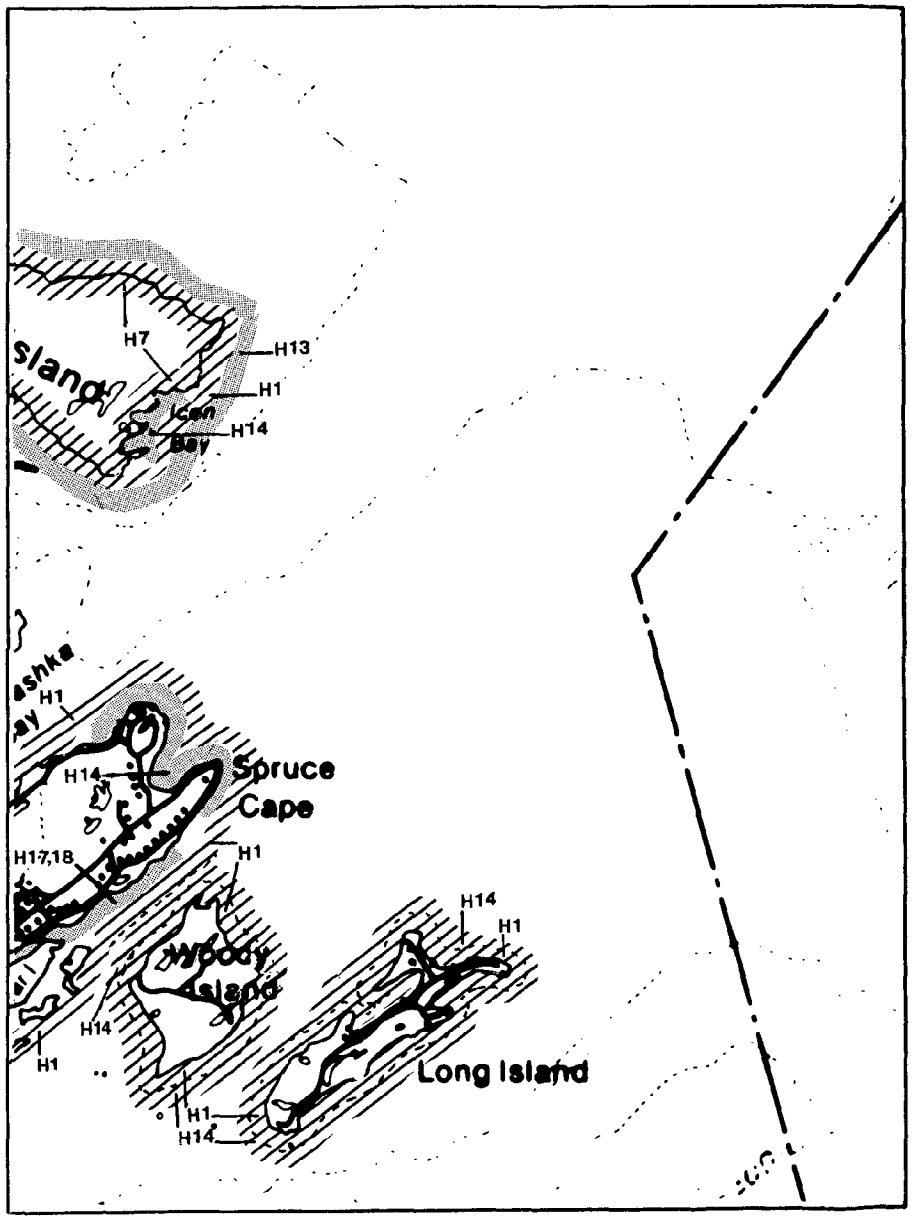
MAP NUMBER 18

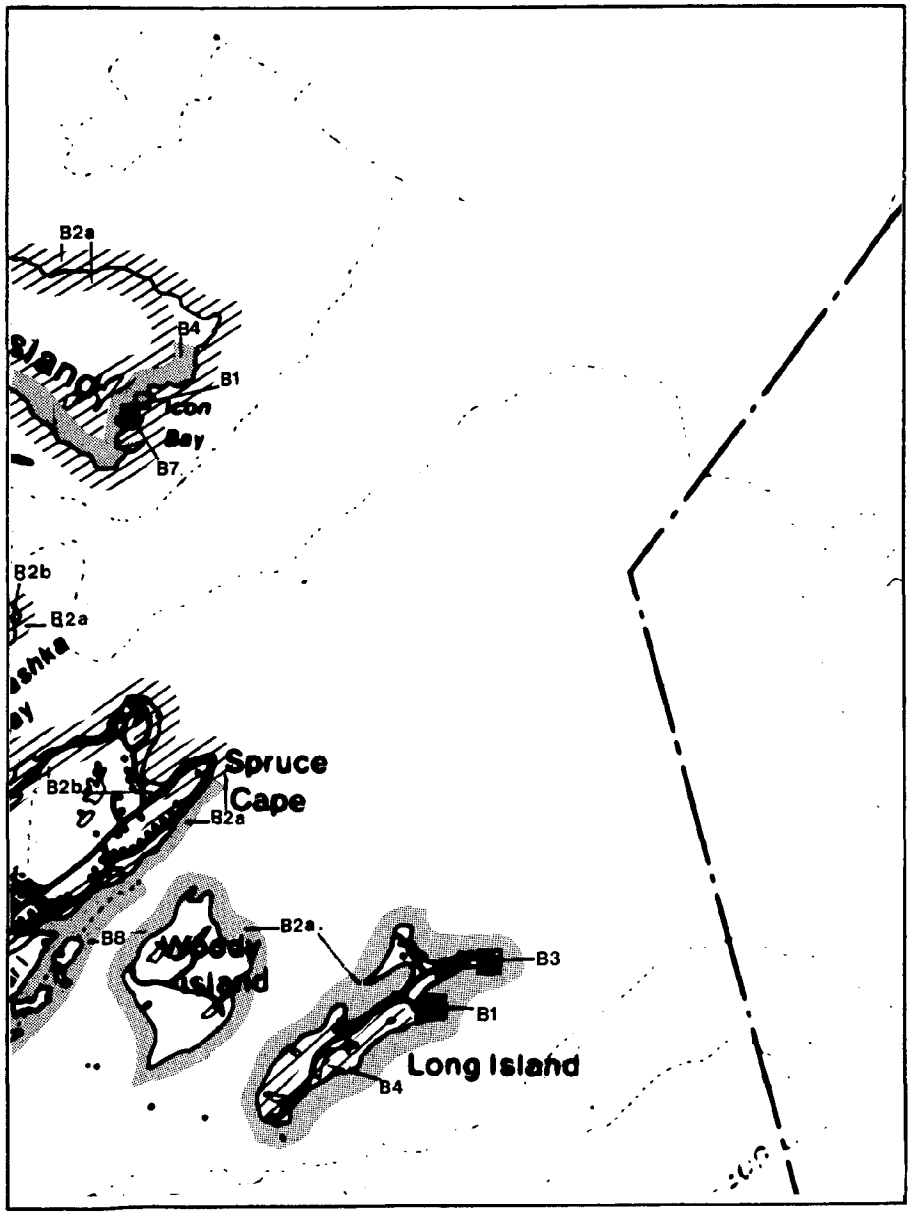
RESOURCE	Winter			Spring			Summer			Fall		
	D	J	F	M	A	M	J	J	A	S	O	N
OIL RESIDENCE												
R-1 Rocky Headlands												
R-2 Wave-Cut Platforms												
R-3 Sand Beaches/Exposed Tidal Flats												
R-4 Mixed Sand and Gravel Beaches												
R-5 Gravel Beaches												
R-6 Sheltered Rocky and Gravel Shores												
R-7 Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon												
H-2 Roe Herring												
H-3 Crab												
H-4 Shrimp												
H-5 Halibut												
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer												
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon												
Recreation												
H-14 Recreation Use Area												
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer												
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults												
Salmon - Juveniles												
Char/Dolly Varden - Adults												
Char/Dolly Varden - Juveniles												
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area												
B-9 Razor Clam Beach												
B-10 Sea Otters												

10	11	12
17	18	19
25	26	27

HIGH MEDIUM LOW





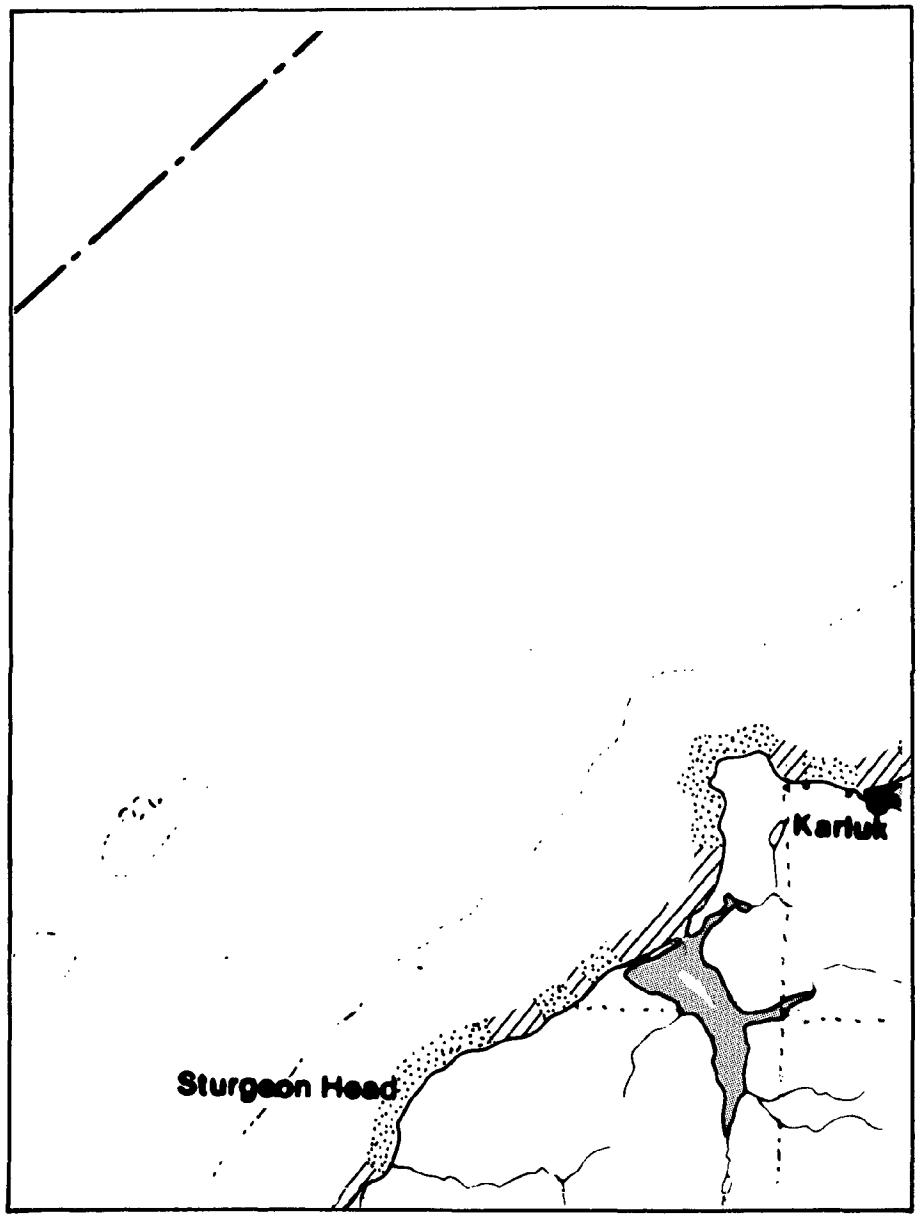


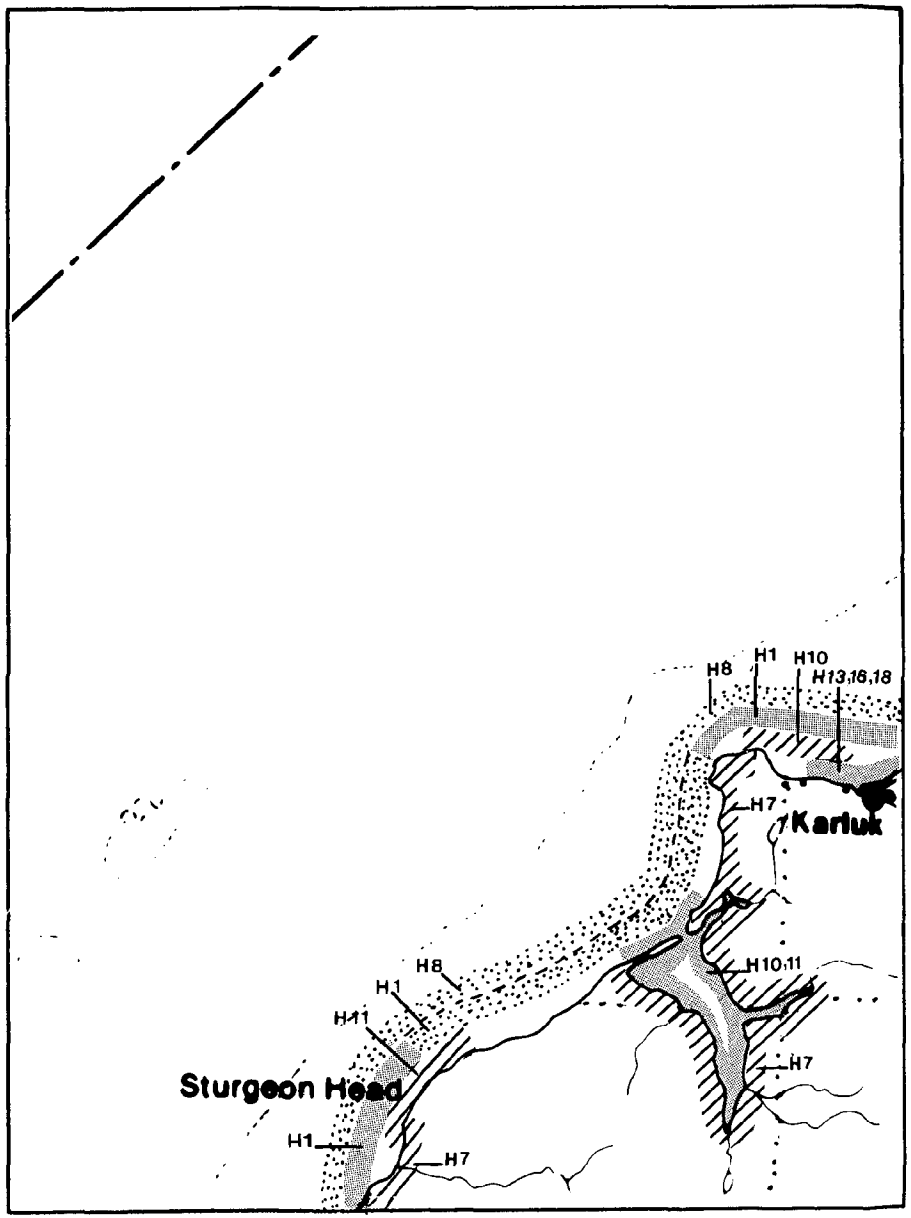
MAP NUMBER 19

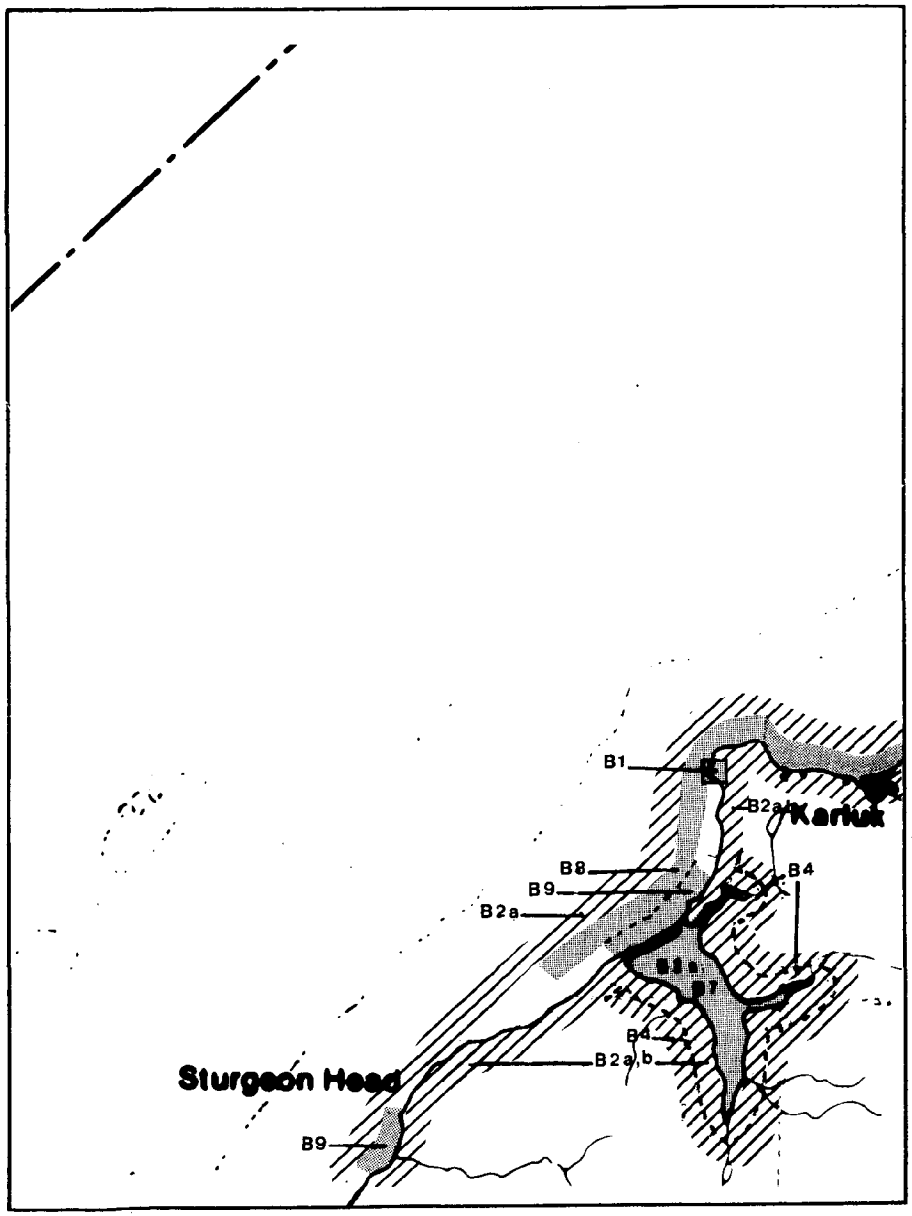
RESOURCE	Winter			Spring			Summer			Fall		
	D	J	F	M	A	M	J	J	A	S	O	N
OIL RESIDENCE												
R-1 Rocky Headlands	—	—	—	—	—	—	—	—	—	—	—	—
R-2 Wave-Cut Platforms	—	—	—	—	—	—	—	—	—	—	—	—
R-3 Sand Beaches/Exposed Tidal Flats	—	—	—	—	—	—	—	—	—	—	—	—
R-4 Mixed Sand and Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-5 Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-6 Sheltered Rocky and Gravel Shores	—	—	—	—	—	—	—	—	—	—	—	—
R-7 Protected Estuarine Tidal Flats and Marshes	—	—	—	—	—	—	—	—	—	—	—	—
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon							—	—	—	—		
H-2 Roe Herring						—	—	—				
H-3 Crab		—	—	—	—	—	—	—	—	—	—	—
H-4 Shrimp												
H-5 Halibut							—	—				
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer	—											—
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon							—	—	—	—	—	—
Recreation												
H-14 Recreation Use Area						—	—	—	—	—		
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property	—	—	—	—	—	—	—	—	—	—	—	—
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony						—	—	—	—	—		
B-2a Waterfowl (overwintering)	—	—	—	—							—	—
B-2b Waterfowl (summer use)						—	—	—	—	—		
B-3 Sea Lion Haul-out	—	—	—	—	—	—	—	—	—	—	—	—
B-4 Black Tail Deer	—	—	—	—								—
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)	—	—	—	—							—	—
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults							—	—	—	—	—	—
Salmon - Juveniles	—	—	—	—	—	—	—	—	—	—	—	—
Char/Dolly Varden - Adults												
Char/Dolly Varden - Juveniles												
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area					—	—	—					
B-9 Razor Clam Beach												
B-10 Sea Otters												

11	12	13
18	19	
26	27	

HIGH MEDIUM LOW



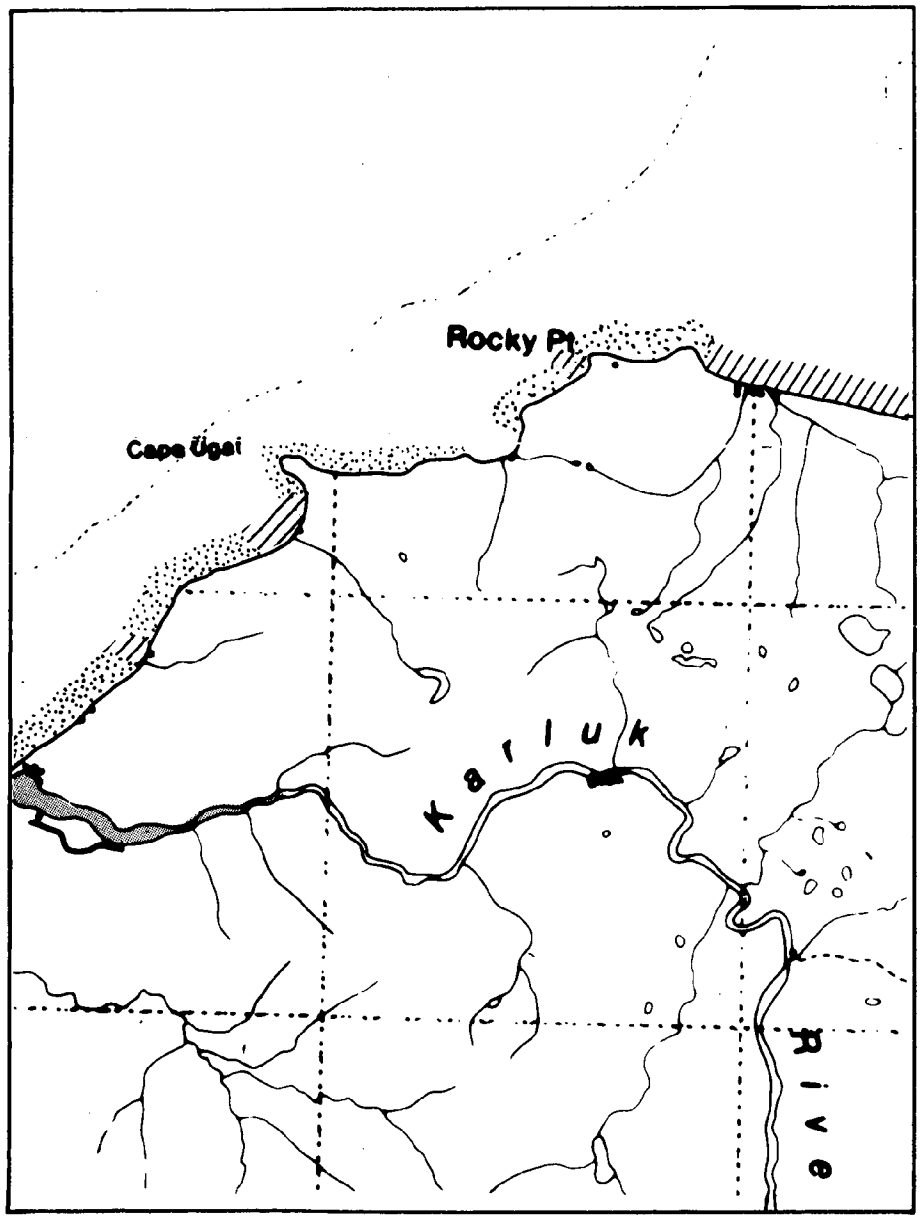


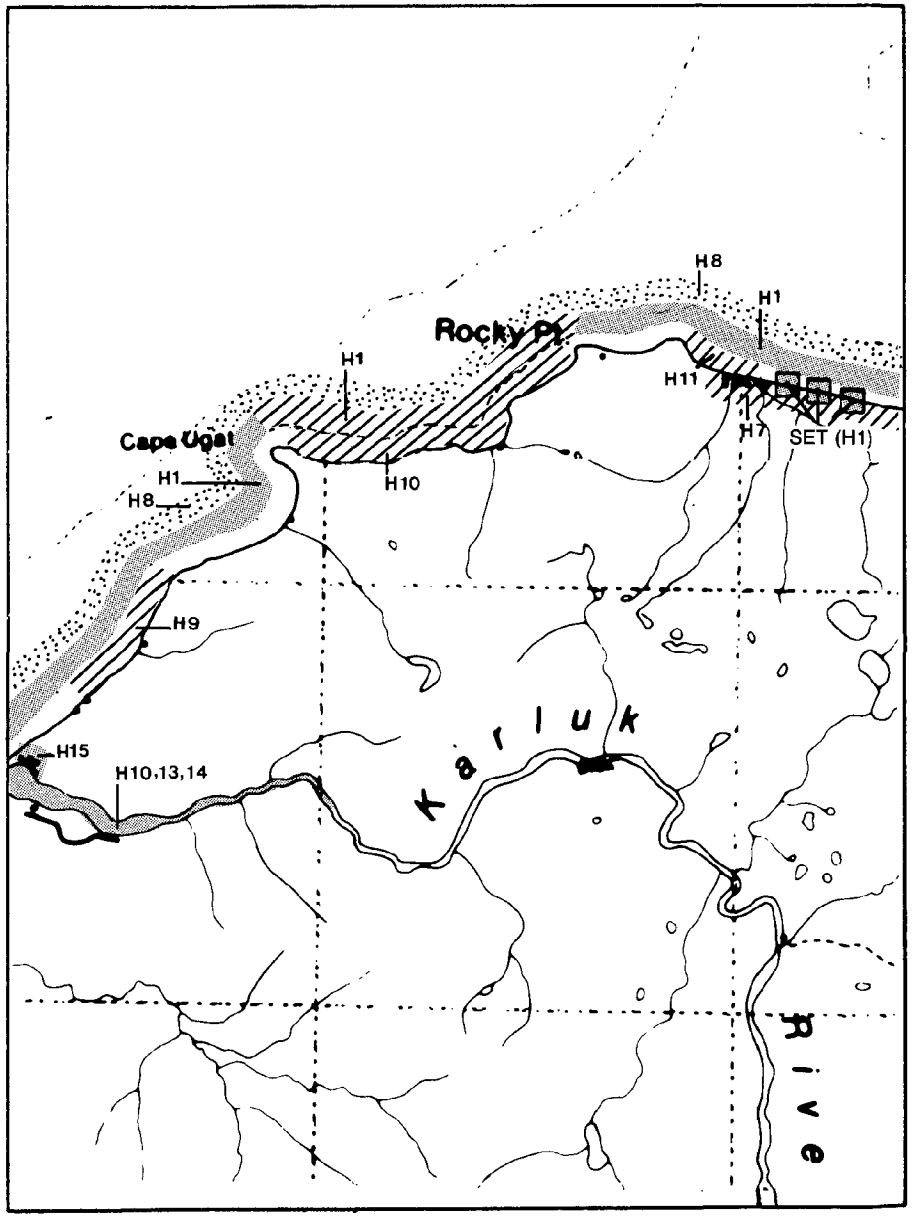


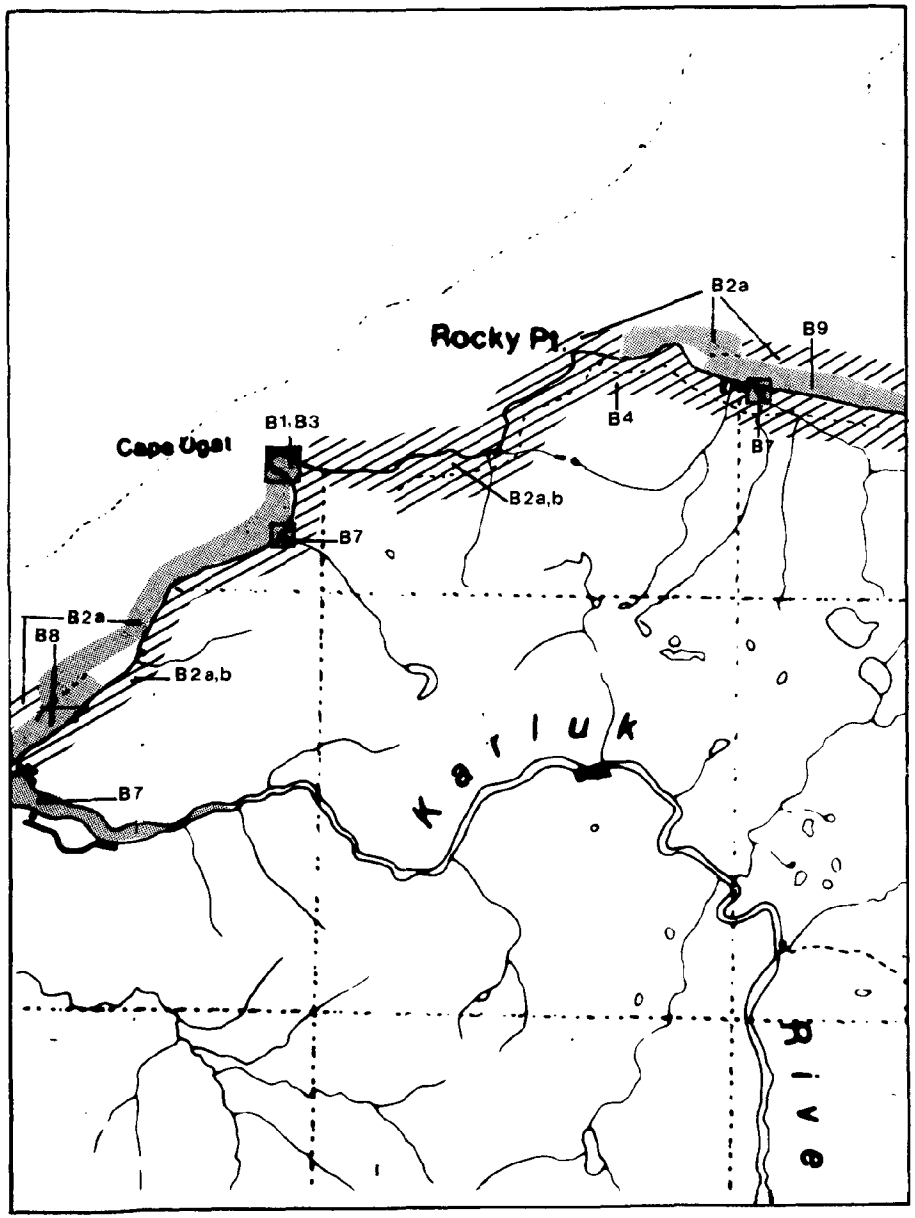
MAP NUMBER 20

RESOURCE	Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE												
R-1 Rocky Headlands												
R-2 Wave-Cut Platforms												
R-3 Sand Beaches/Exposed Tidal Flats												
R-4 Mixed Sand and Gravel Beaches												
R-5 Gravel Beaches												
R-6 Sheltered Rocky and Gravel Shores												
R-7 Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon												
H-2 Roe Herring												
H-3 Crab												
H-4 Shrimp												
H-5 Halibut												
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer												
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon												
Recreation												
H-14 Recreation Use Area												
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer												
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults												
Salmon - Juveniles												
Char/Dolly Varden - Adults												
Char/Dolly Varden - Juveniles												
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area												
B-9 Razor Clam Beach												
B-10 Sea Otters												

HIGH MEDIUM LOW



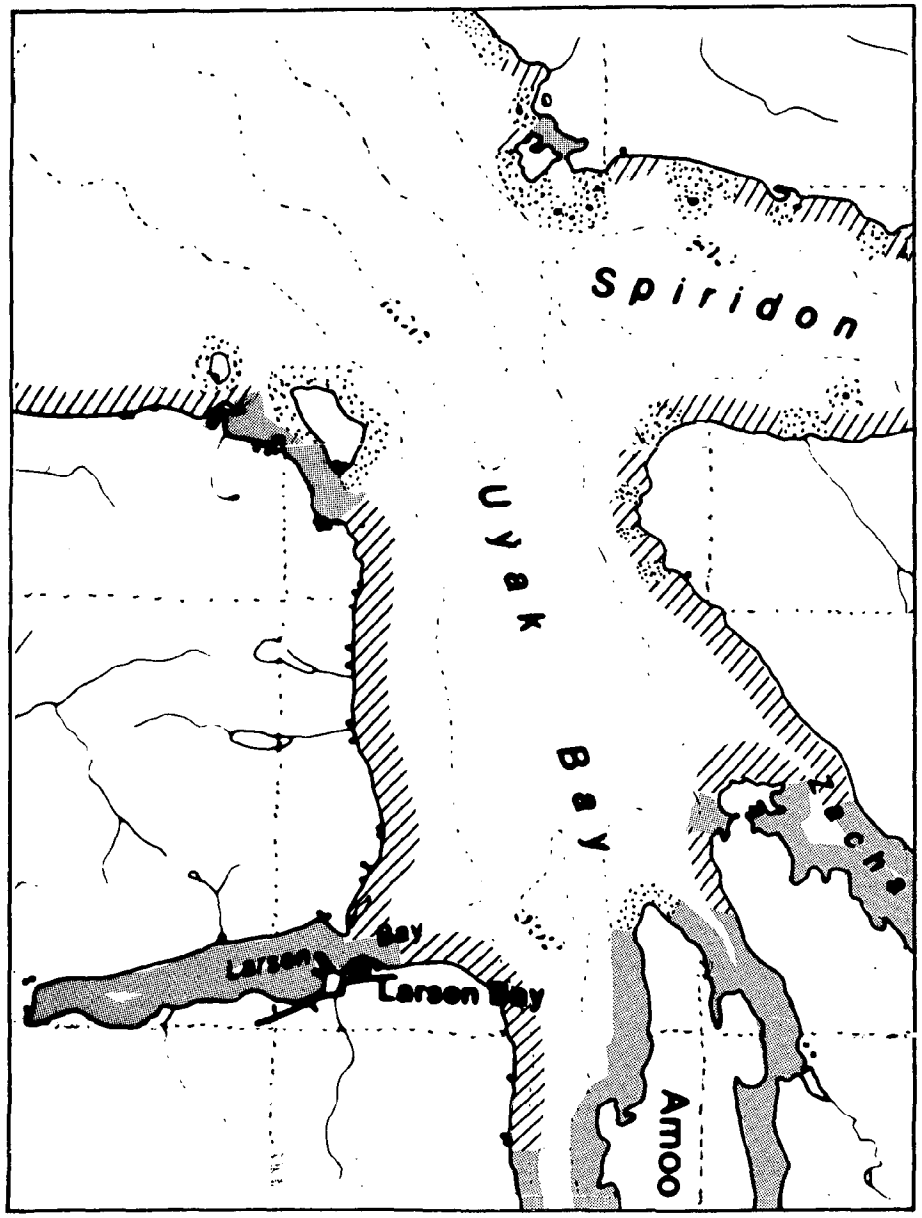


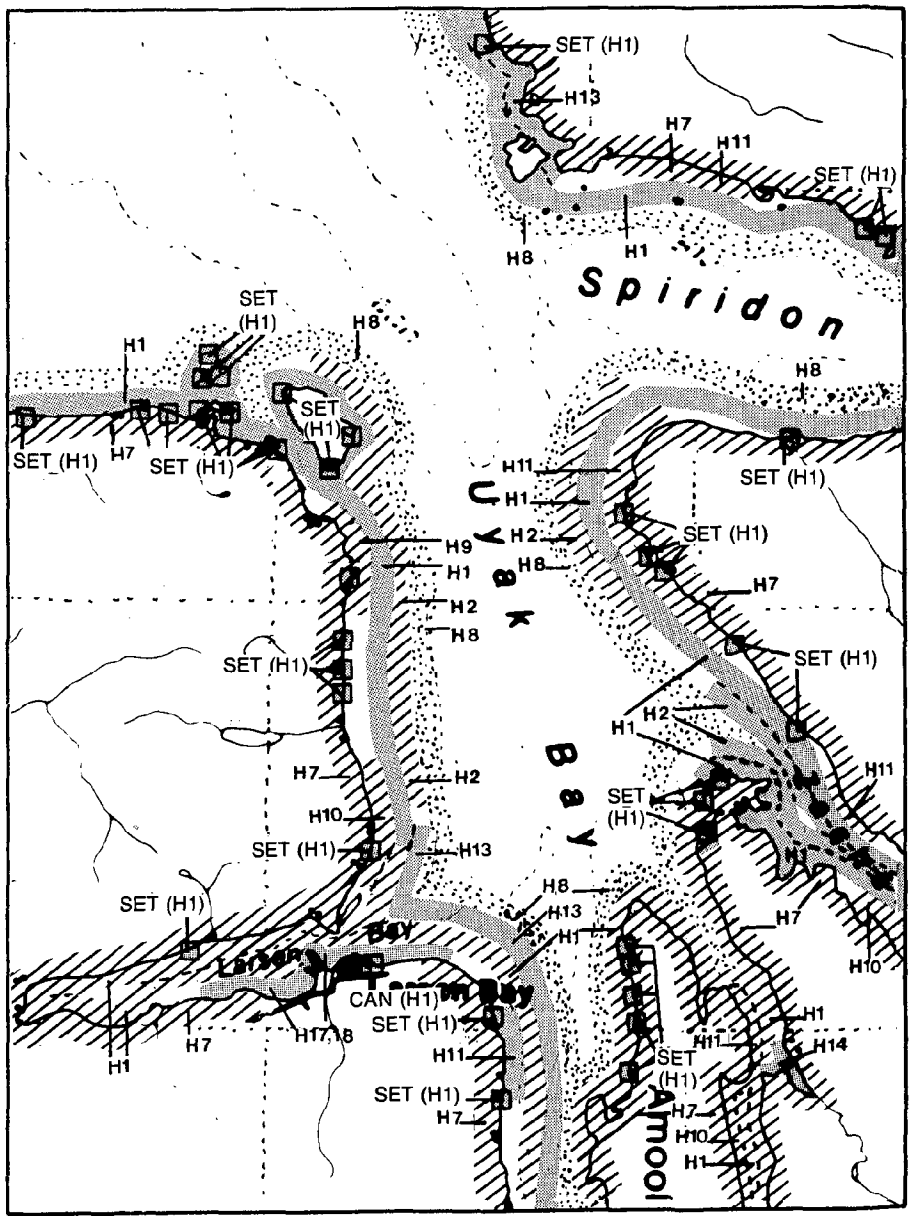


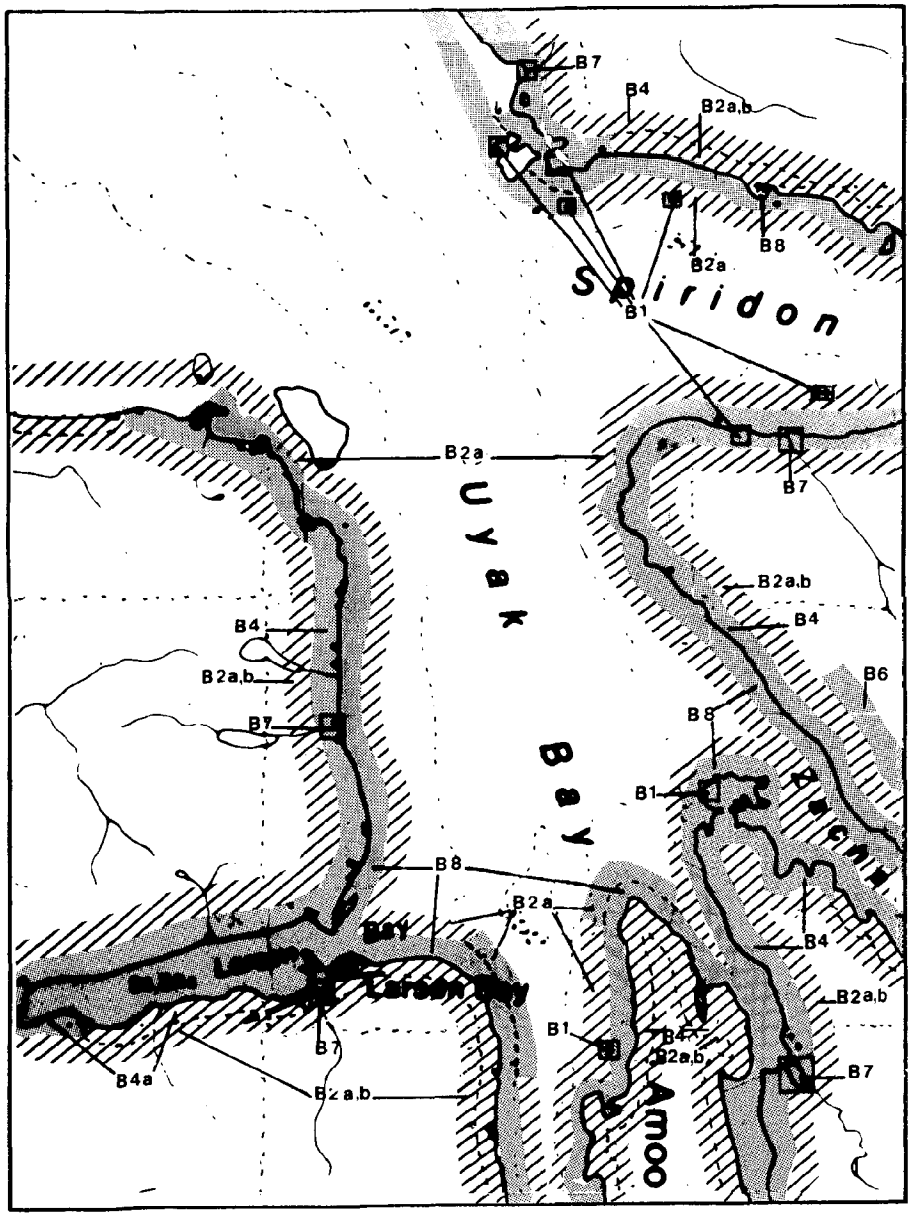
MAP NUMBER 21

RESOURCE	Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE												
R-1 Rocky Headlands												
R-2 Wave-Cut Platforms												
R-3 Sand Beaches/Exposed Tidal Flats												
R-4 Mixed Sand and Gravel Beaches												
R-5 Gravel Beaches												
R-6 Sheltered Rocky and Gravel Shores												
R-7 Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon												
H-2 Roe Herring												
H-3 Crab												
H-4 Shrimp												
H-5 Halibut												
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer												
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon												
Recreation												
H-14 Recreation Use Area												
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer												
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults												
Salmon - Juveniles												
Char/Dolly Varden - Adults												
Char/Dolly Varden - Juveniles												
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area												
B-9 Razor Clam Beach												
B-10 Sea Otters												

HIGH MEDIUM LOW





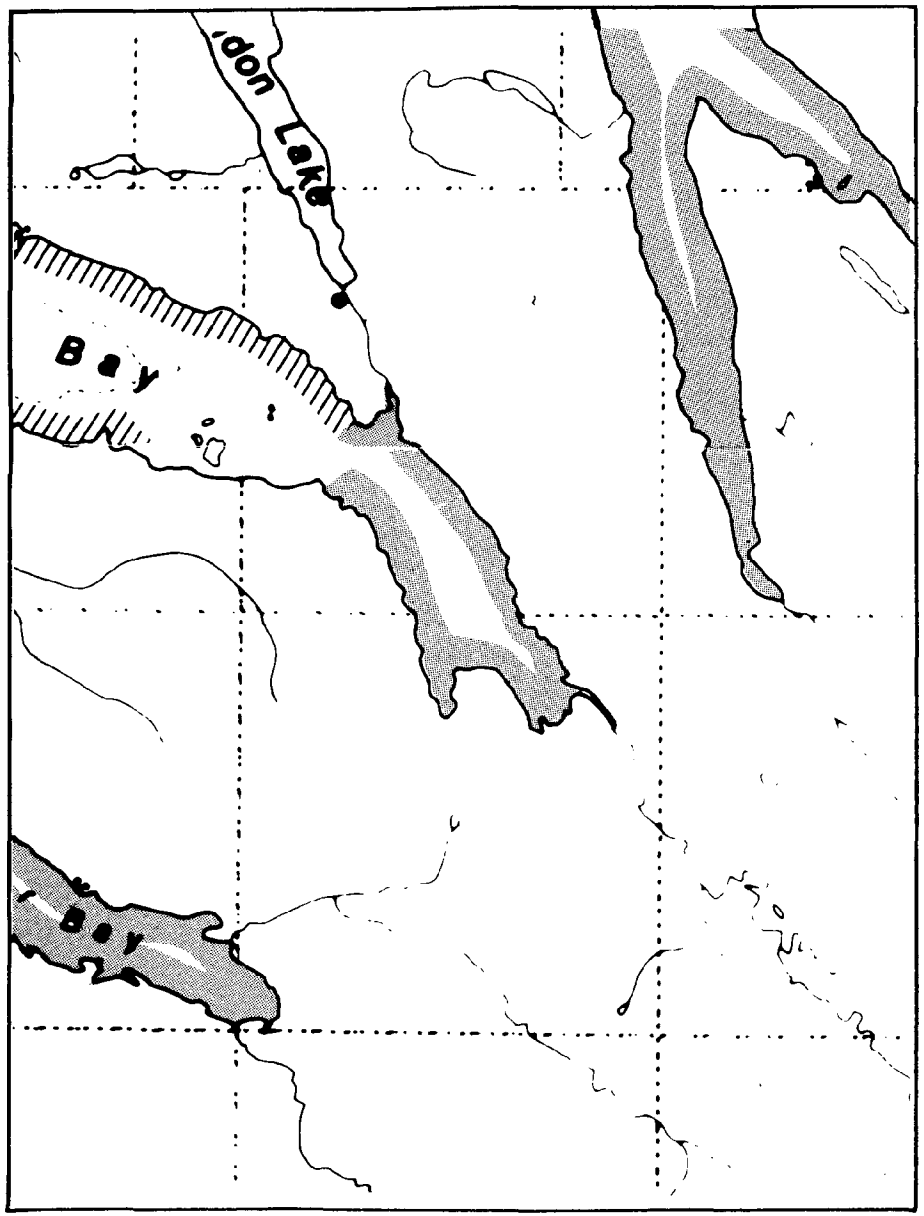


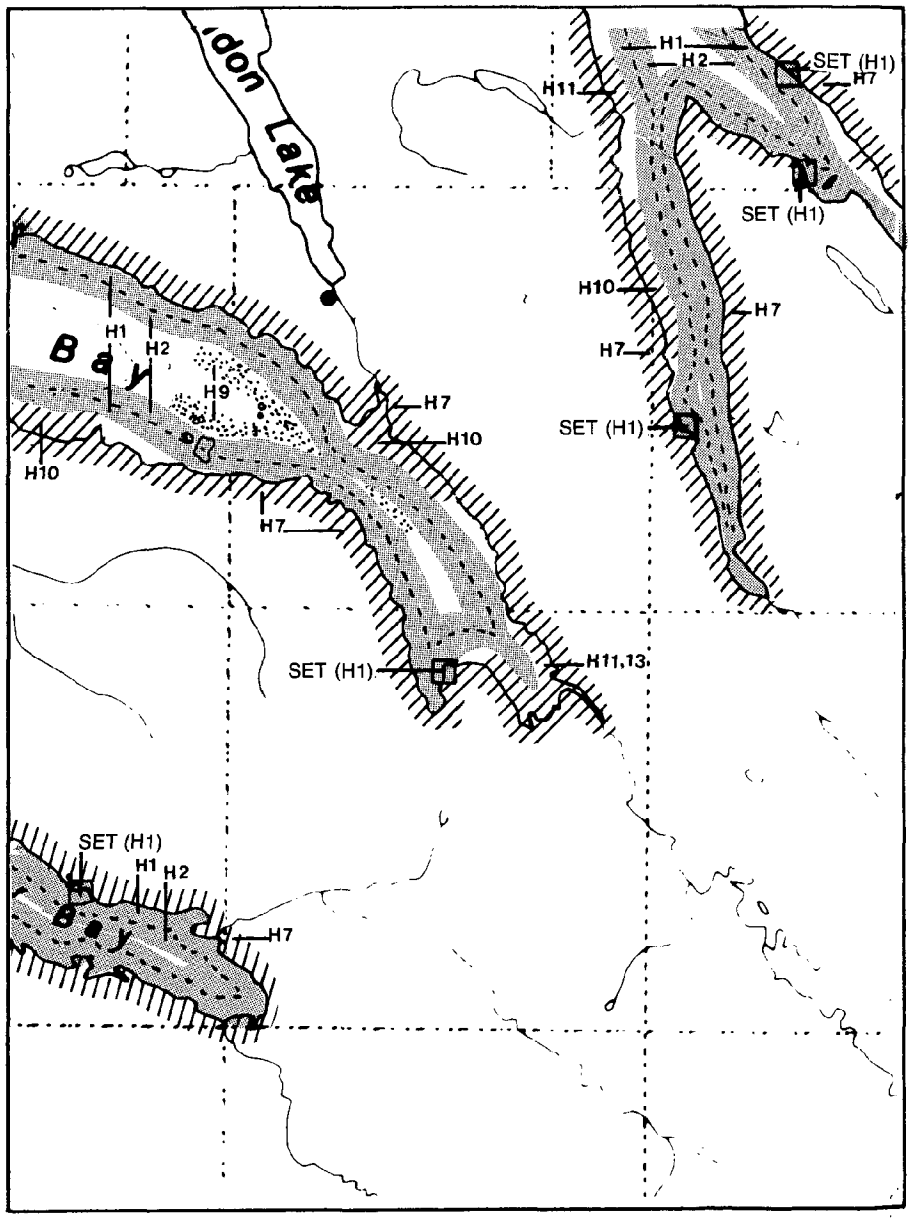
MAP NUMBER 22

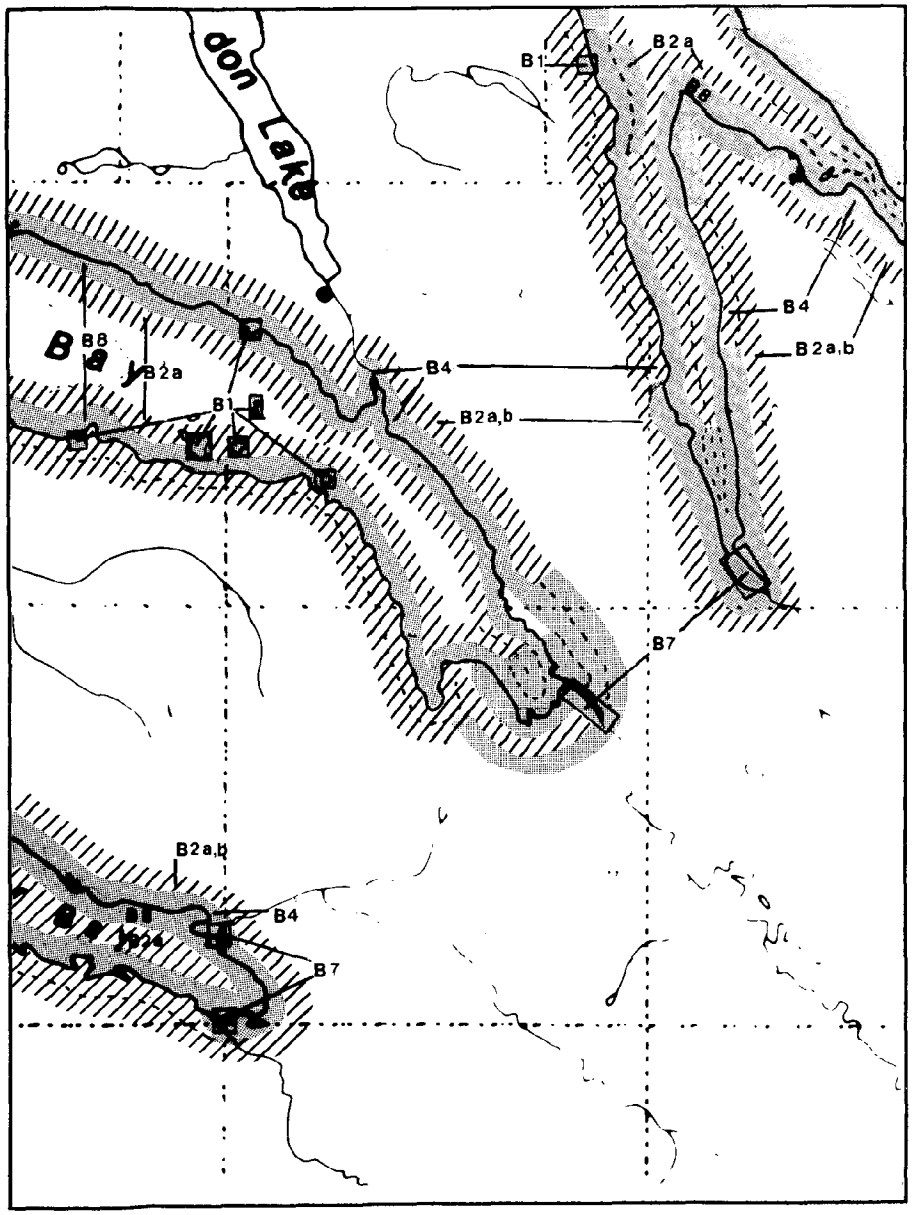
RESOURCE	Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE												
R-1 Rocky Headlands												
R-2 Wave-Cut Platforms												
R-3 Sand Beaches/Exposed Tidal Flats												
R-4 Mixed Sand and Gravel Beaches												
R-5 Gravel Beaches												
R-6 Sheltered Rocky and Gravel Shores												
R-7 Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon							—	—	—	—		
H-2 Roe Herring					—	—	—					
H-3 Crab						—	—	—	—	—	—	
H-4 Shrimp												
H-5 Halibut							—	—				
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer	—											—
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl											—	—
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon	—					—						
Recreation												
H-14 Recreation Use Area						—	—	—	—	—	—	
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony						—	—	—	—	—		
B-2a Waterfowl (overwintering)		—	—	—							—	—
B-2b Waterfowl (summer use)				—	—	—	—	—	—	—		
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer	—	—	—	—								—
B-5 Elk												
B-6 Brown Bear					—	—				—	—	—
Offshore												
B-2a Waterfowl (overwintering)	—	—	—	—							—	—
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults						—	—	—	—	—	—	—
Salmon - Juveniles												
Char/Dolly Varden - Adults												
Char/Dolly Varden - Juveniles												
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area					—	—						
B-9 Razor Clam Beach												
B-10 Sea Otters												

	14	15
21	22	23
	29	30

HIGH MEDIUM LOW



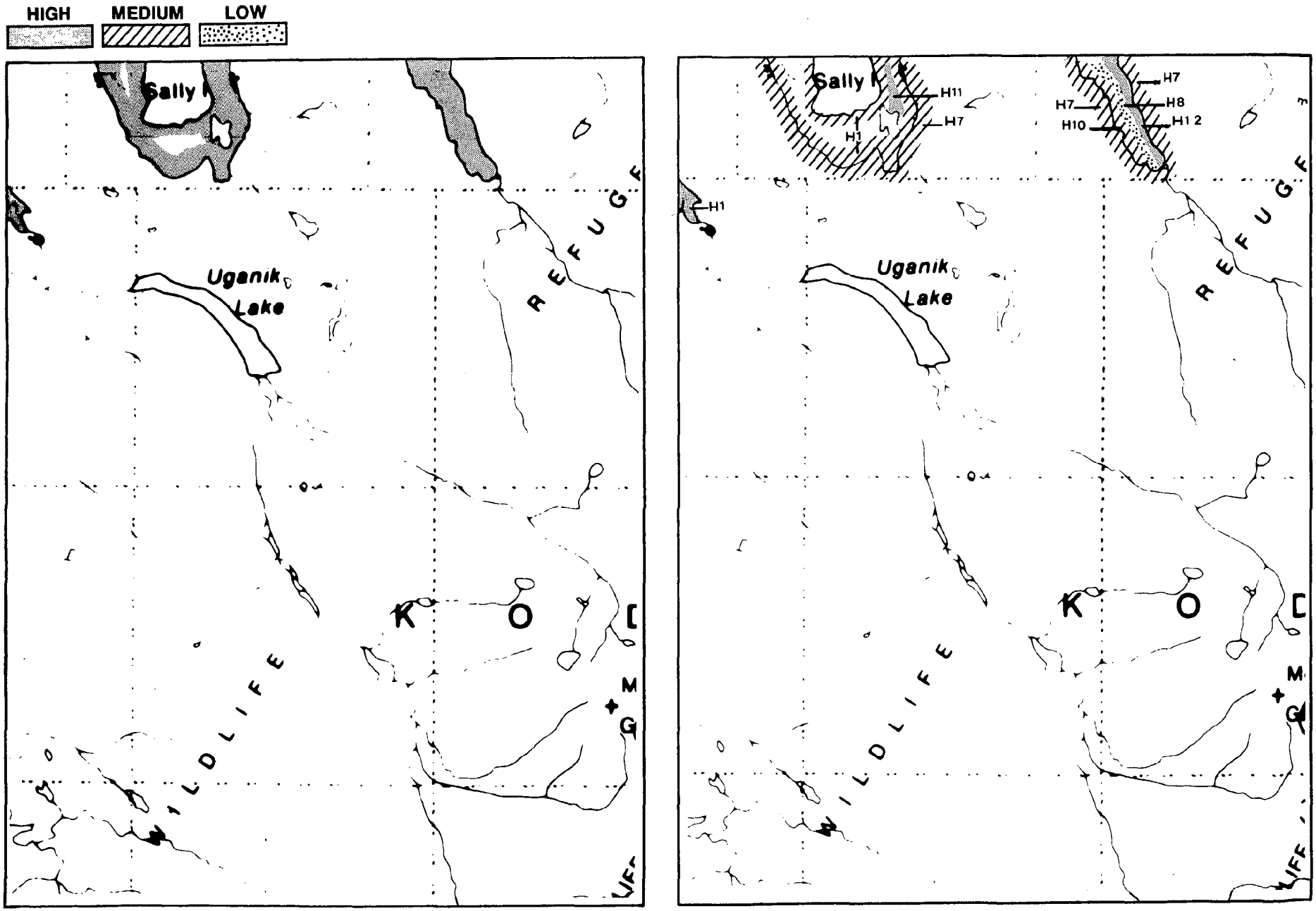


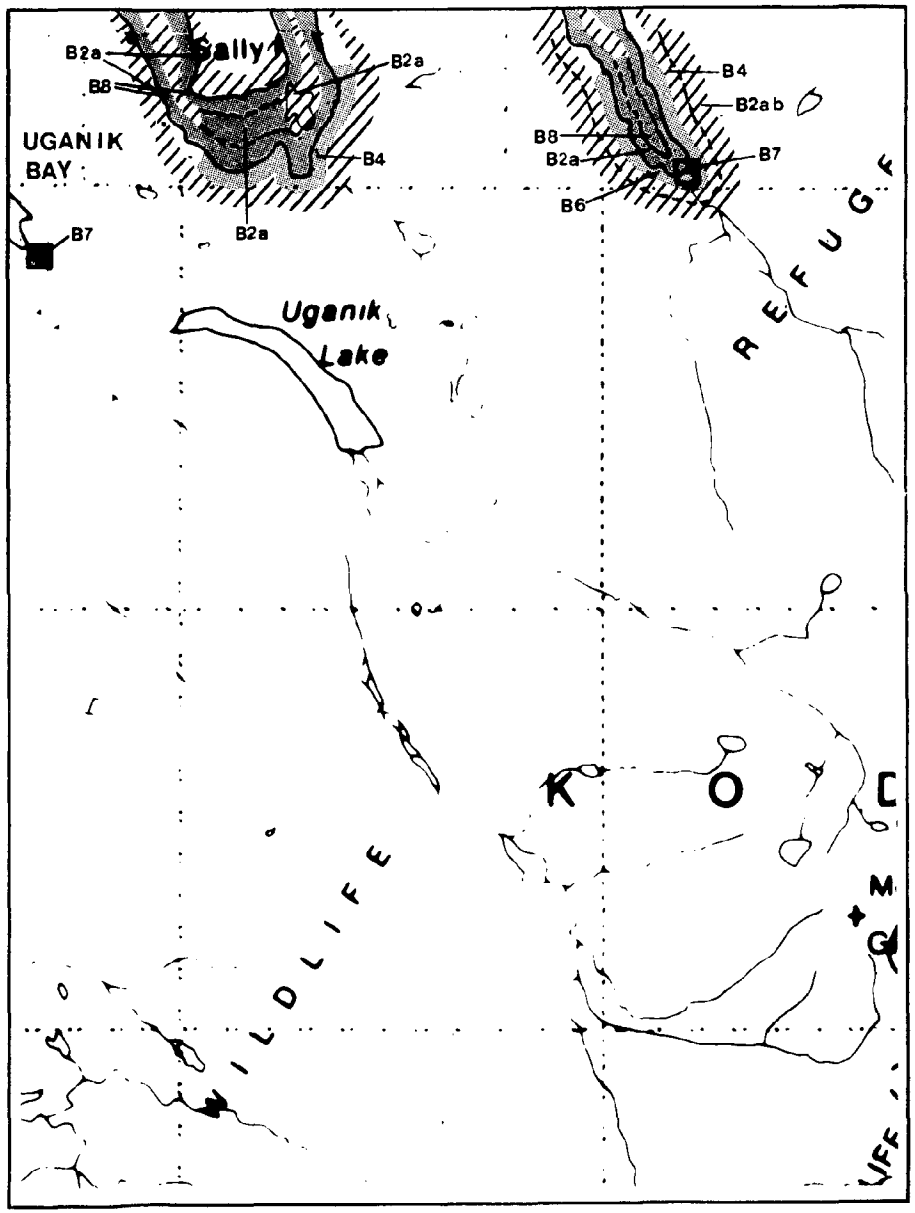


MAP NUMBER 23

RESOURCE	Winter			Spring			Summer			Fall		
	D	J	F	M	A	M	J	J	A	S	O	N
OIL RESIDENCE												
R-1 Rocky Headlands												
R-2 Wave-Cut Platforms												
R-3 Sand Beaches/Exposed Tidal Flats												
R-4 Mixed Sand and Gravel Beaches												
R-5 Gravel Beaches												
R-6 Sheltered Rocky and Gravel Shores												
R-7 Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon												
H-2 Roe Herring												
H-3 Crab												
H-4 Shrimp												
H-5 Halibut												
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer												
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon												
Recreation												
H-14 Recreation Use Area												
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer												
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults												
Salmon - Juveniles												
Char/Dolly Varden - Adults												
Char/Dolly Varden - Juveniles												
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area												
B-9 Razor Clam Beach												
B-10 Sea Otters												

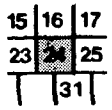
14 15 16
22 23 24
30


HIGH
MEDIUM
LOW
Sally
Uganik
Lake
REFUGE
WILDLIFE
K O D
H1
H11
H7
H8
H10
H12

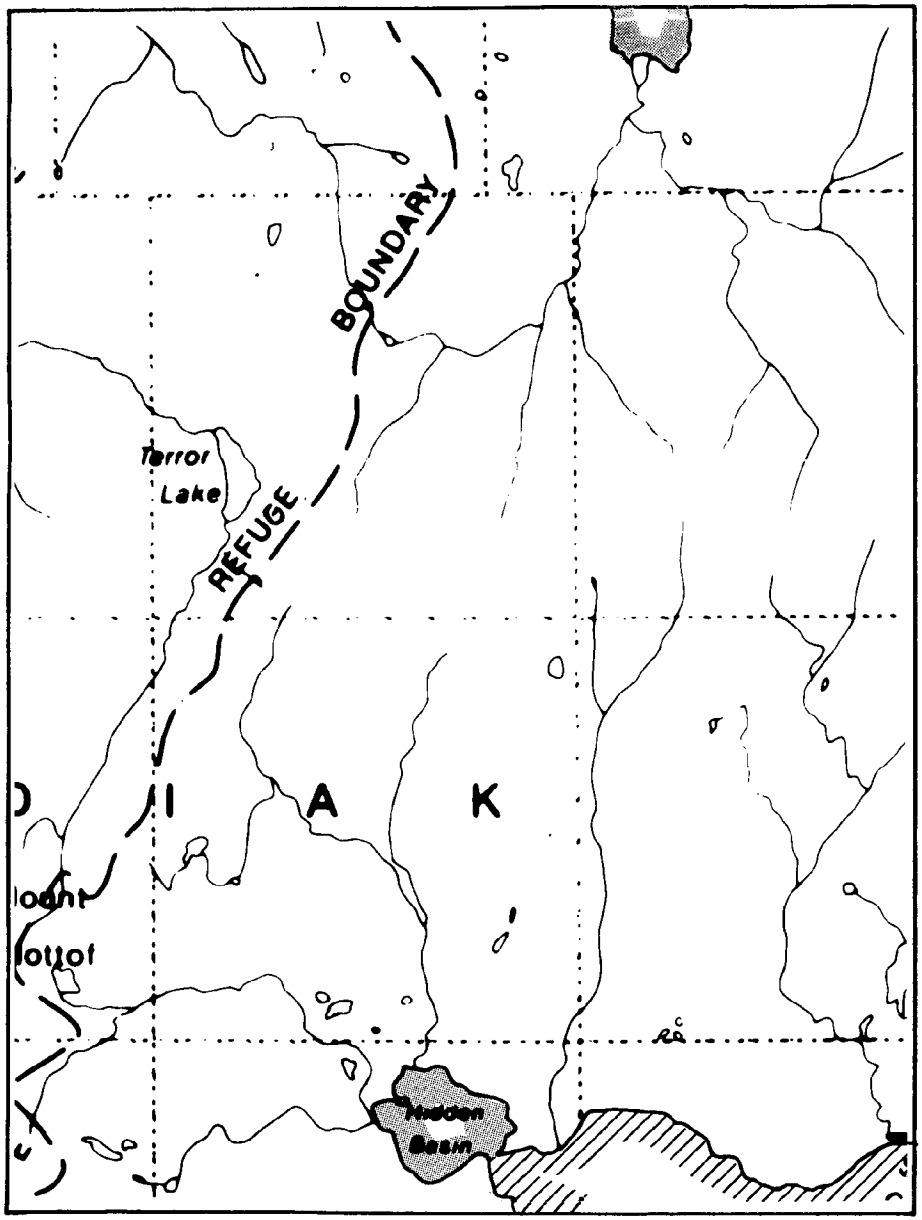


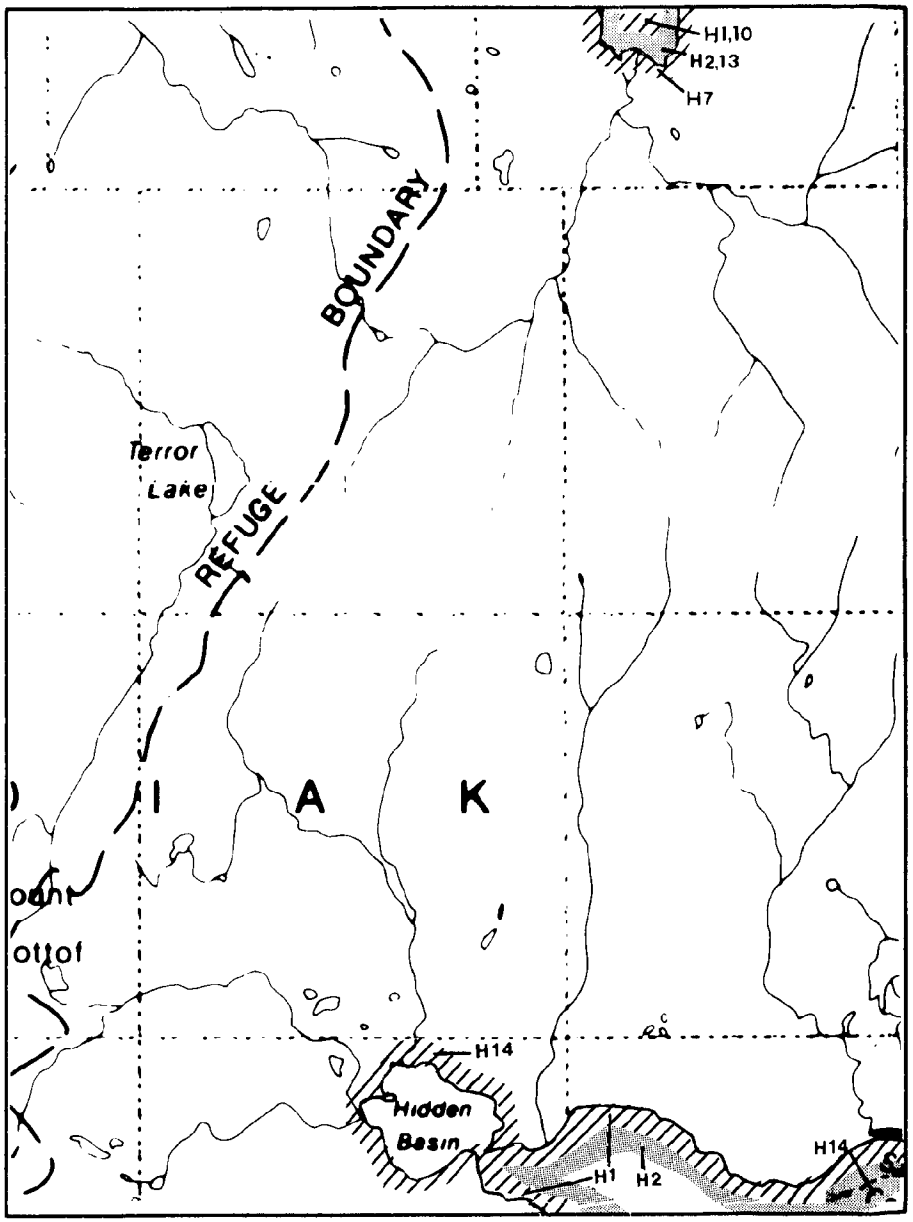
MAP NUMBER 24

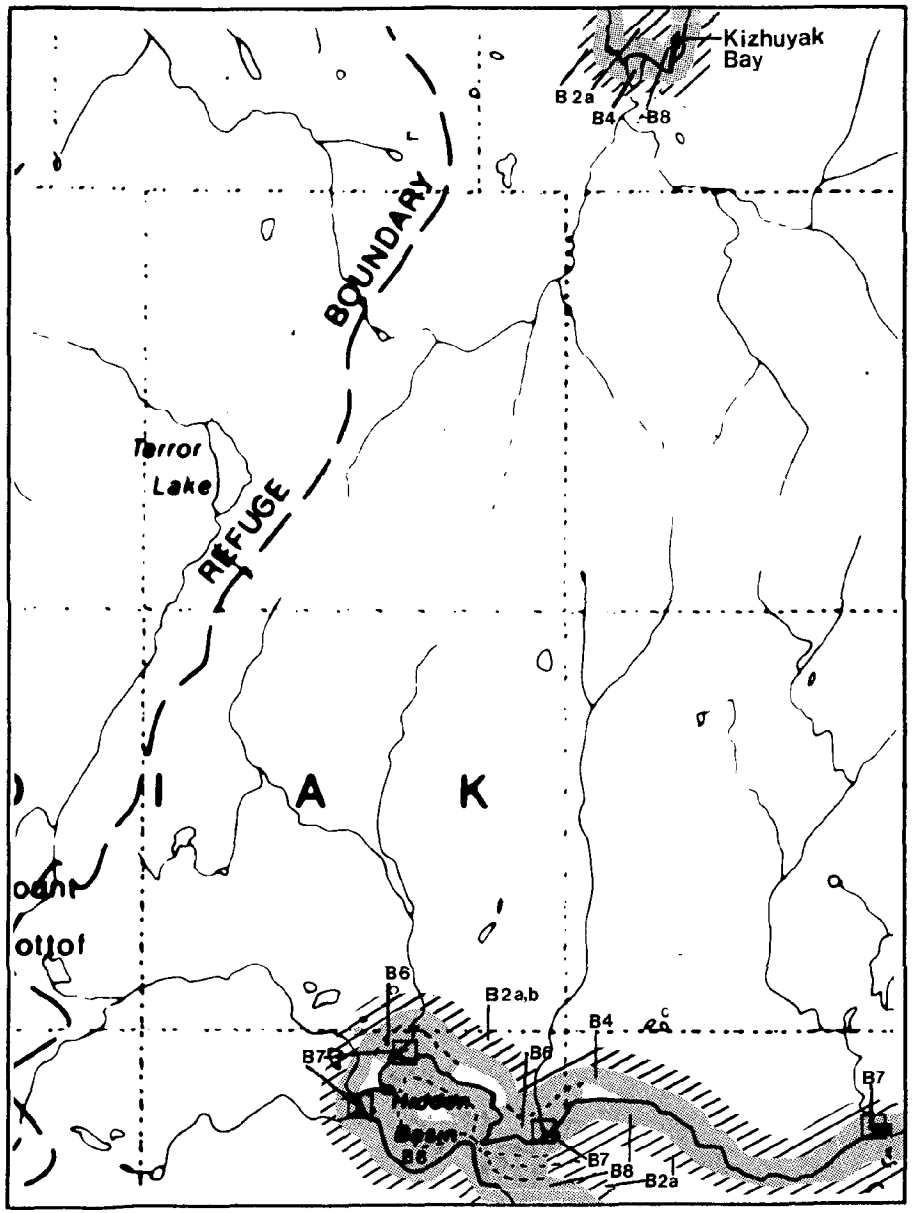
RESOURCE		Winter			Spring			Summer			Fall		
		D	J	F	M	A	M	J	J	A	S	O	N
OIL RESIDENCE													
R-1	Rocky Headlands	—	—	—	—	—	—	—	—	—	—	—	—
R-2	Wave-Cut Platforms	—	—	—	—	—	—	—	—	—	—	—	—
R-3	Sand Beaches/Exposed Tidal Flats	—	—	—	—	—	—	—	—	—	—	—	—
R-4	Mixed Sand and Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-5	Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-6	Sheltered Rocky and Gravel Shores	—	—	—	—	—	—	—	—	—	—	—	—
R-7	Protected Estuarine Tidal Flats and Marshes	—	—	—	—	—	—	—	—	—	—	—	—
HUMAN USE INDEX													
Commercial Fisheries													
H-1	Salmon							—	—	—	—		
H-2	Roe Herring					—	—	—					
H-3	Crab						—	—	—	—	—	—	
H-4	Shrimp												
H-5	Halibut												
H-6	Whitefish												
Subsistence													
H-7	Deer/Elk/Reindeer	—											—
H-8	Marine Mammal	—	—	—	—	—	—	—	—	—	—	—	—
H-9	Crab												
H-10	Waterfowl	—	—	—	—	—						—	—
H-11	Clams	—	—	—	—	—	—	—	—	—	—	—	—
H-12	Halibut/Marine Fish												
H-13	Salmon												
Recreation													
H-14	Recreation Use Area												
H-15	Recreation Facility												
Infrastructure													
H-16	Boat Harbor												
H-17	Dock												
H-18	Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX													
Onshore													
B-1	Seabird Colony												
B-2a	Waterfowl (overwintering)	—	—	—	—							—	—
B-2b	Waterfowl (summer use)						—	—	—	—	—		
B-3	Sea Lion Haul-out												
B-4	Black Tail Deer	—	—	—	—								—
B-5	Elk												
B-6	Brown Bear					—	—				—	—	—
Offshore													
B-2a	Waterfowl (overwintering)	—	—	—	—							—	—
B-2b	Waterfowl (summer use)												
B-7	Anadromous Fish Streams												
	Salmon - Adults						—	—	—	—	—	—	
	Salmon - Juveniles	—	—	—	—	—	—	—	—	—	—	—	—
	Char/Dolly Varden - Adults	—							—	—	—	—	—
	Char/Dolly Varden - Juveniles					—	—	—					
	Steelhead - Adults												
	Steelhead - Juveniles												
B-8	Herring Spawning Area												
B-9	Razor Clam Beach		—	—	—	—	—	—	—	—	—	—	—
B-10	Sea Otters												



HIGH MEDIUM LOW



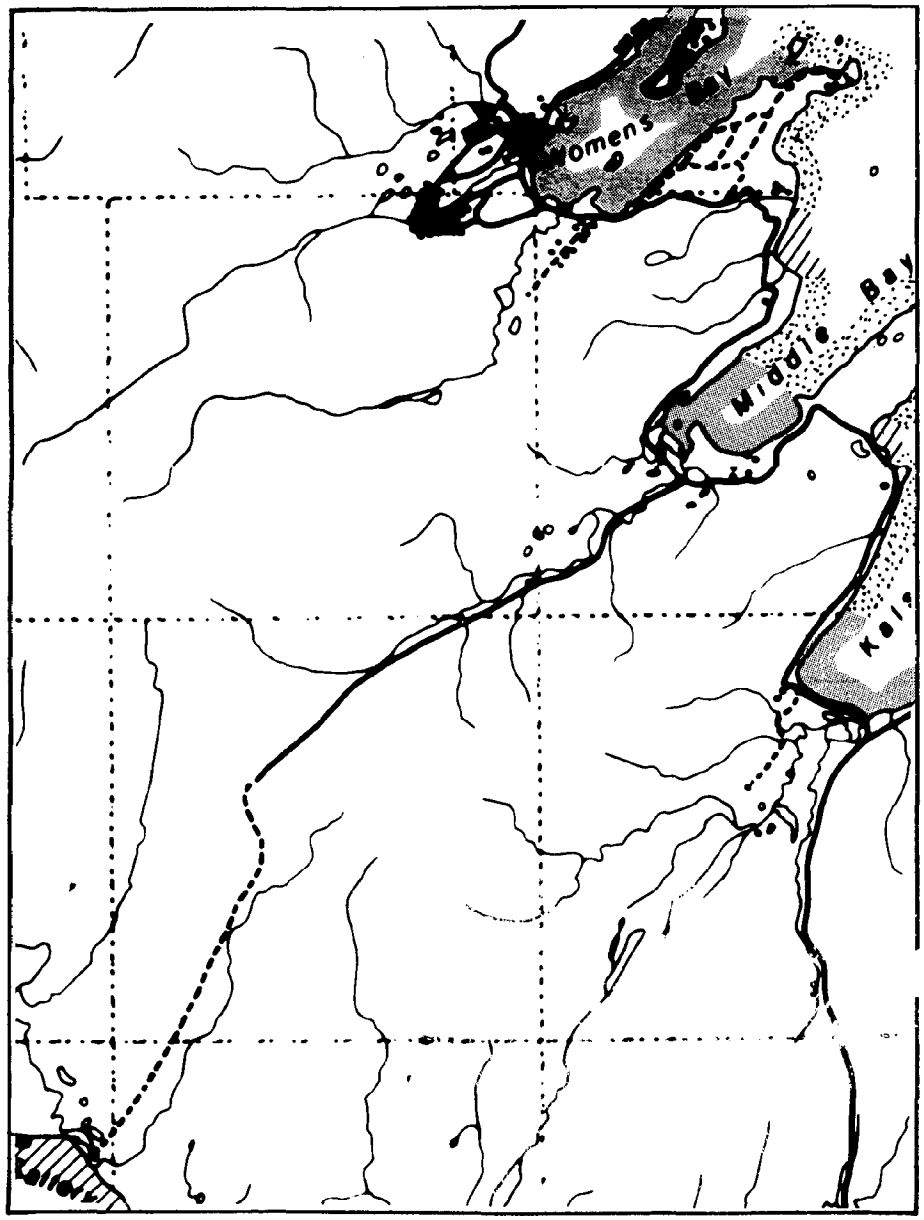


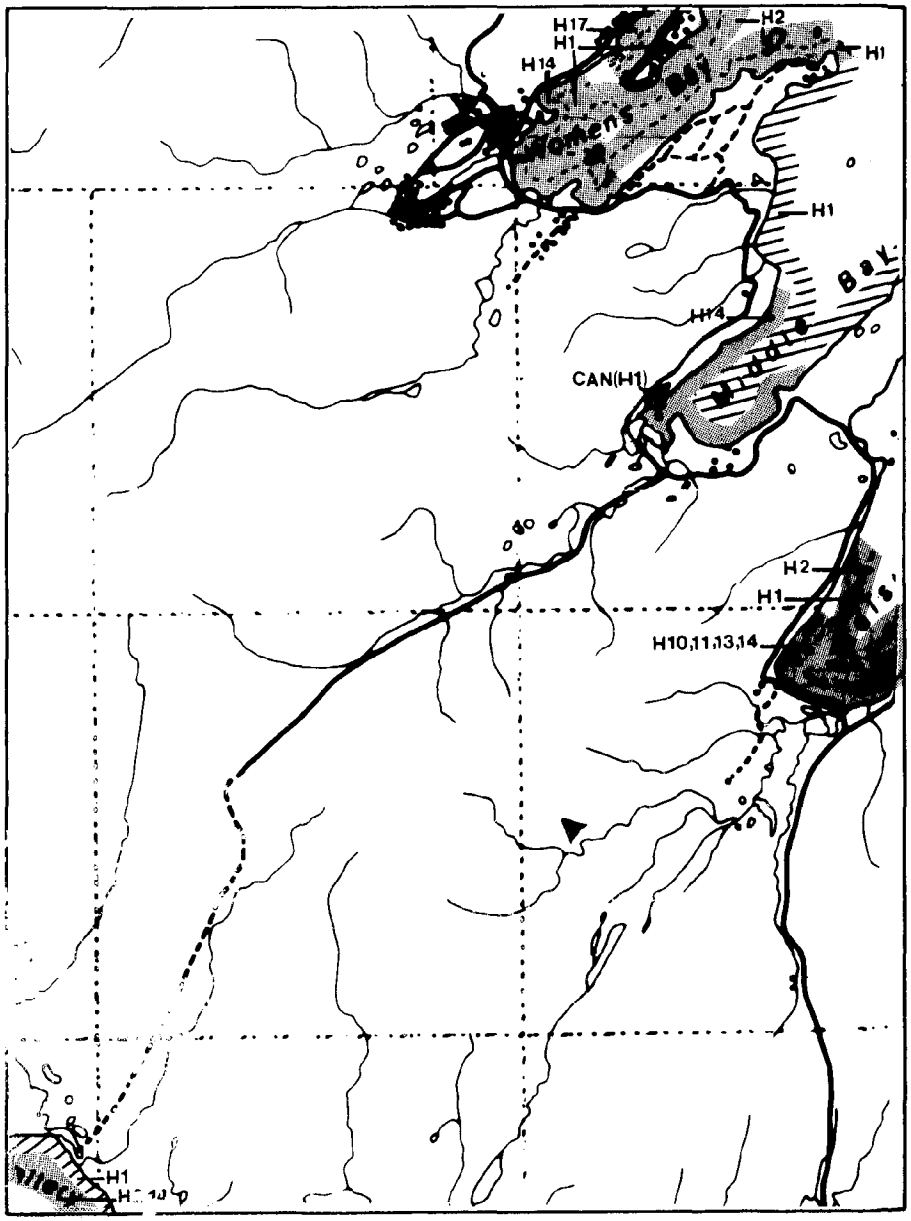


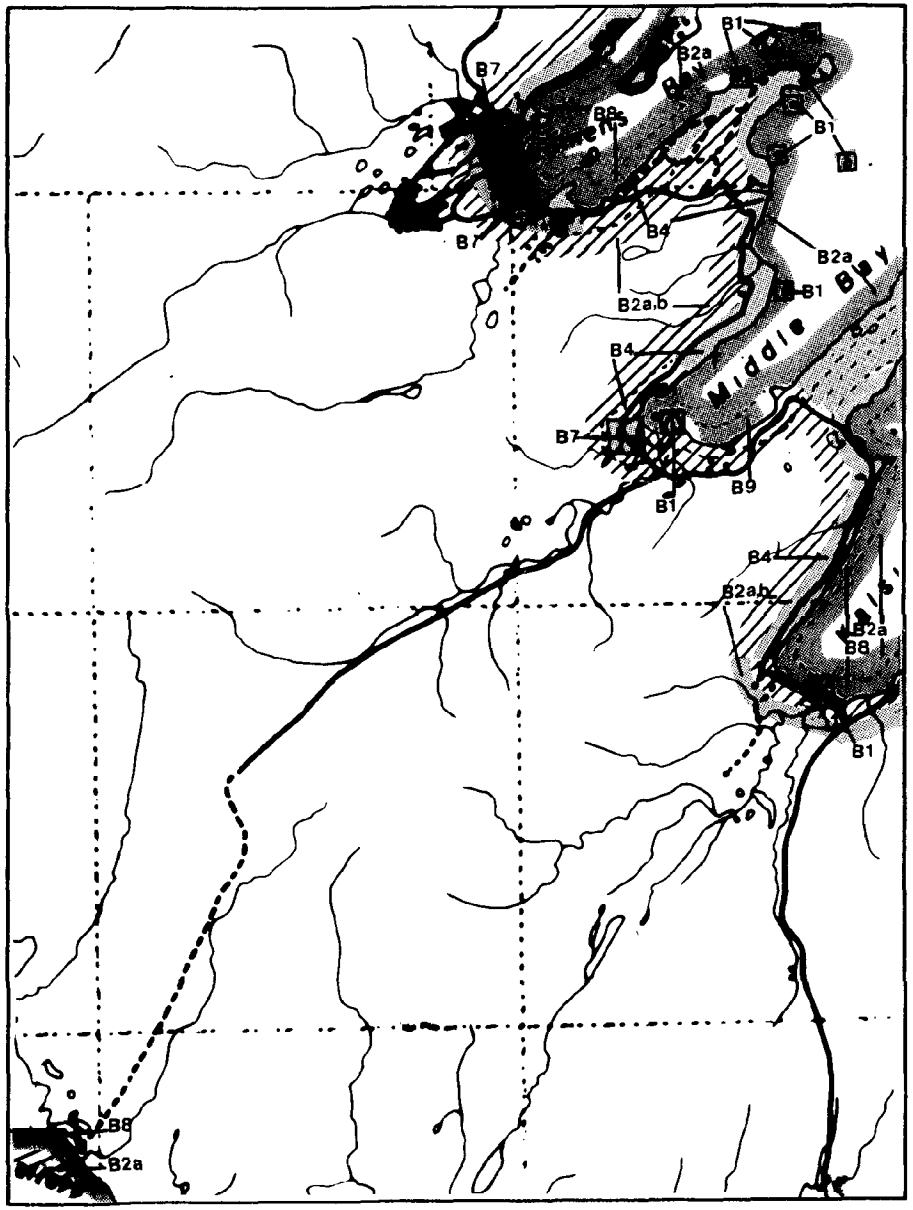
MAP NUMBER 25

RESOURCE	Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE												
R-1 Rocky Headlands												
R-2 Wave-Cut Platforms												
R-3 Sand Beaches/Exposed Tidal Flats												
R-4 Mixed Sand and Gravel Beaches												
R-5 Gravel Beaches												
R-6 Sheltered Rocky and Gravel Shores												
R-7 Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon												
H-2 Roe Herring												
H-3 Crab												
H-4 Shrimp												
H-5 Halibut												
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer												
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon												
Recreation												
H-14 Recreation Use Area												
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer												
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults												
Salmon - Juveniles												
Char/Dolly Varden - Adults												
Char/Dolly Varden - Juveniles												
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area												
B-9 Razor Clam Beach												
B-10 Sea Otters												

HIGH MEDIUM LOW





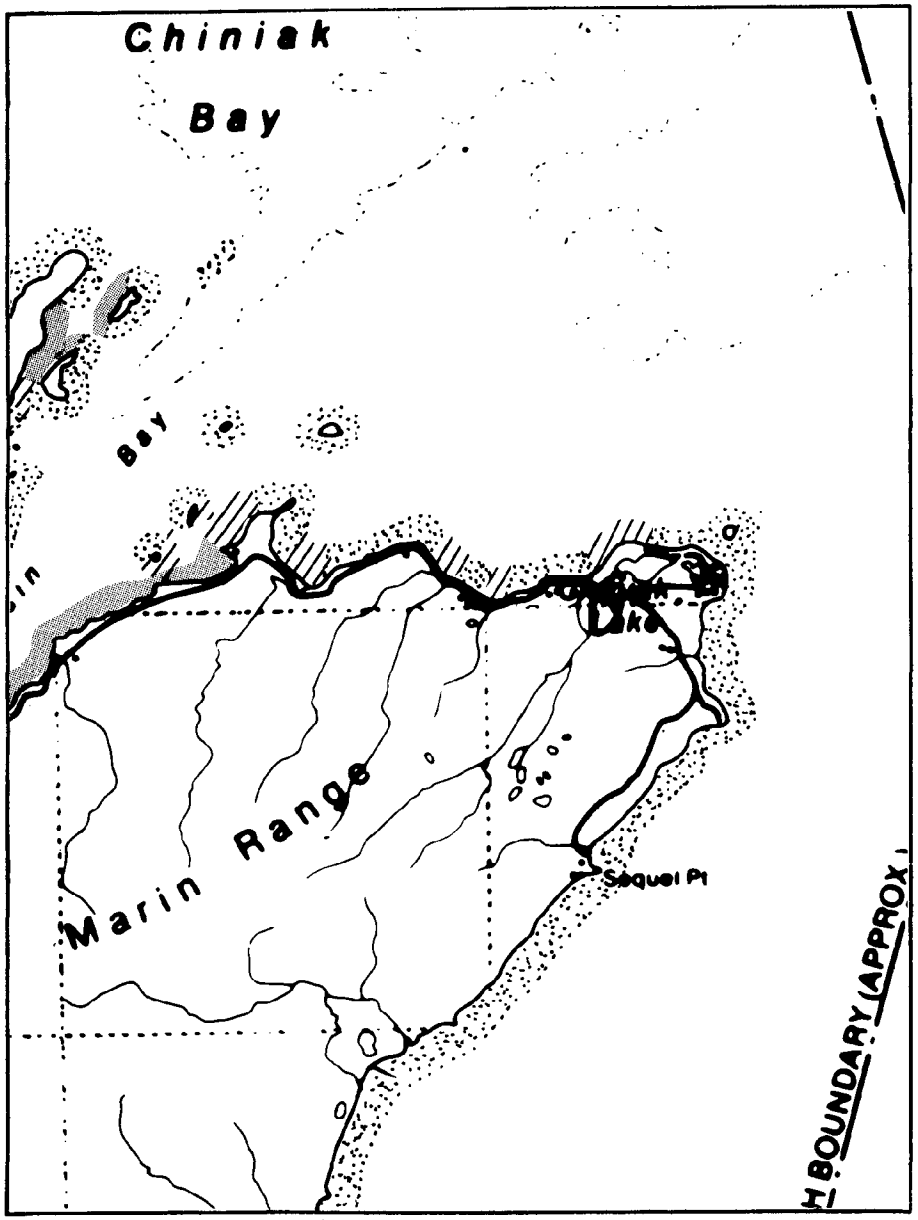


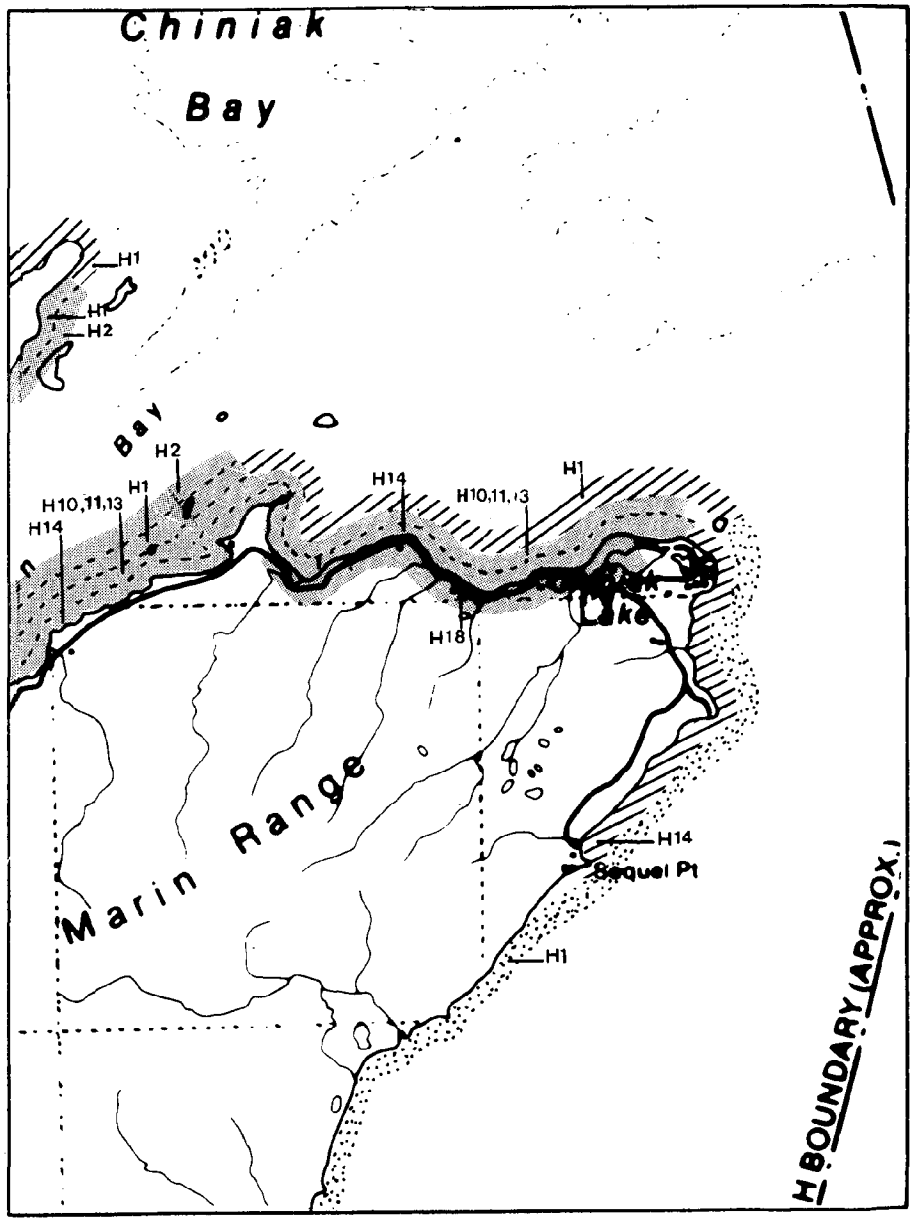
MAP NUMBER 26

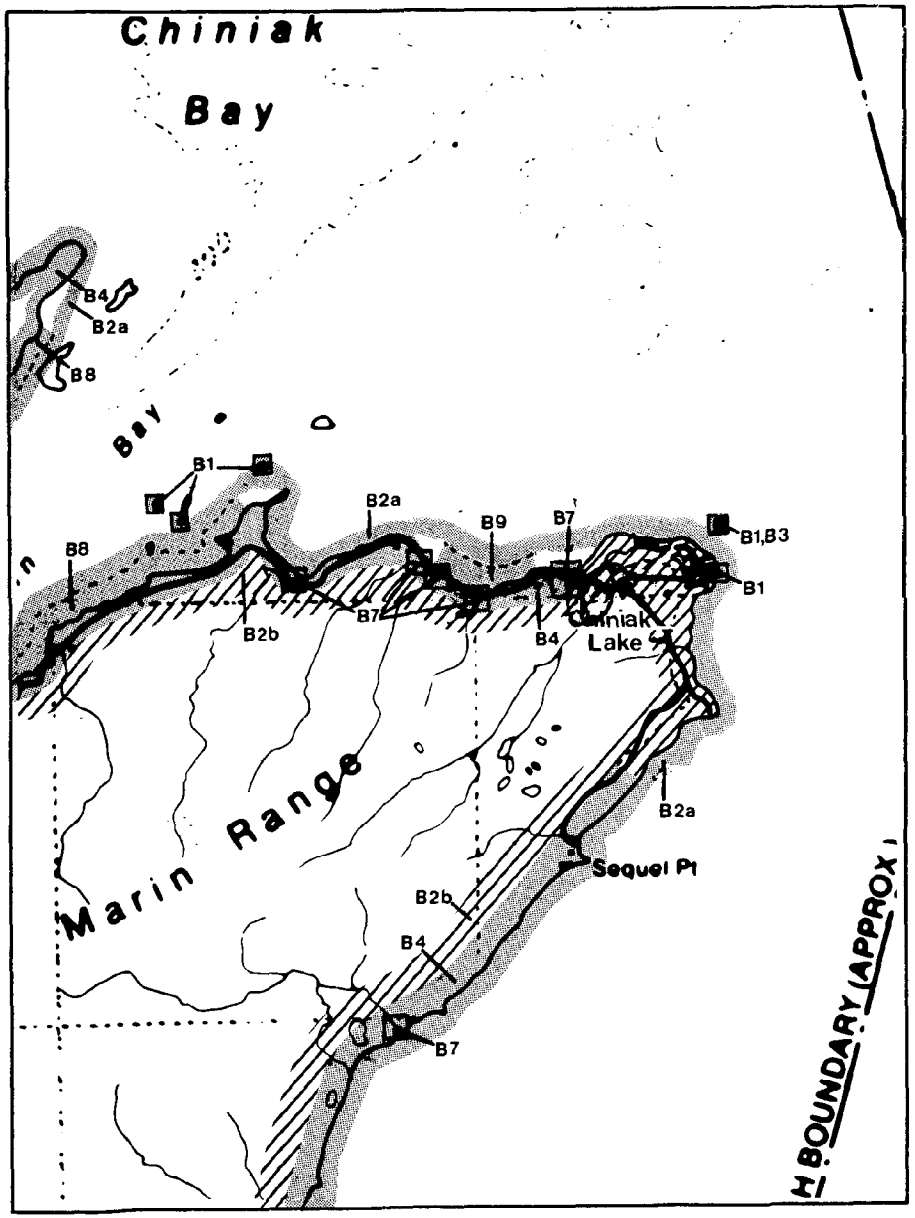
RESOURCE	D	J	F	M	A	M	J	J	A	S	O	N
	Winter			Spring			Summer			Fall		
OIL RESIDENCE												
R-1 Rocky Headlands												
R-2 Wave-Cut Platforms												
R-3 Sand Beaches/Exposed Tidal Flats												
R-4 Mixed Sand and Gravel Beaches												
R-5 Gravel Beaches												
R-6 Sheltered Rocky and Gravel Shores												
R-7 Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon												
H-2 Roe Herring												
H-3 Crab												
H-4 Shrimp												
H-5 Halibut												
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer												
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon												
Recreation												
H-14 Recreation Use Area												
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer												
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults												
Salmon - Juveniles												
Char/Dolly Varden - Adults												
Char/Dolly Varden - Juveniles												
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area												
B-9 Razor Clam Beach												
B-10 Sea Otters												

17 18 19
25 26 27
32 33

HIGH MEDIUM LOW



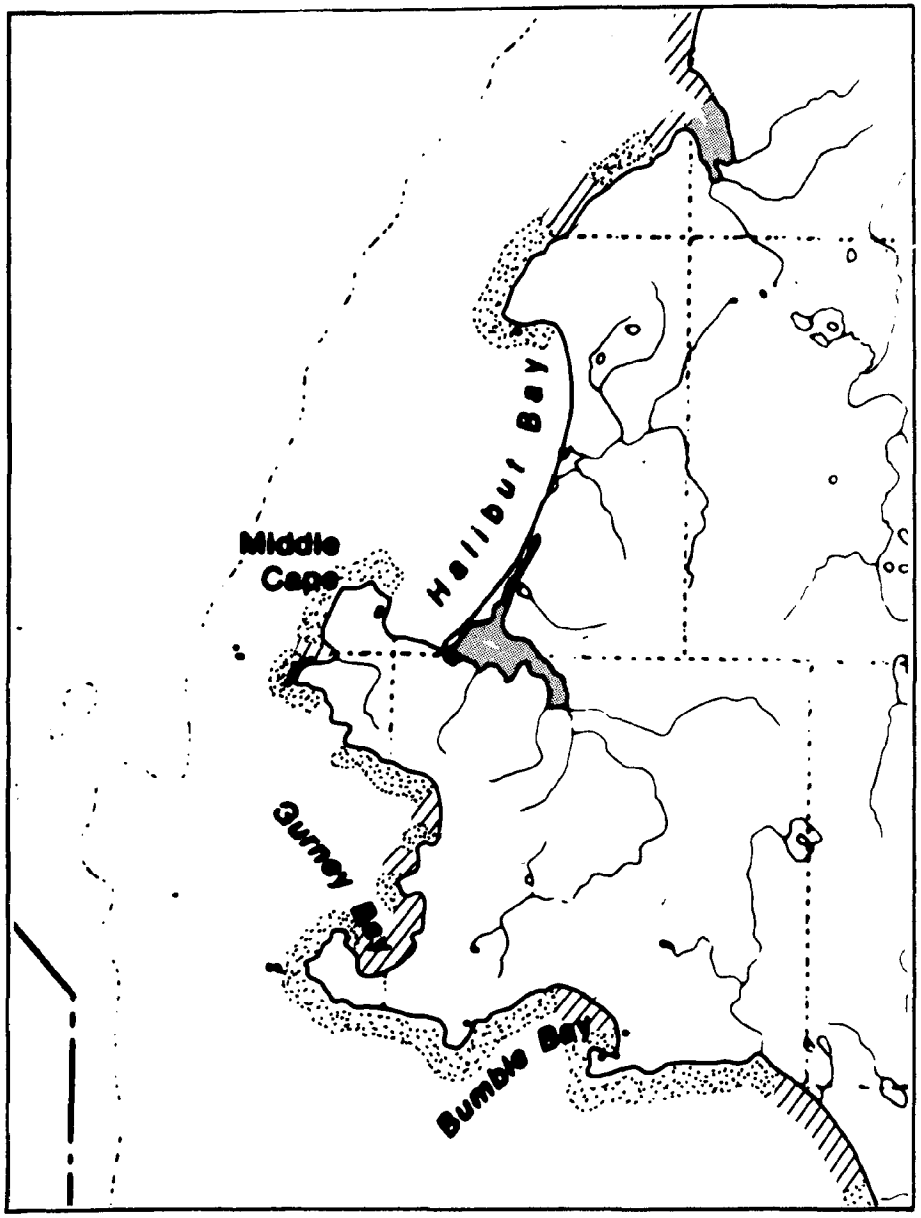


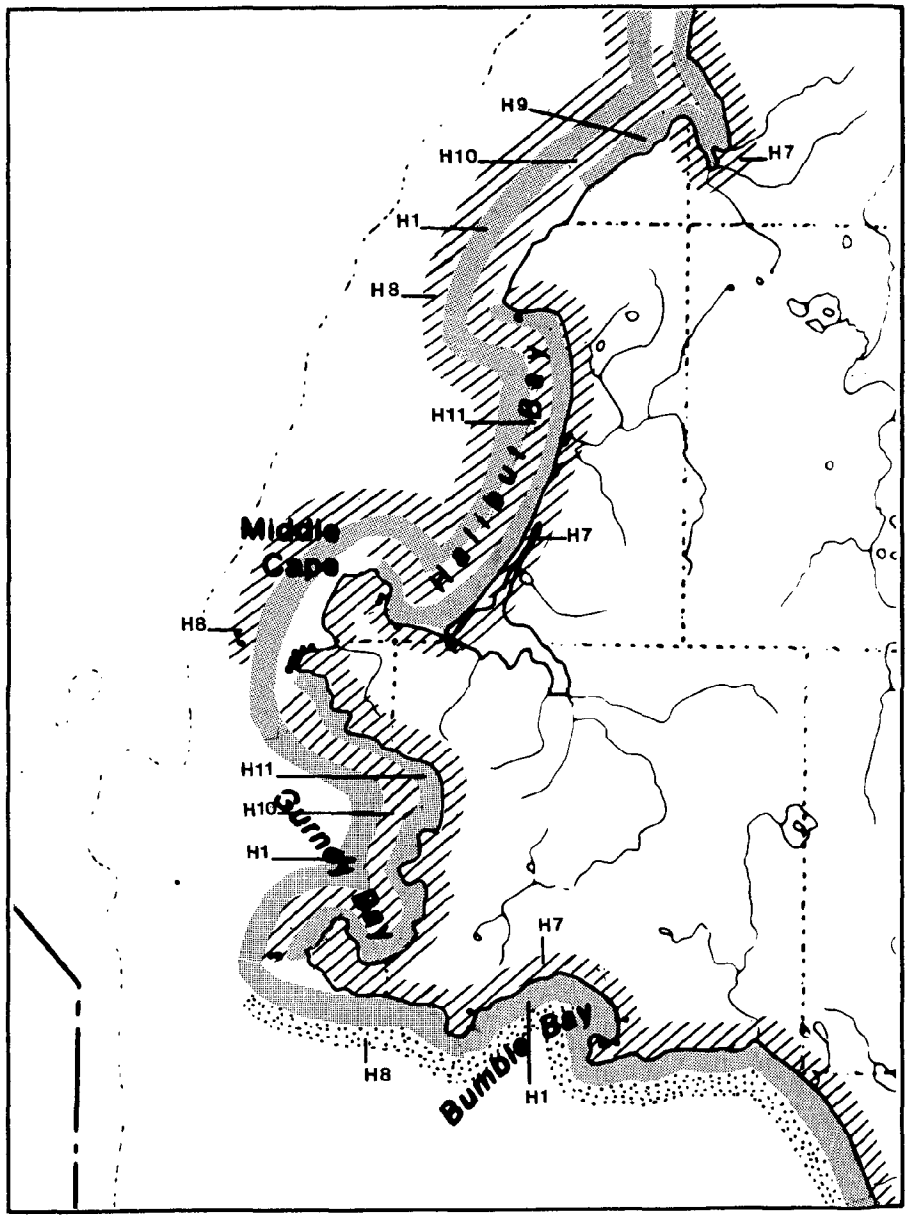


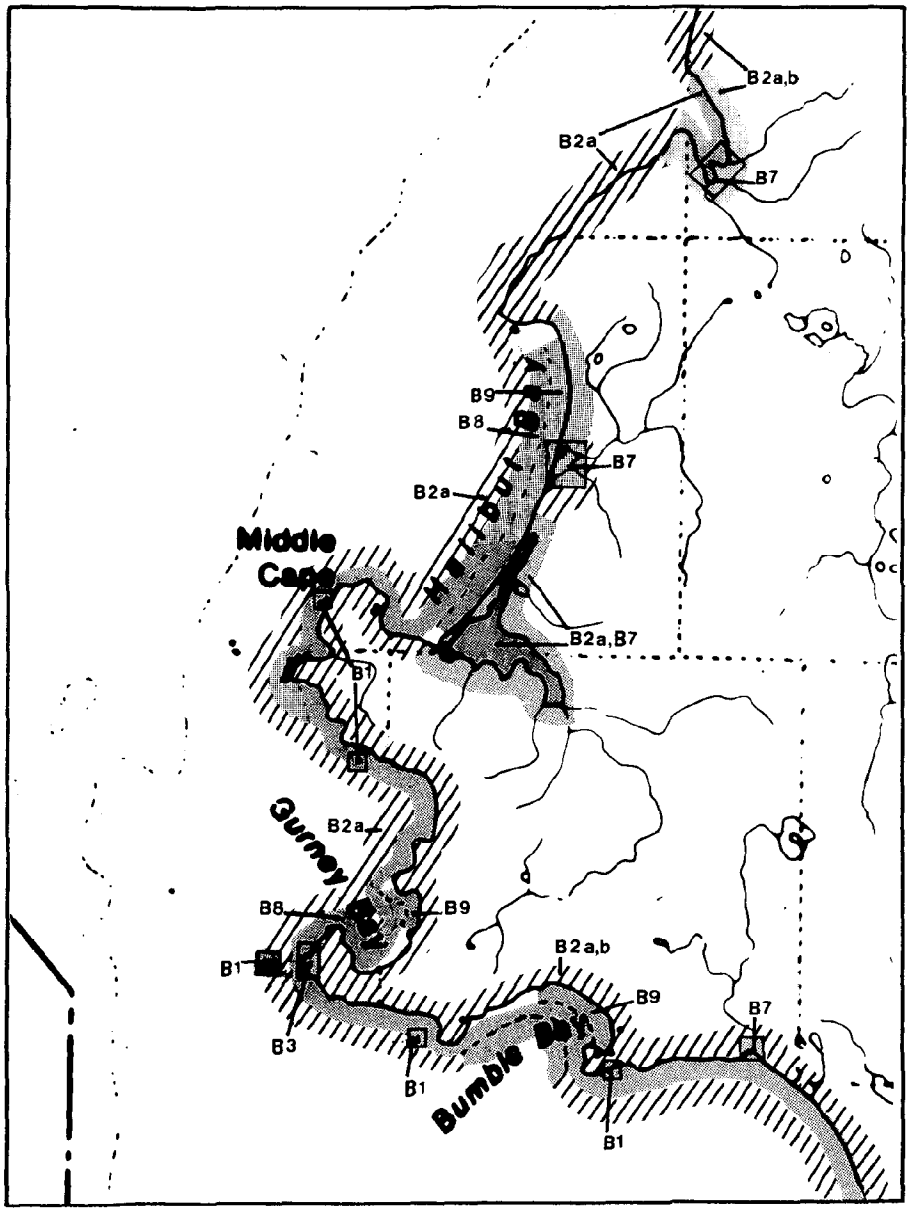
MAP NUMBER 27

RESOURCE	Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE												
R-1 Rocky Headlands												
R-2 Wave-Cut Platforms												
R-3 Sand Beaches/Exposed Tidal Flats												
R-4 Mixed Sand and Gravel Beaches												
R-5 Gravel Beaches												
R-6 Sheltered Rocky and Gravel Shores												
R-7 Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon												
H-2 Roe Herring												
H-3 Crab												
H-4 Shrimp												
H-5 Halibut												
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer												
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon												
Recreation												
H-14 Recreation Use Area												
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer												
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults												
Salmon - Juveniles												
Char/Dolly Varden - Adults												
Char/Dolly Varden - Juveniles												
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area												
B-9 Razor Clam Beach												
B-10 Sea Otters												

HIGH MEDIUM LOW

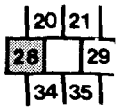


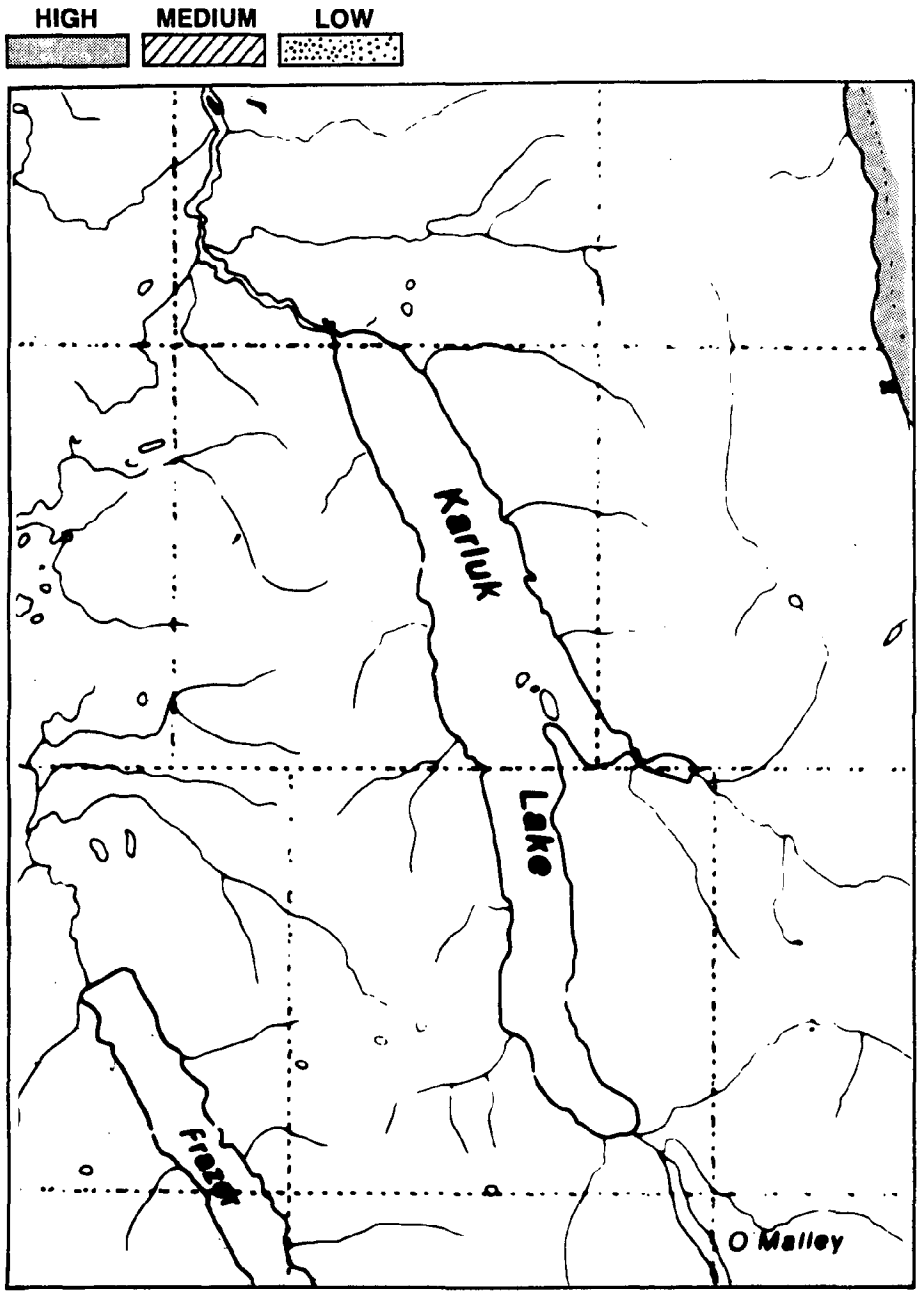


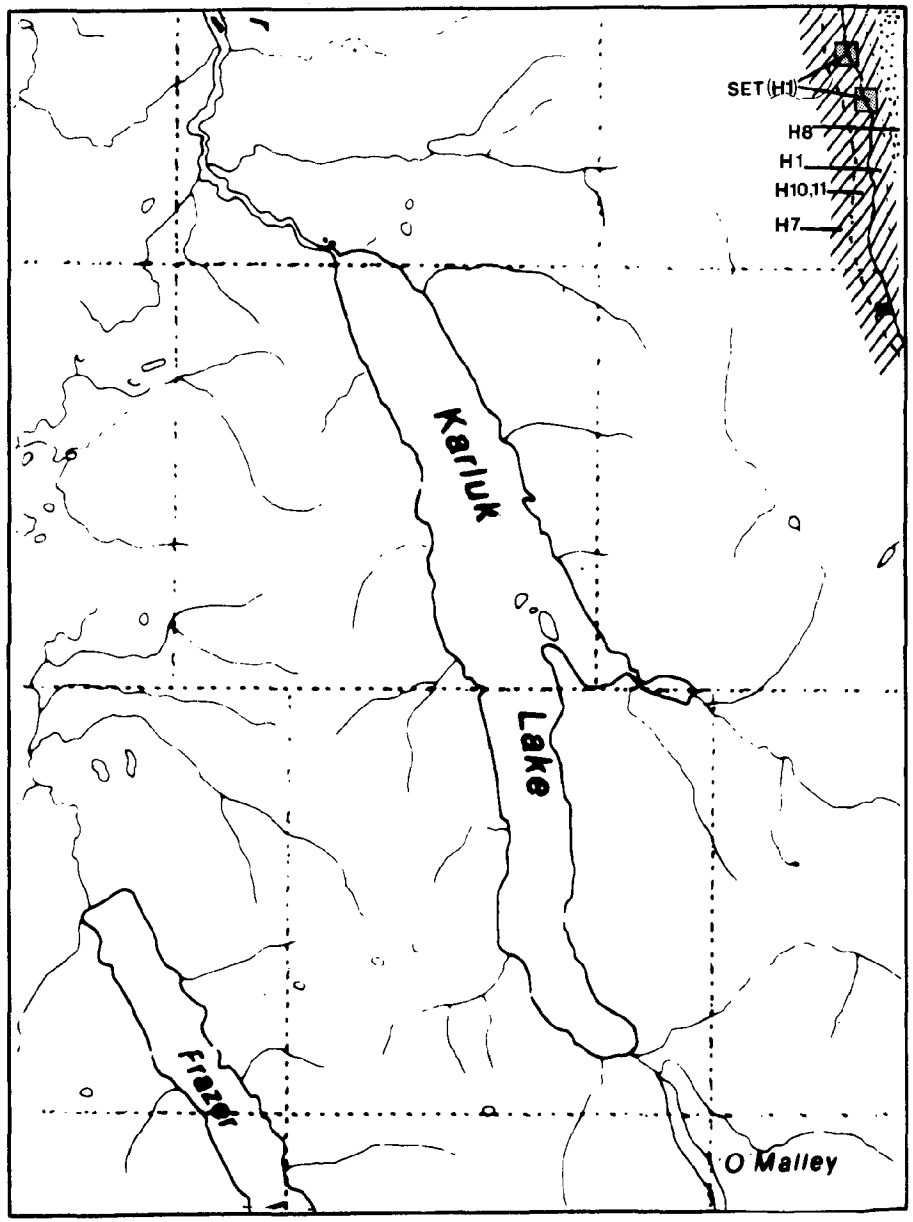


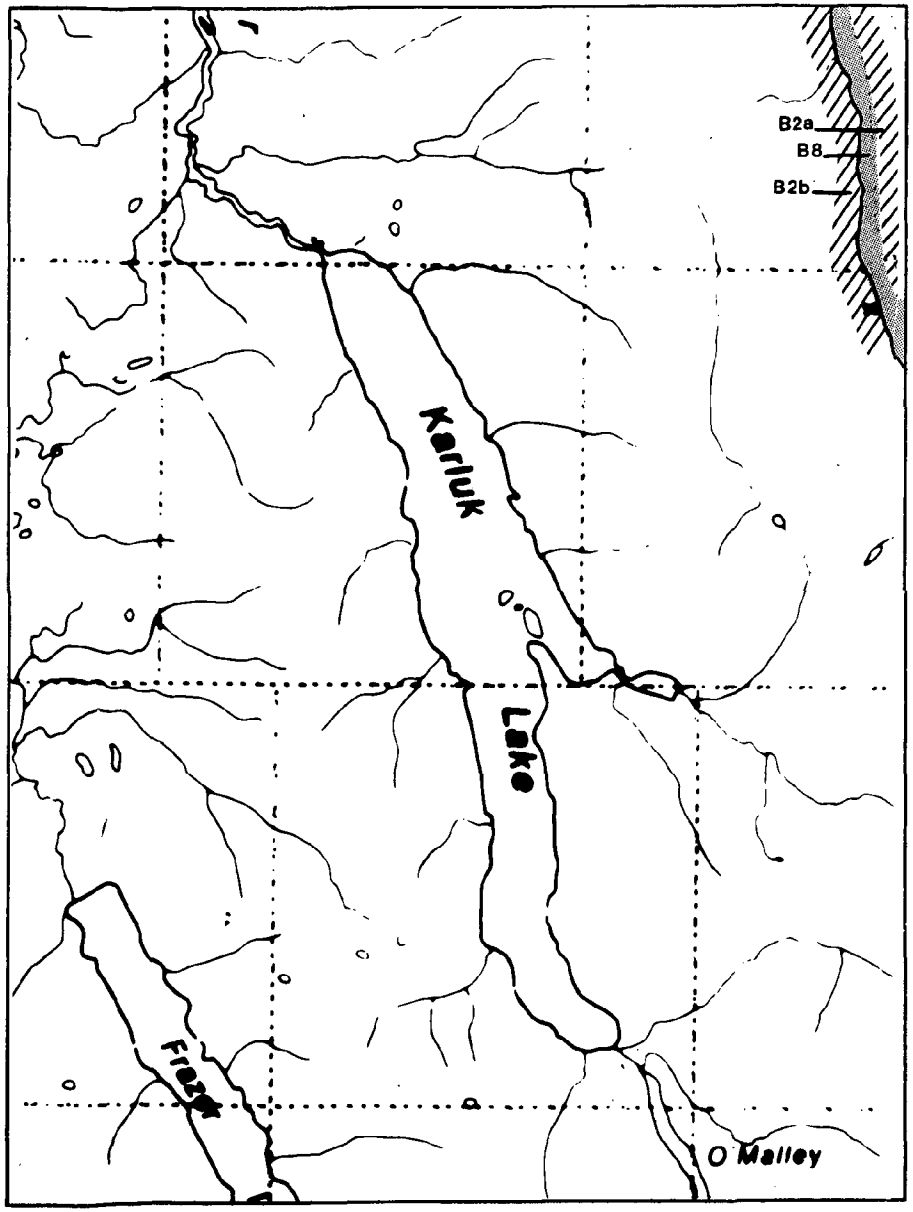
MAP NUMBER 28

RESOURCE	Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE												
R-1 Rocky Headlands												
R-2 Wave-Cut Platforms												
R-3 Sand Beaches/Exposed Tidal Flats												
R-4 Mixed Sand and Gravel Beaches												
R-5 Gravel Beaches												
R-6 Sheltered Rocky and Gravel Shores												
R-7 Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon												
H-2 Roe Herring												
H-3 Crab												
H-4 Shrimp												
H-5 Halibut												
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer												
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon												
Recreation												
H-14 Recreation Use Area												
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer												
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults												
Salmon - Juveniles												
Char/Dolly Varden - Adults												
Char/Dolly Varden - Juveniles												
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area												
B-9 Razor Clam Beach												
B-10 Sea Otters												



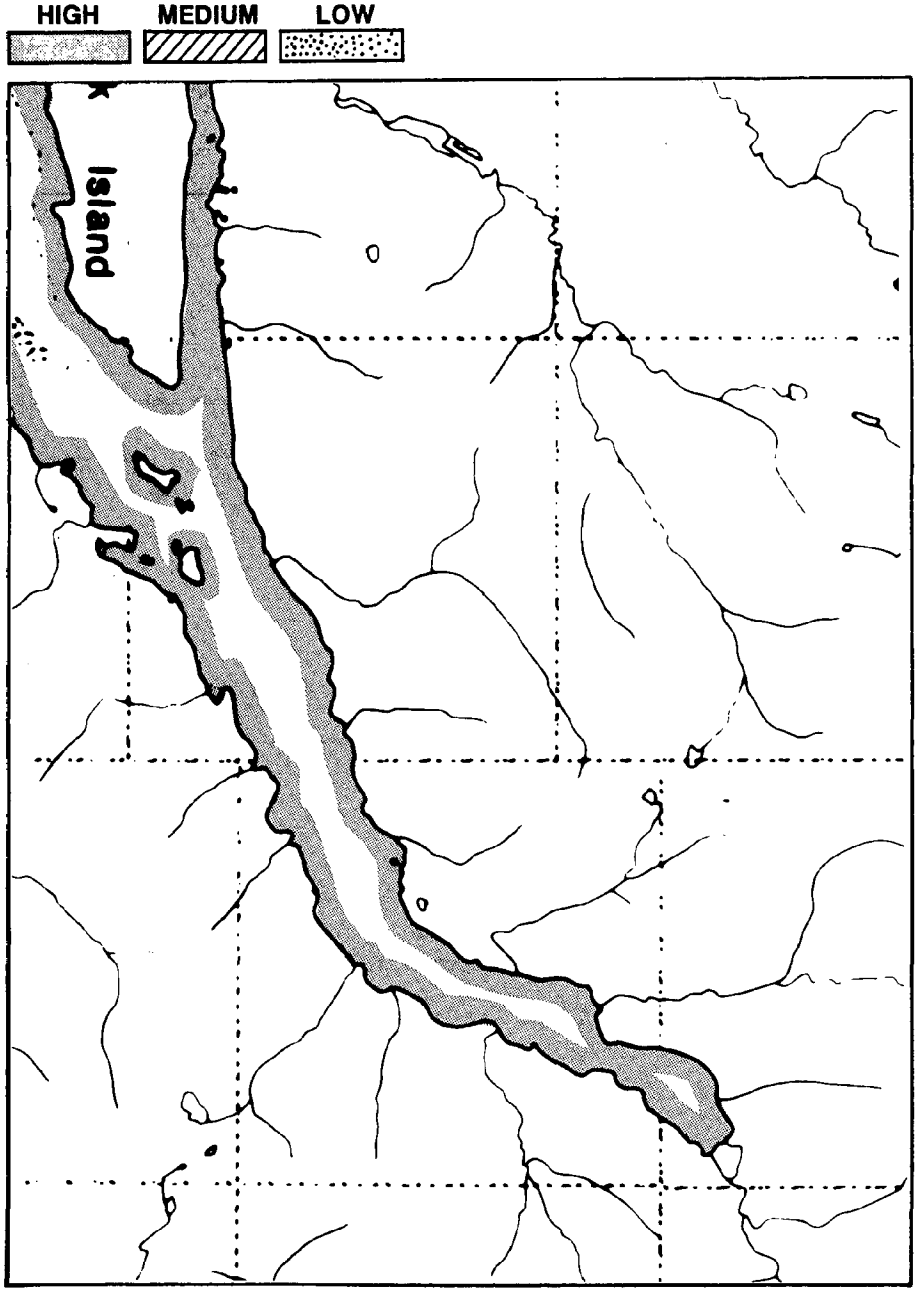

HIGH
MEDIUM
LOW
Karluk
Lake
Frazer
O Malley

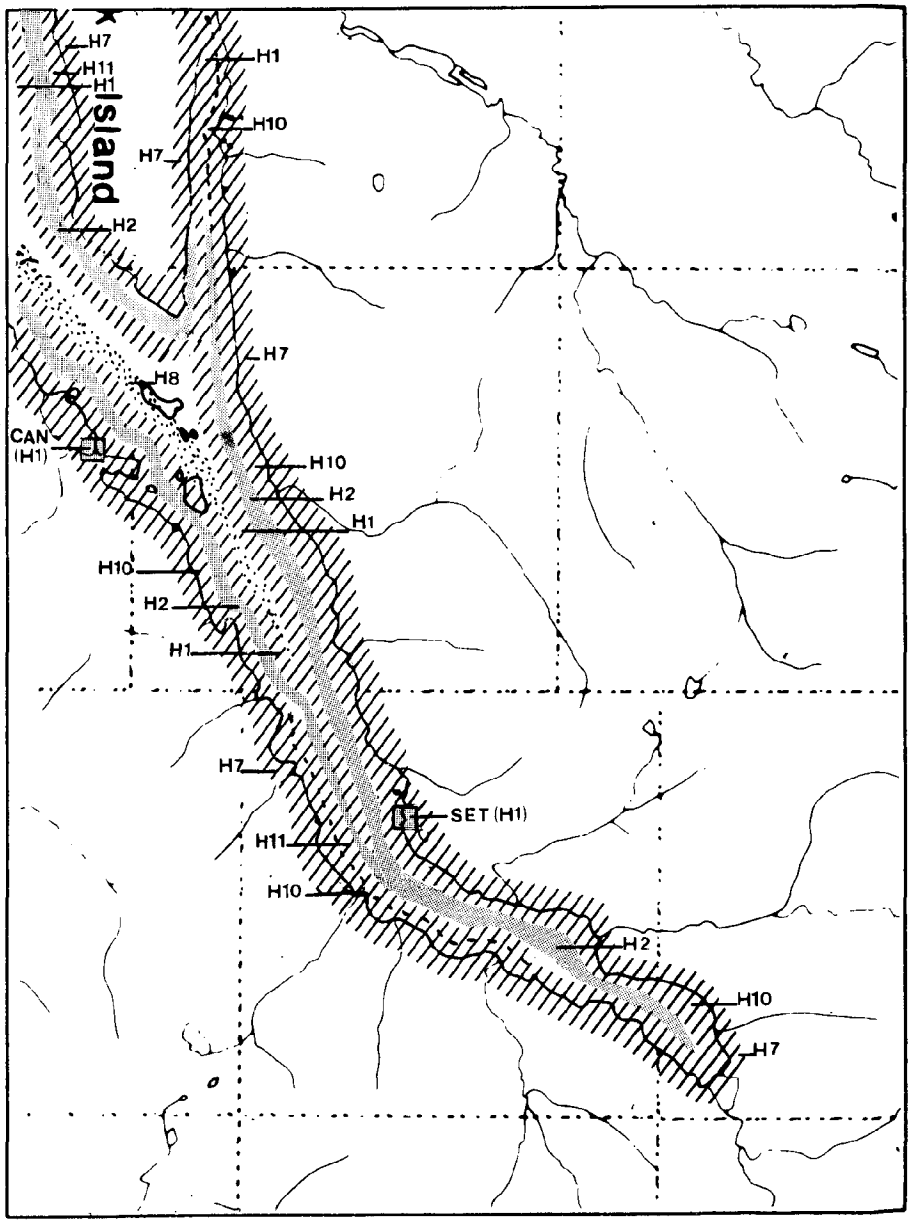

SET (H1)
H8
H1
H10,11
H7
Karluk
Lake
Frazer
O Malley

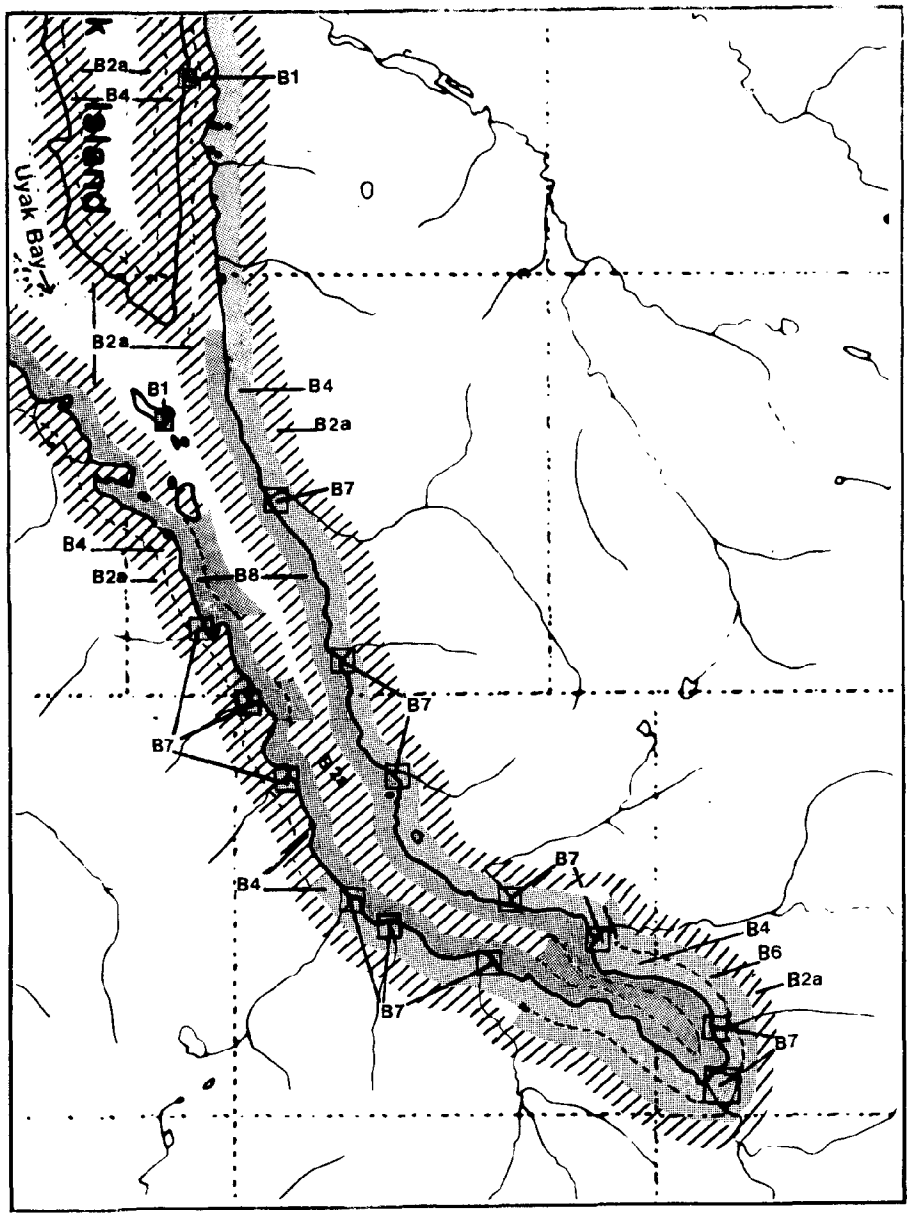


MAP NUMBER 29

RESOURCE	Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE												
R-1 Rocky Headlands												
R-2 Wave-Cut Platforms												
R-3 Sand Beaches/Exposed Tidal Flats												
R-4 Mixed Sand and Gravel Beaches												
R-5 Gravel Beaches												
R-6 Sheltered Rocky and Gravel Shores												
R-7 Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon												
H-2 Roe Herring												
H-3 Crab												
H-4 Shrimp												
H-5 Halibut												
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer												
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon												
Recreation												
H-14 Recreation Use Area												
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer												
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults												
Salmon - Juveniles												
Char/Dolly Varden - Adults												
Char/Dolly Varden - Juveniles												
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area												
B-9 Razor Clam Beach												
B-10 Sea Otters												

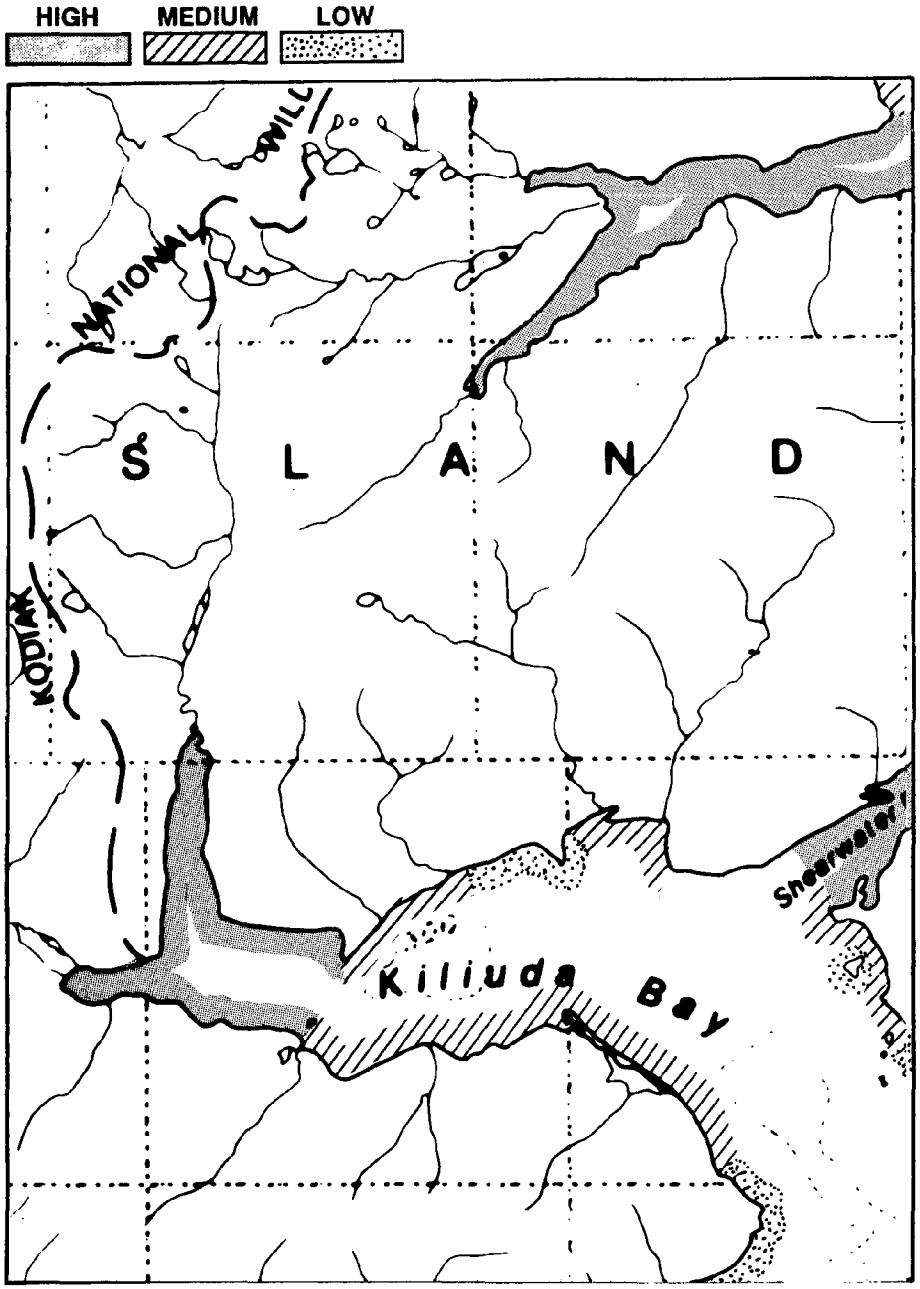

HIGH
MEDIUM
LOW
Island

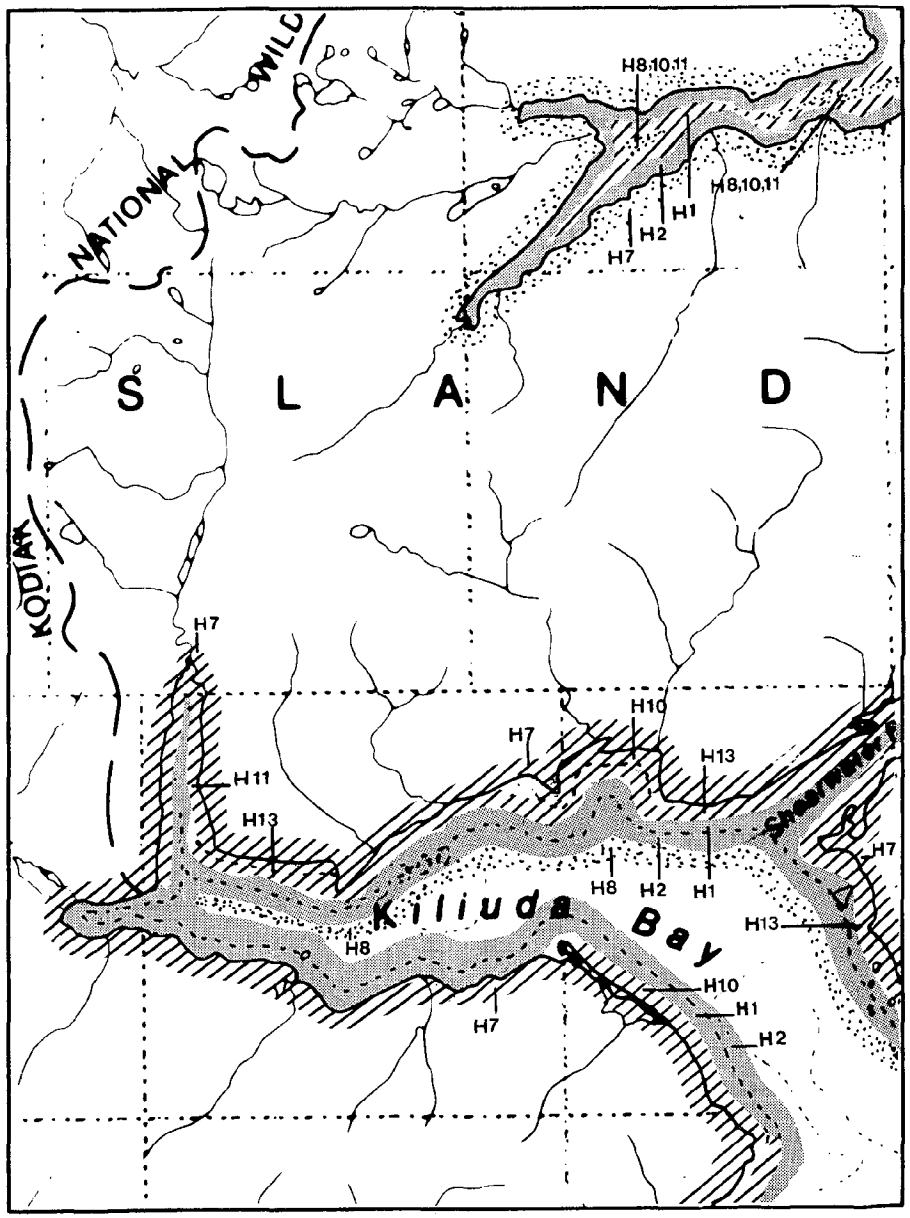

Island
H7
H11
H1
H1
H10
H7
H2
H7
H8
CAN
(H1)
H10
H2
H1
H10
H2
H1
H7
SET (H1)
H11
H10
H2
H10
H7

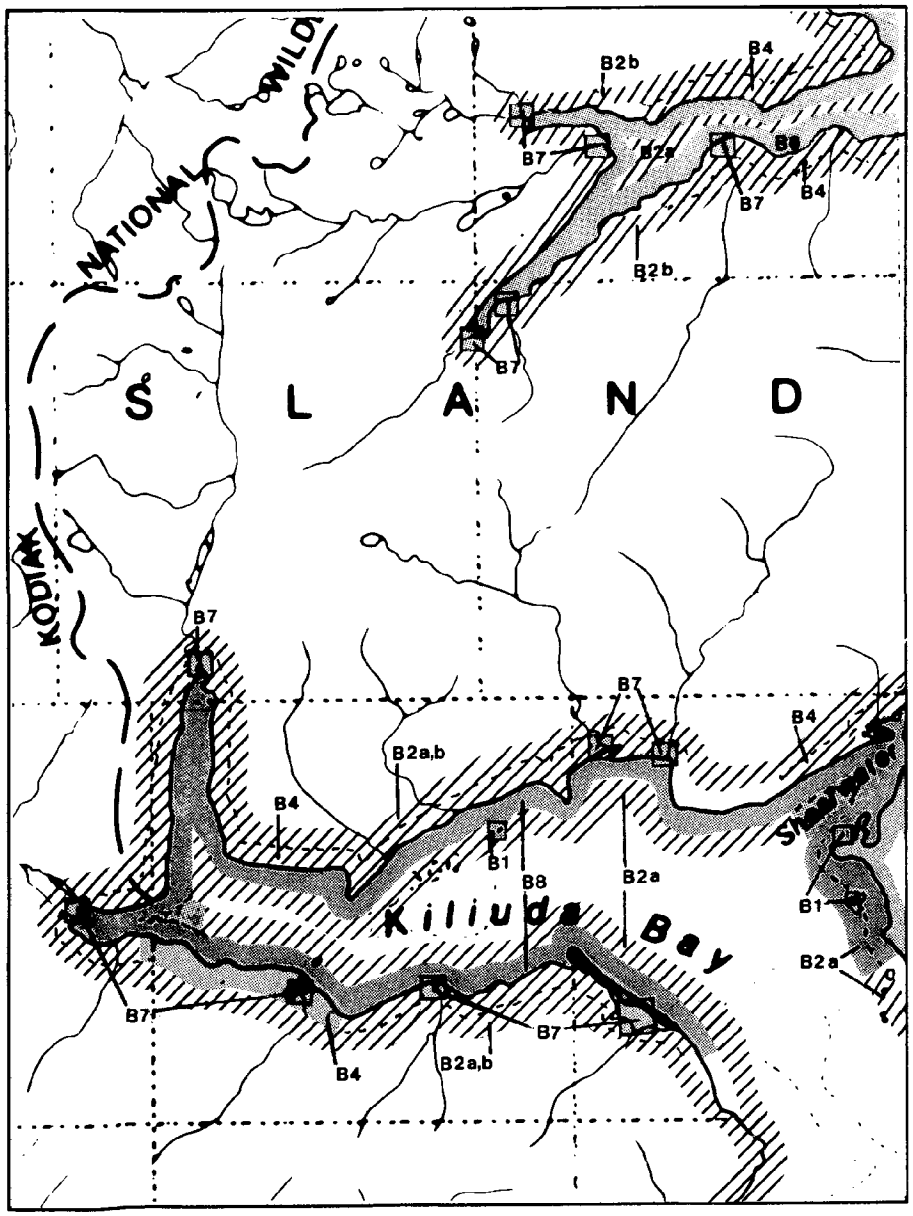


MAP NUMBER 30

RESOURCE		Winter			Spring			Summer			Fall		
		D	J	F	M	A	M	J	J	A	S	O	N
OIL RESIDENCE													
R-1	Rocky Headlands												
R-2	Wave-Cut Platforms												
R-3	Sand Beaches/Exposed Tidal Flats												
R-4	Mixed Sand and Gravel Beaches												
R-5	Gravel Beaches												
R-6	Sheltered Rocky and Gravel Shores												
R-7	Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX													
Commercial Fisheries													
H-1	Salmon												
H-2	Roe Herring												
H-3	Crab												
H-4	Shrimp												
H-5	Halibut												
H-6	Whitefish												
Subsistence													
H-7	Deer/Elk/Reindeer												
H-8	Marine Mammal												
H-9	Crab												
H-10	Waterfowl												
H-11	Clams												
H-12	Halibut/Marine Fish												
H-13	Salmon												
Recreation													
H-14	Recreation Use Area												
H-15	Recreation Facility												
Infrastructure													
H-16	Boat Harbor												
H-17	Dock												
H-18	Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX													
Onshore													
B-1	Seabird Colony												
B-2a	Waterfowl (overwintering)												
B-2b	Waterfowl (summer use)												
B-3	Sea Lion Haul-out												
B-4	Black Tail Deer												
B-5	Elk												
B-6	Brown Bear												
Offshore													
B-2a	Waterfowl (overwintering)												
B-2b	Waterfowl (summer use)												
B-7	Anadromous Fish Streams												
	Salmon - Adults												
	Salmon - Juveniles												
	Char/Dolly Varden - Adults												
	Char/Dolly Varden - Juveniles												
	Steelhead - Adults												
	Steelhead - Juveniles												
B-8	Herring Spawning Area												
B-9	Razor Clam Beach												
B-10	Sea Otters												

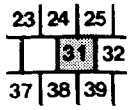

HIGH
MEDIUM
LOW
NATIONAL
WILD
S L A N D
KODIAK
Shearwater
Kiliuda Bay


NATIONAL
WILD
H8,10,11
H8,10,11
H1
H2
H7
S L A N D
KODIAK
H7
H10
H7
H13
H11
H13
Shearwater
H7
H8
H2
H1
Kiliuda Bay
H13
H8
H10
H1
H7
H2

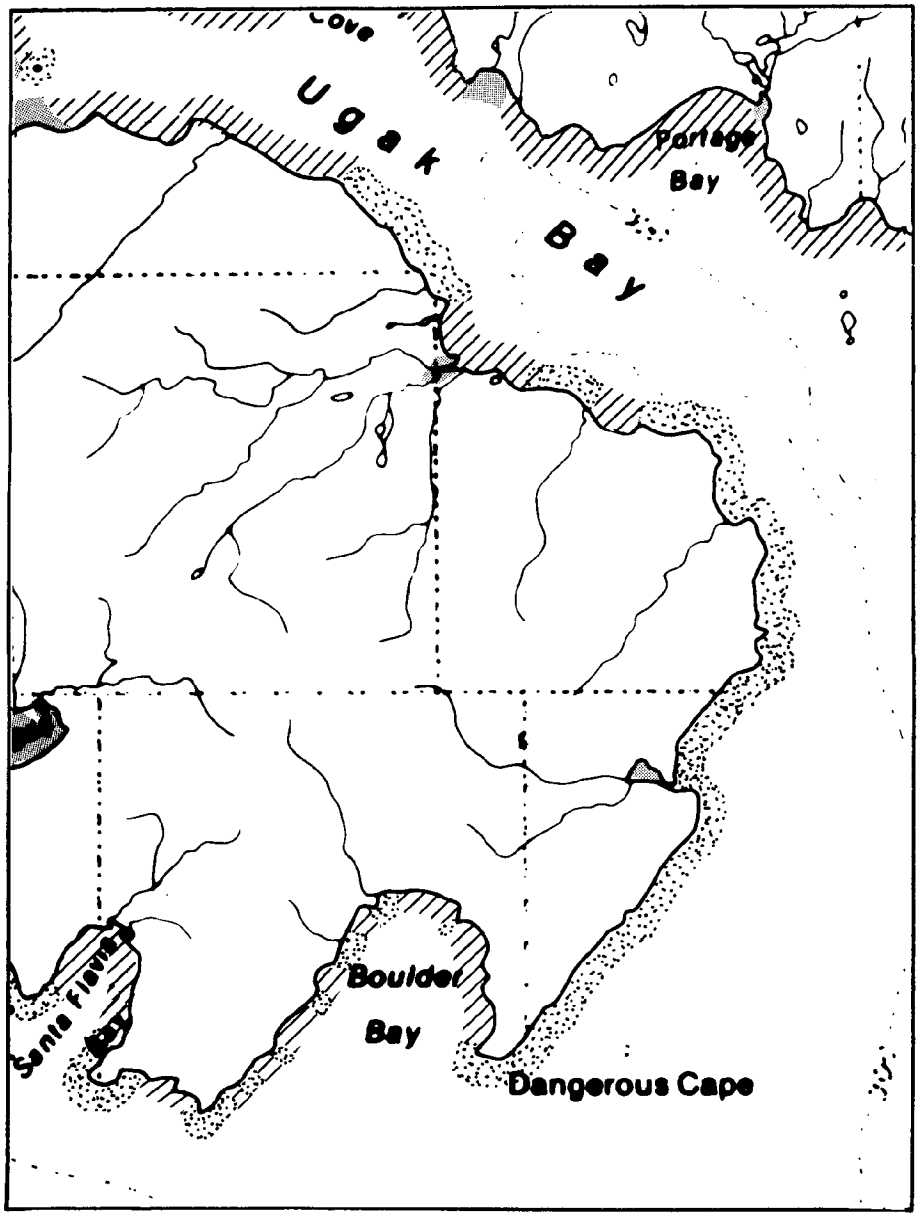


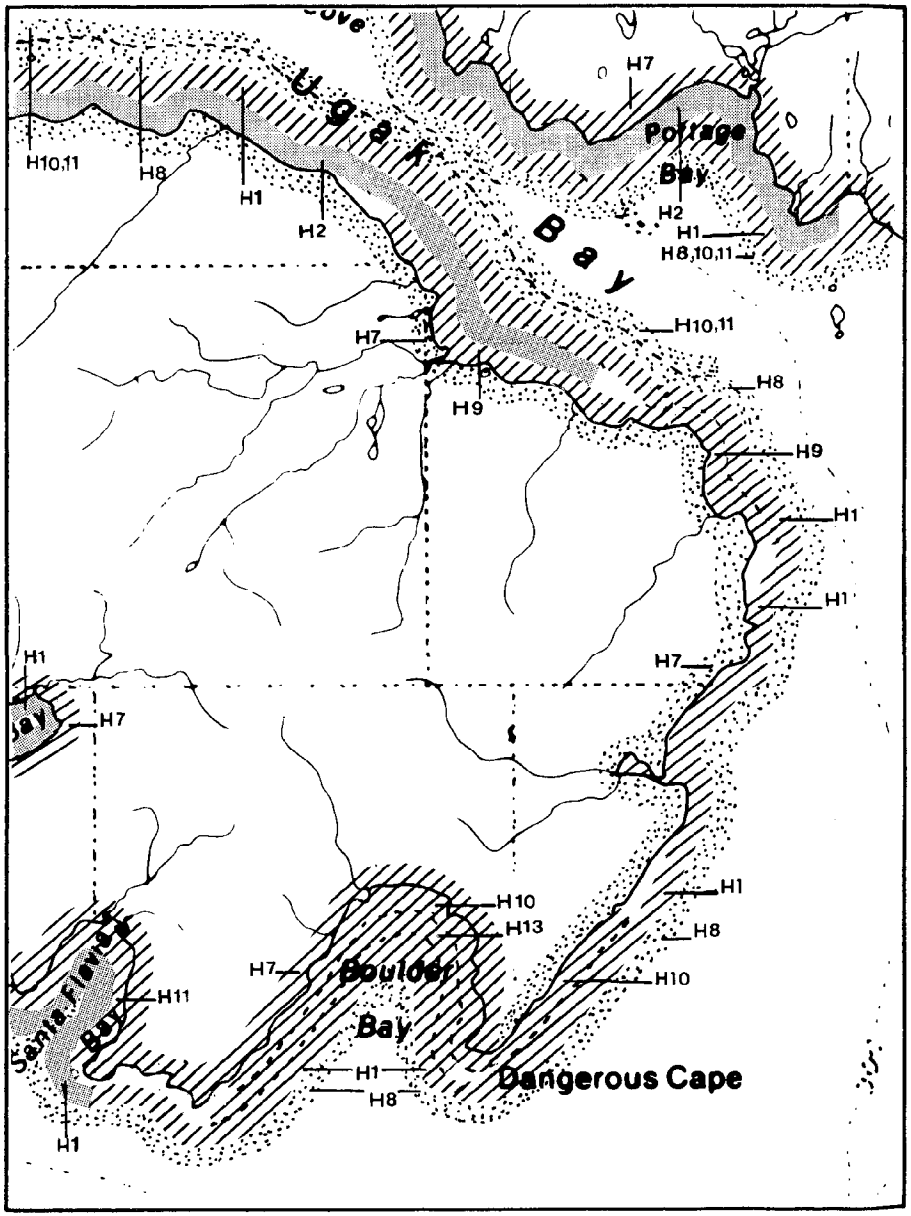
MAP NUMBER 31

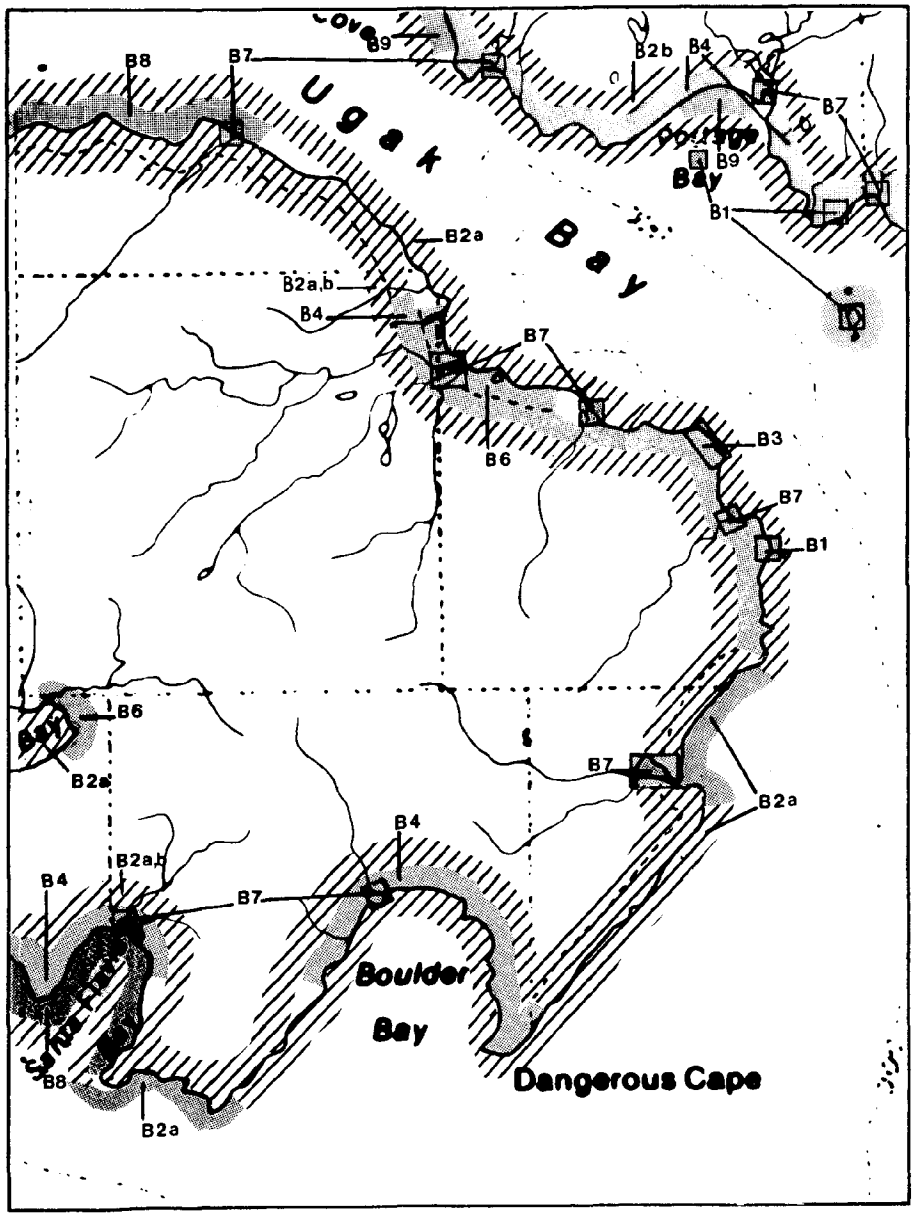
RESOURCE	Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE												
R-1 Rocky Headlands												
R-2 Wave-Cut Platforms												
R-3 Sand Beaches/Exposed Tidal Flats												
R-4 Mixed Sand and Gravel Beaches												
R-5 Gravel Beaches												
R-6 Sheltered Rocky and Gravel Shores												
R-7 Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon												
H-2 Roe Herring												
H-3 Crab												
H-4 Shrimp												
H-5 Halibut												
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer												
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon												
Recreation												
H-14 Recreation Use Area												
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer												
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults												
Salmon - Juveniles												
Char/Dolly Varden - Adults												
Char/Dolly Varden - Juveniles												
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area												
B-9 Razor Clam Beach												
B-10 Sea Otters												



HIGH MEDIUM LOW





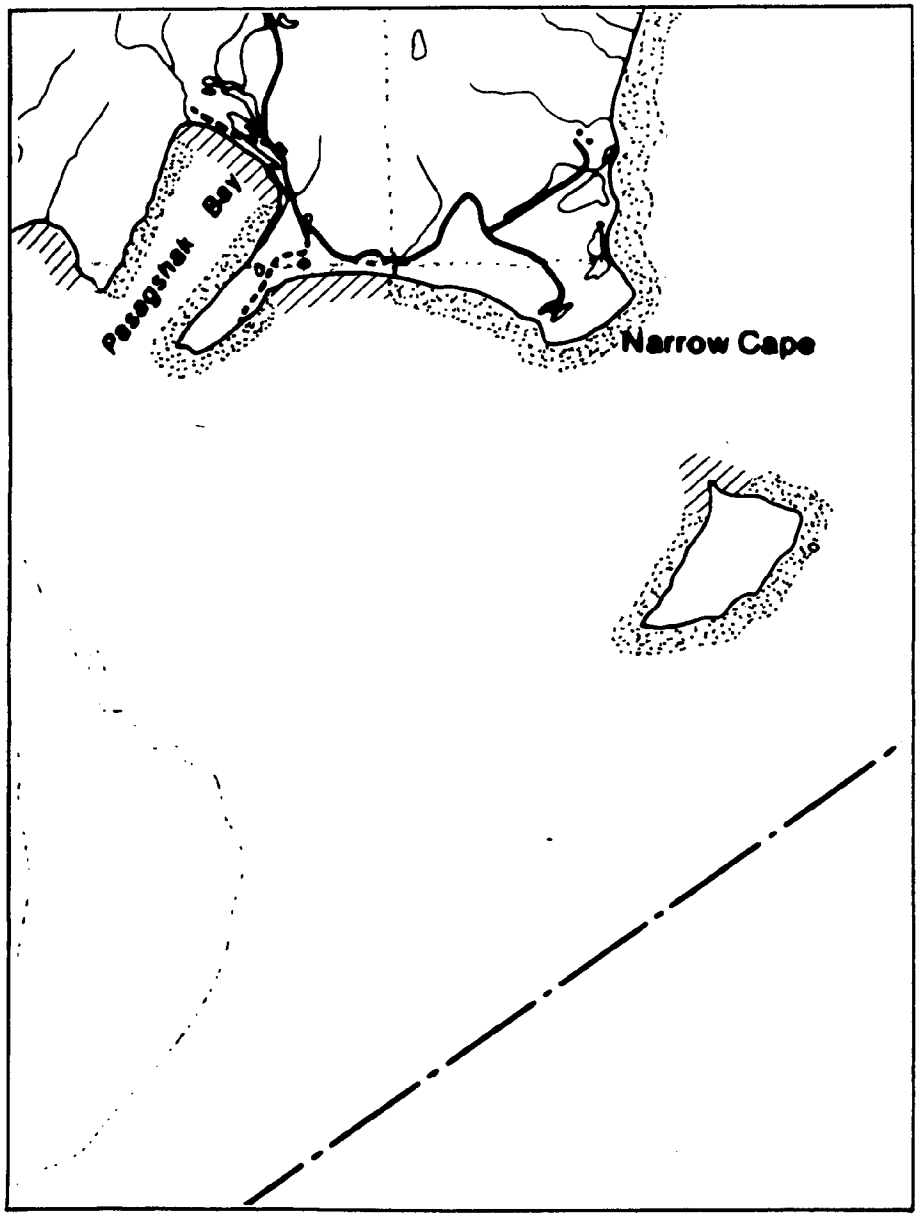


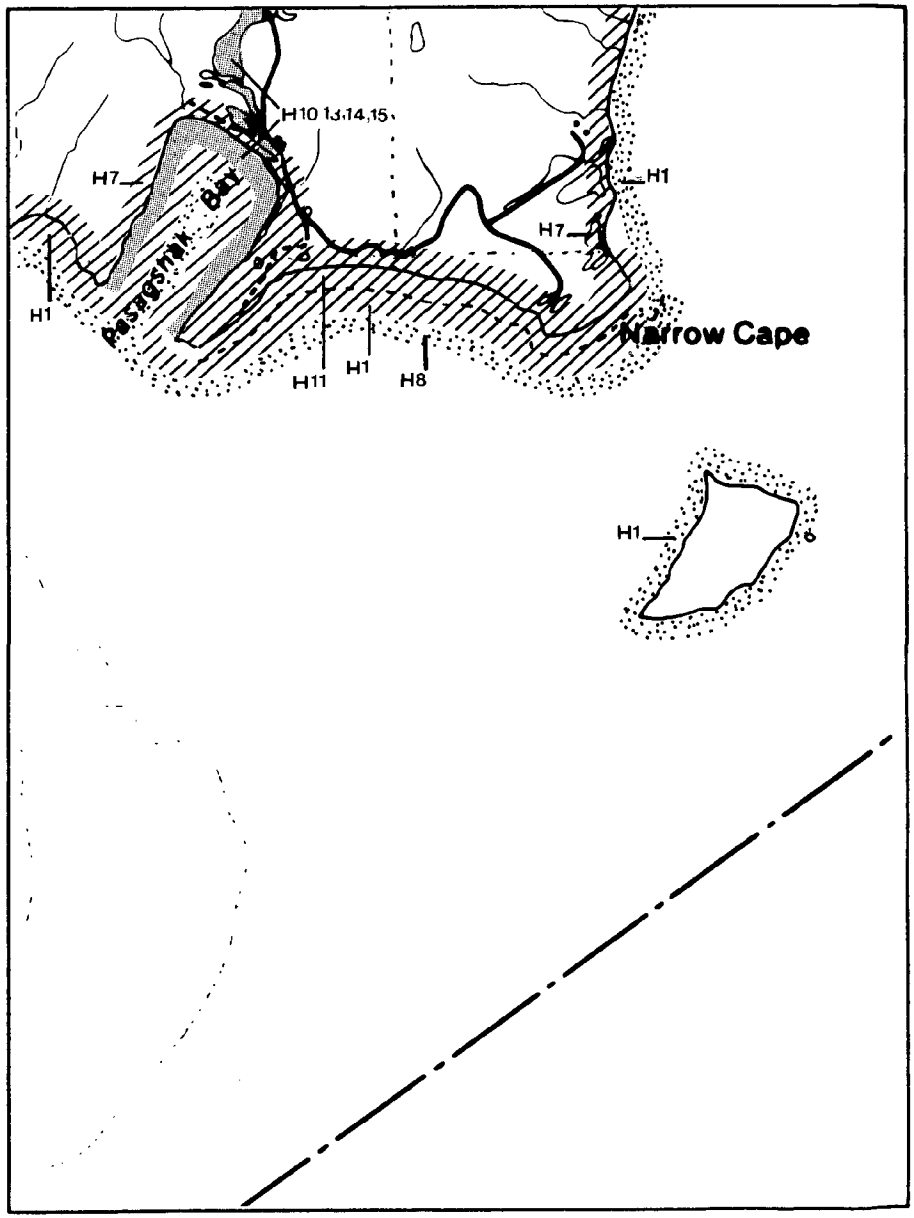
MAP NUMBER 32

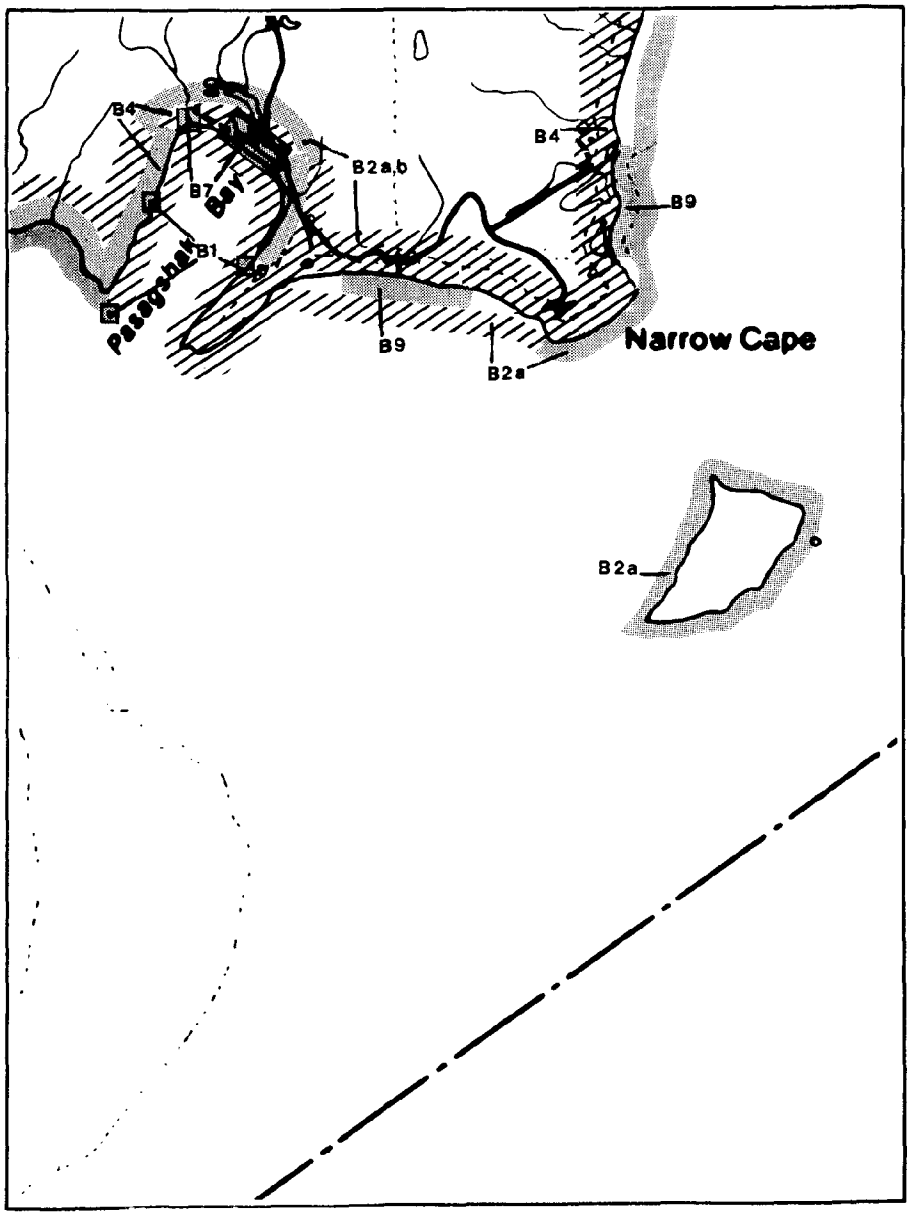
RESOURCE		Winter			Spring			Summer			Fall		
		D	J	F	M	A	M	J	J	A	S	O	N
OIL RESIDENCE													
R-1	Rocky Headlands												
R-2	Wave-Cut Platforms												
R-3	Sand Beaches/Exposed Tidal Flats												
R-4	Mixed Sand and Gravel Beaches												
R-5	Gravel Beaches												
R-6	Sheltered Rocky and Gravel Shores												
R-7	Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX													
Commercial Fisheries													
H-1	Salmon												
H-2	Roe Herring												
H-3	Crab												
H-4	Shrimp												
H-5	Halibut												
H-6	Whitefish												
Subsistence													
H-7	Deer/Elk/Reindeer												
H-8	Marine Mammal												
H-9	Crab												
H-10	Waterfowl												
H-11	Clams												
H-12	Halibut/Marine Fish												
H-13	Salmon												
Recreation													
H-14	Recreation Use Area												
H-15	Recreation Facility												
Infrastructure													
H-16	Boat Harbor												
H-17	Dock												
H-18	Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX													
Onshore													
B-1	Seabird Colony												
B-2a	Waterfowl (overwintering)												
B-2b	Waterfowl (summer use)												
B-3	Sea Lion Haul-out												
B-4	Black Tail Deer												
B-5	Elk												
B-6	Brown Bear												
Offshore													
B-2a	Waterfowl (overwintering)												
B-2b	Waterfowl (summer use)												
B-7	Anadromous Fish Streams												
	Salmon - Adults												
	Salmon - Juveniles												
	Char/Dolly Varden - Adults												
	Char/Dolly Varden - Juveniles												
	Steelhead - Adults												
	Steelhead - Juveniles												
B-8	Herring Spawning Area												
B-9	Razor Clam Beach												
B-10	Sea Otters												

24 25 26 27
31 32 33
38 39

HIGH MEDIUM LOW

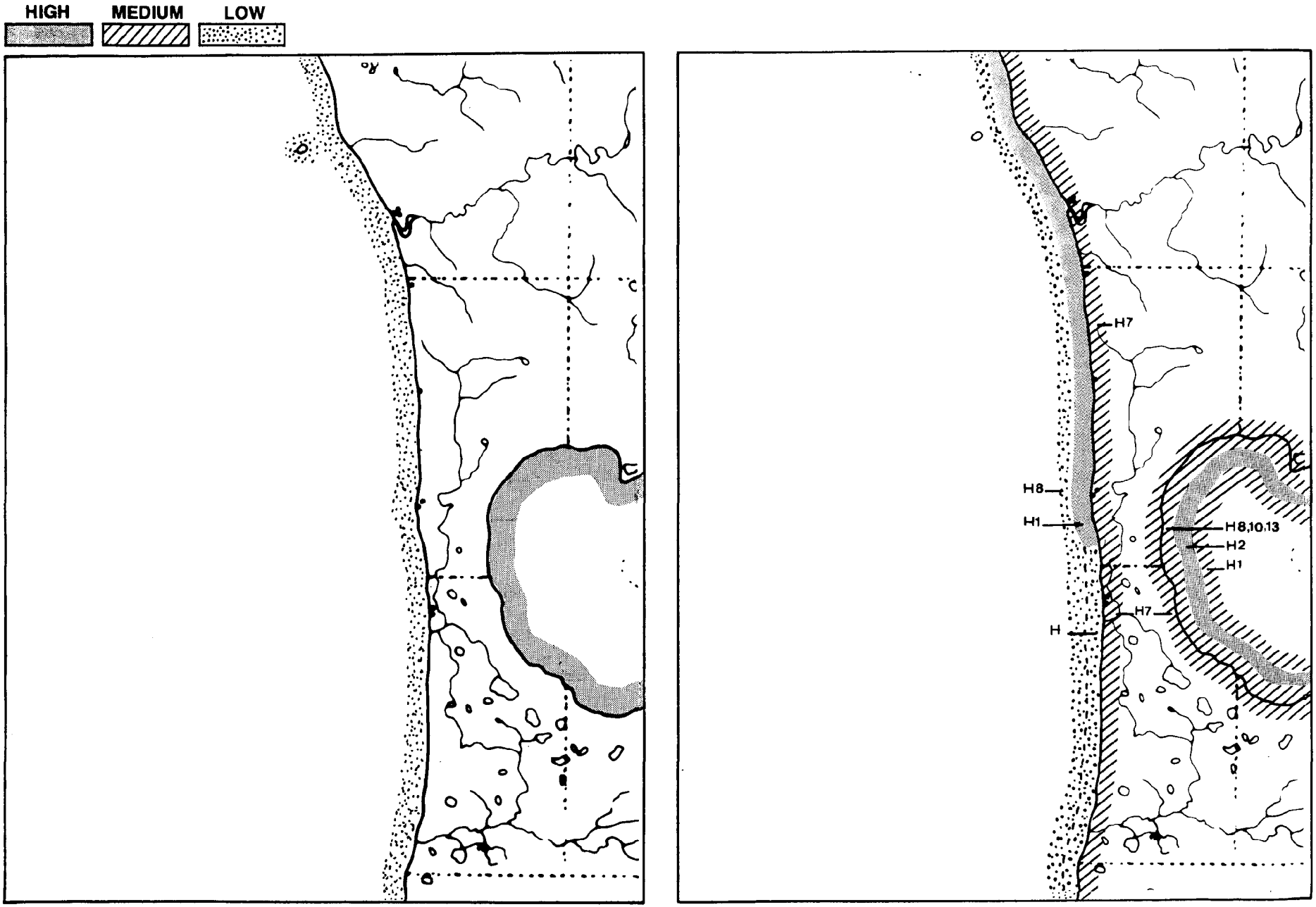


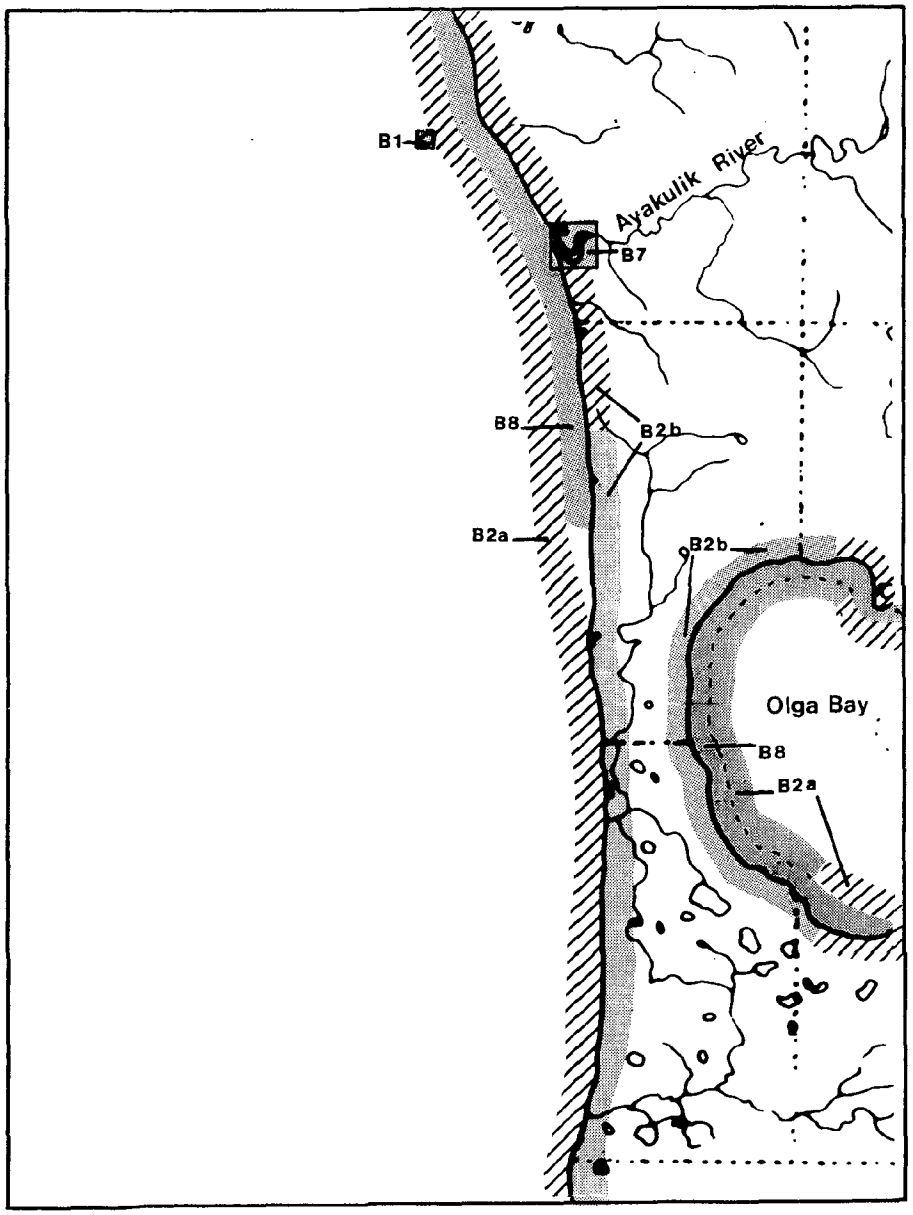




MAP NUMBER 33

RESOURCE	Winter			Spring			Summer			Fall		
	D	J	F	M	A	M	J	J	A	S	O	N
OIL RESIDENCE												
R-1 Rocky Headlands	—	—	—	—	—	—	—	—	—	—	—	—
R-2 Wave-Cut Platforms	—	—	—	—	—	—	—	—	—	—	—	—
R-3 Sand Beaches/Exposed Tidal Flats	—	—	—	—	—	—	—	—	—	—	—	—
R-4 Mixed Sand and Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-5 Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-6 Sheltered Rocky and Gravel Shores	—	—	—	—	—	—	—	—	—	—	—	—
R-7 Protected Estuarine Tidal Flats and Marshes	—	—	—	—	—	—	—	—	—	—	—	—
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon							—	—	—	—		
H-2 Roe Herring												
H-3 Crab		—	—	—	—	—	—	—	—	—	—	—
H-4 Shrimp												
H-5 Halibut							—	—				
H-6 Whitefish	—	—	—	—	—	—	—	—	—	—	—	—
Subsistence												
H-7 Deer/Elk/Reindeer	—											—
H-8 Marine Mammal	—	—	—	—	—	—	—	—	—	—	—	—
H-9 Crab												
H-10 Waterfowl	—									—	—	—
H-11 Clams	—	—	—	—	—	—	—	—	—	—	—	—
H-12 Halibut/Marine Fish												
H-13 Salmon						—	—	—	—	—	—	—
Recreation												
H-14 Recreation Use Area	—					—	—	—	—	—	—	—
H-15 Recreation Facility	—	—	—	—	—	—	—	—	—	—	—	—
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony						—	—	—	—	—		
B-2a Waterfowl (overwintering)	—	—	—	—							—	—
B-2b Waterfowl (summer use)						—	—	—	—	—		
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer	—	—	—	—								—
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)	—	—	—	—							—	—
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults				—	—	—	—	—	—	—	—	
Salmon - Juveniles		—	—	—	—	—	—	—	—	—	—	—
Char/Dolly Varden - Adults	—							—	—	—	—	—
Char/Dolly Varden - Juveniles					—	—	—					
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area												
B-9 Razor Clam Beach	—	—	—	—	—	—	—	—	—	—	—	—
B-10 Sea Otters												

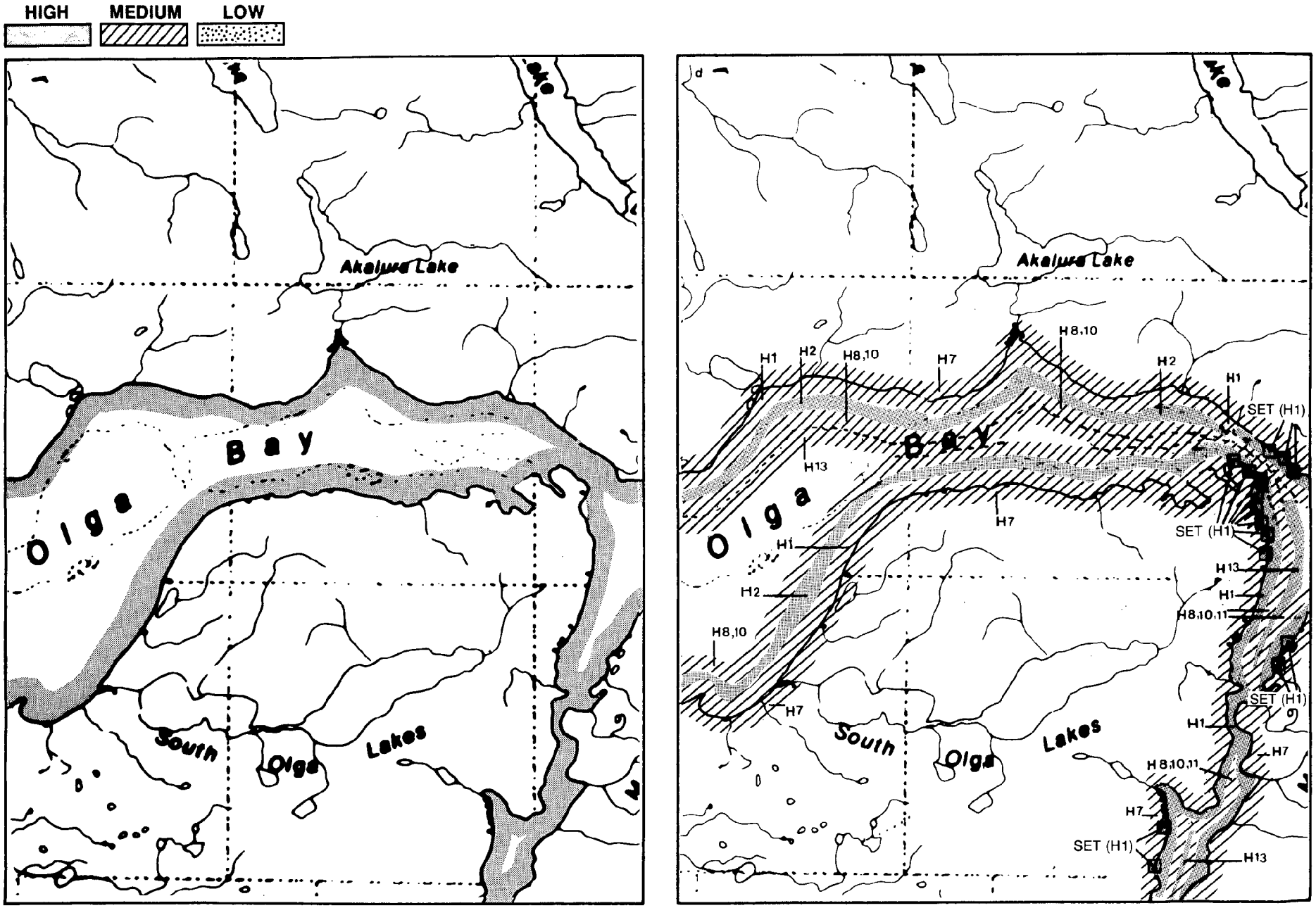

HIGH
MEDIUM
LOW
H7
H8
H1
H8,10,13
H2
H1
H7
H

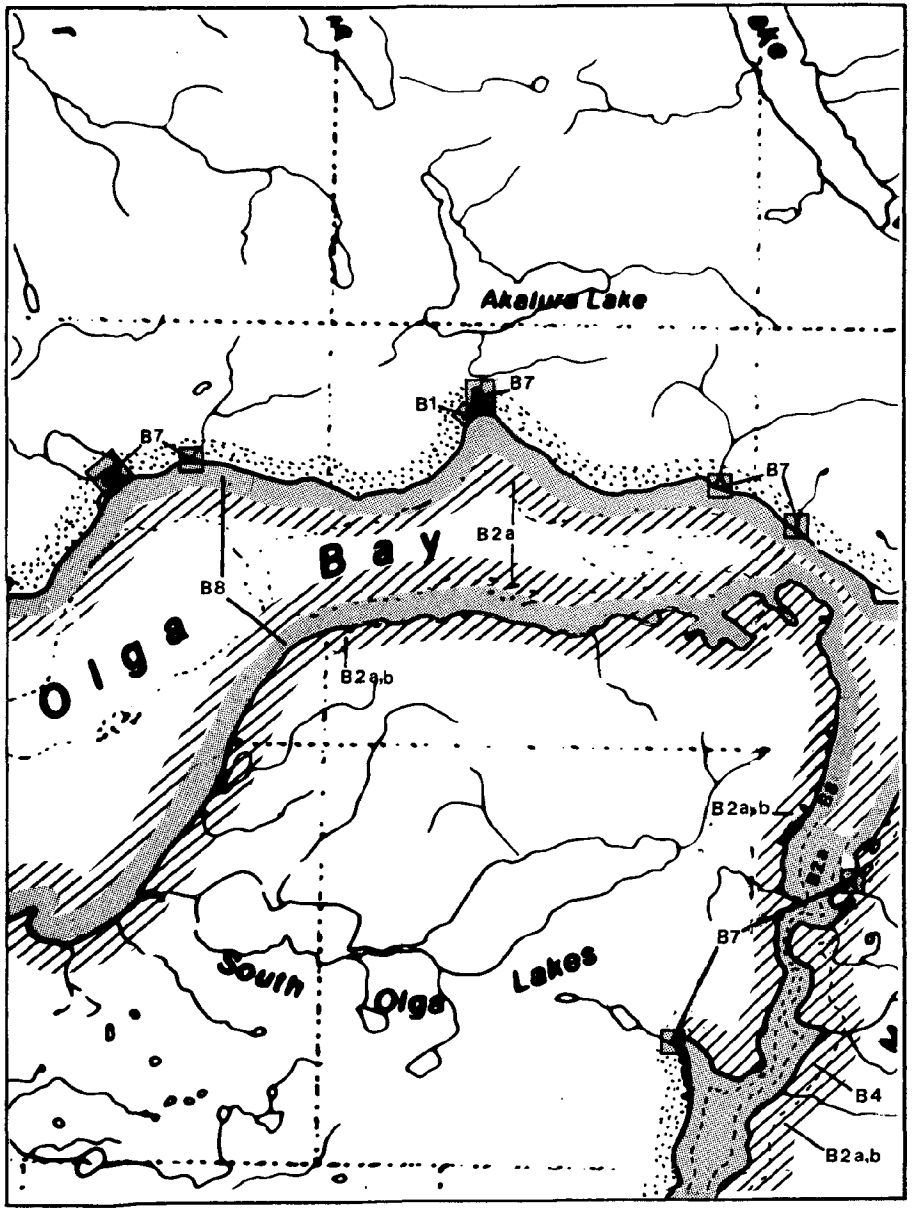


MAP NUMBER 34

RESOURCE	Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE												
R-1 Rocky Headlands	—	—	—	—	—	—	—	—	—	—	—	—
R-2 Wave-Cut Platforms	—	—	—	—	—	—	—	—	—	—	—	—
R-3 Sand Beaches/Exposed Tidal Flats	—	—	—	—	—	—	—	—	—	—	—	—
R-4 Mixed Sand and Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-5 Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-6 Sheltered Rocky and Gravel Shores	—	—	—	—	—	—	—	—	—	—	—	—
R-7 Protected Estuarine Tidal Flats and Marshes	—	—	—	—	—	—	—	—	—	—	—	—
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon							—	—	—	—		
H-2 Roe Herring					—	—	—					
H-3 Crab		—	—	—	—	—	—	—	—	—	—	—
H-4 Shrimp												
H-5 Halibut							—	—				
H-6 Whitefish	—	—	—	—	—	—	—	—	—	—	—	—
Subsistence												
H-7 Deer/Elk/Reindeer	—											—
H-8 Marine Mammal	—	—	—	—	—	—	—	—	—	—	—	—
H-9 Crab												
H-10 Waterfowl	—	—	—	—	—	—				—	—	—
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon	—	—	—			—	—	—	—	—	—	—
Recreation												
H-14 Recreation Use Area												
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony						—	—	—	—	—		
B-2a Waterfowl (overwintering)	—	—	—	—							—	—
B-2b Waterfowl (summer use)						—	—	—	—	—		
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer												
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)	—	—	—	—							—	—
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults				—	—	—	—	—	—	—	—	
Salmon - Juveniles	—	—	—	—	—	—	—	—	—	—	—	—
Char/Dolly Varden - Adults	—							—	—	—	—	—
Char/Dolly Varden - Juveniles					—	—	—	—				
Steelhead - Adults	—	—	—	—	—	—	—		—	—	—	—
Steelhead - Juveniles							—	—	—			
B-8 Herring Spawning Area						—	—					
B-9 Razor Clam Beach												
B-10 Sea Otters												

28 29
34 35 36
40 41

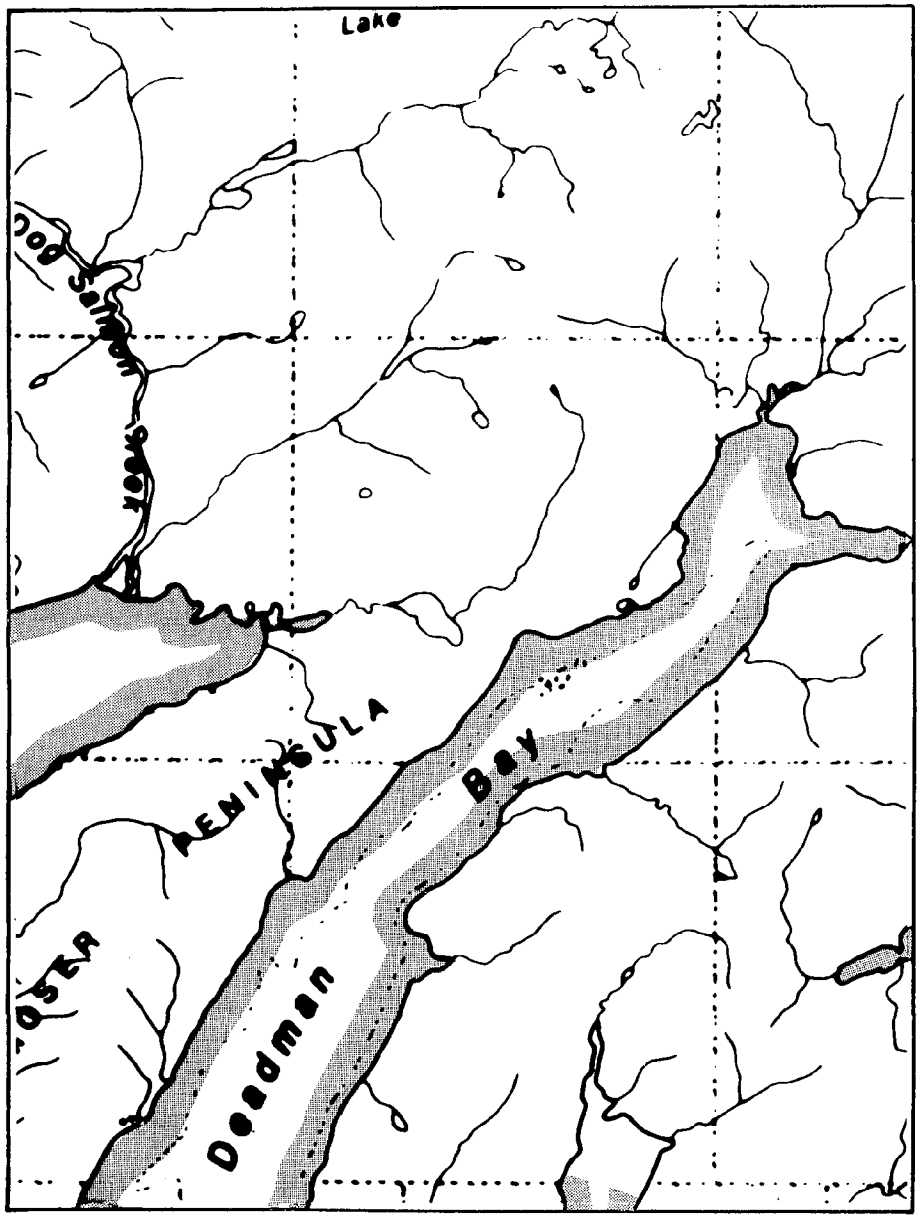

HIGH
MEDIUM
LOW
Akaiura Lake
Olga Bay
South Olga Lakes
Akaiura Lake
H1
H2
H8,10
H7
H8,10
H2
H1
SET (H1)
H13
Olga Bay
H7
SET (H1)
H1
H13
H2
H1
H8,10,11
H8,10
SET (H1)
H7
South Olga Lakes
H1
H7
H8,10,11
H7
SET (H1)
H13

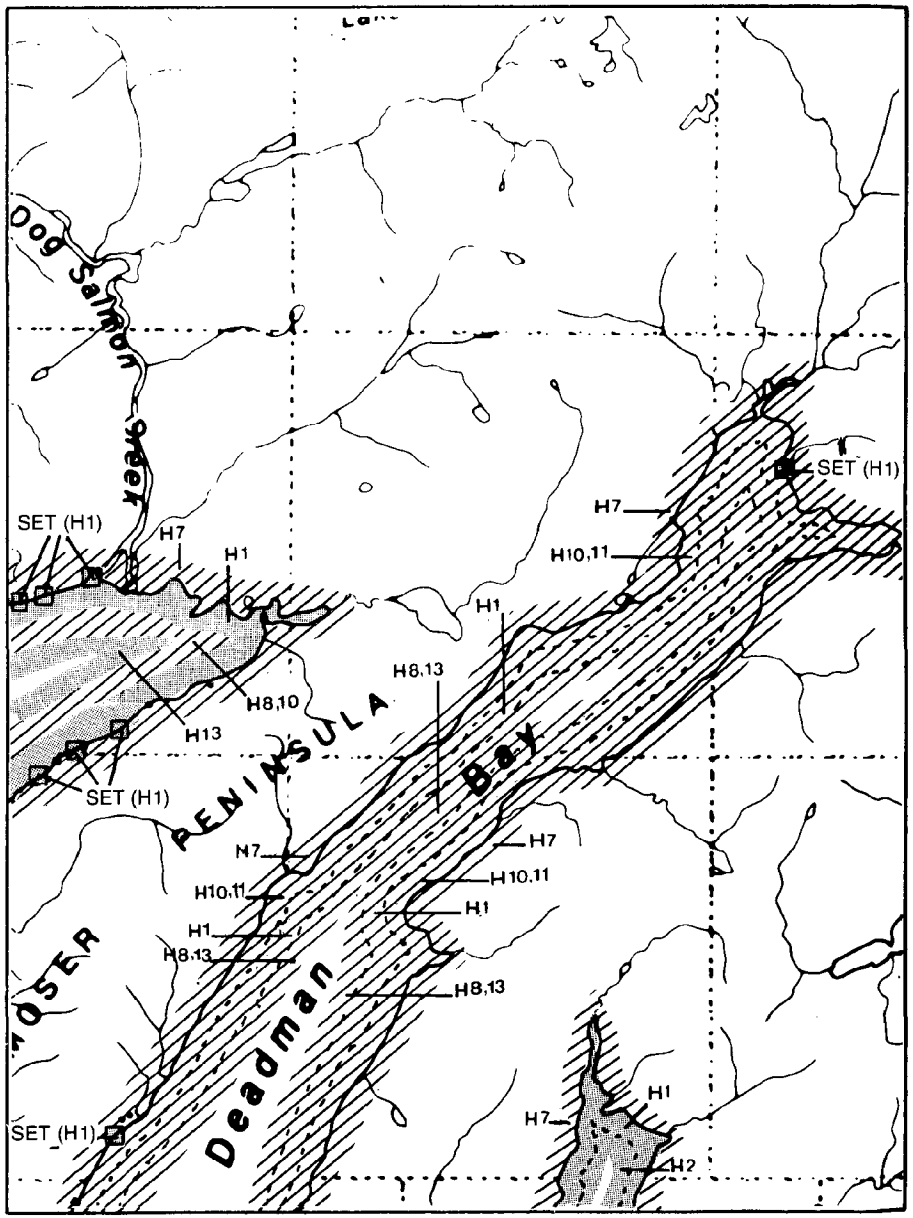


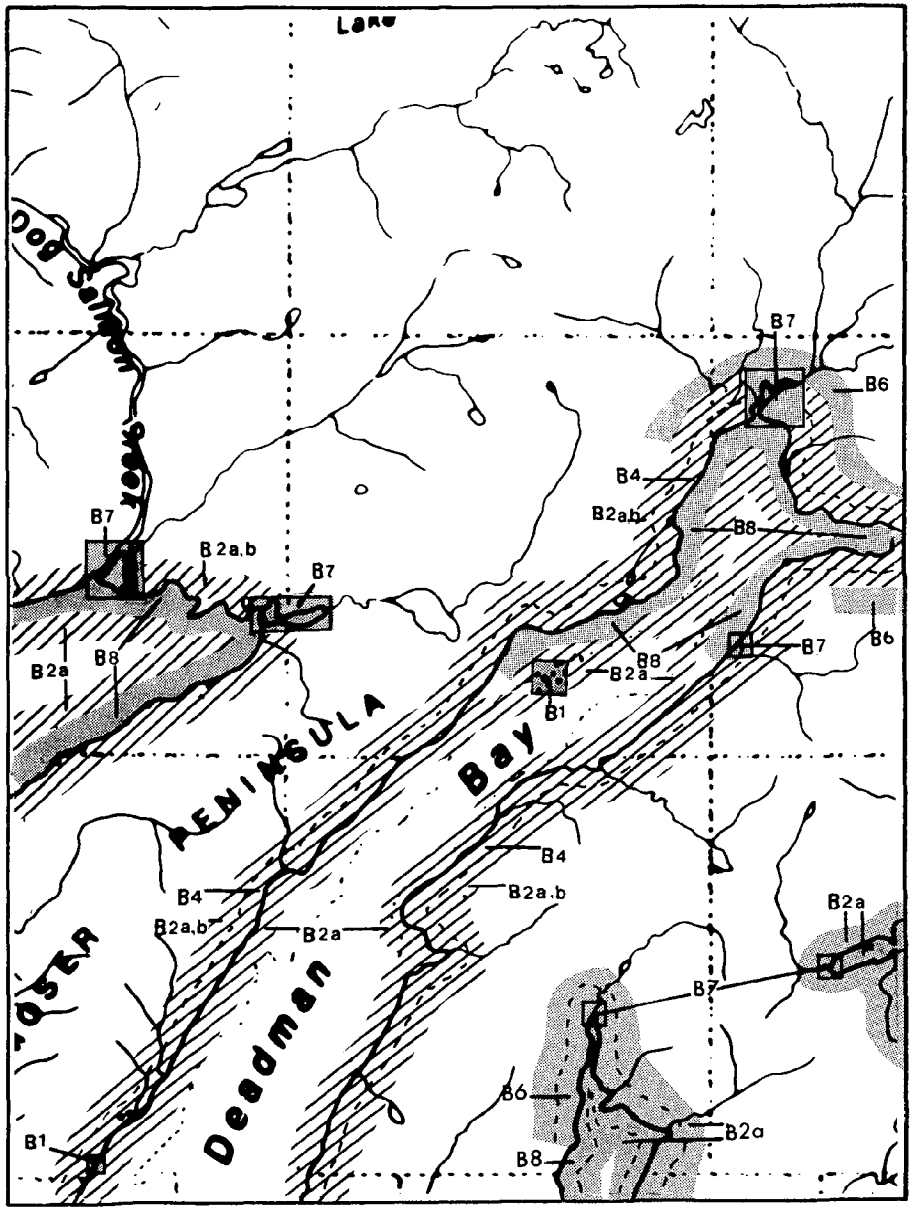
MAP NUMBER 35

RESOURCE	Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE												
R-1 Rocky Headlands												
R-2 Wave-Cut Platforms												
R-3 Sand Beaches/Exposed Tidal Flats												
R-4 Mixed Sand and Gravel Beaches												
R-5 Gravel Beaches												
R-6 Sheltered Rocky and Gravel Shores												
R-7 Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon												
H-2 Roe Herring												
H-3 Crab												
H-4 Shrimp												
H-5 Halibut												
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer												
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon												
Recreation												
H-14 Recreation Use Area												
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer												
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults												
Salmon - Juveniles												
Char/Dolly Varden - Adults												
Char/Dolly Varden - Juveniles												
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area												
B-9 Razor Clam Beach												
B-10 Sea Otters												

HIGH MEDIUM LOW





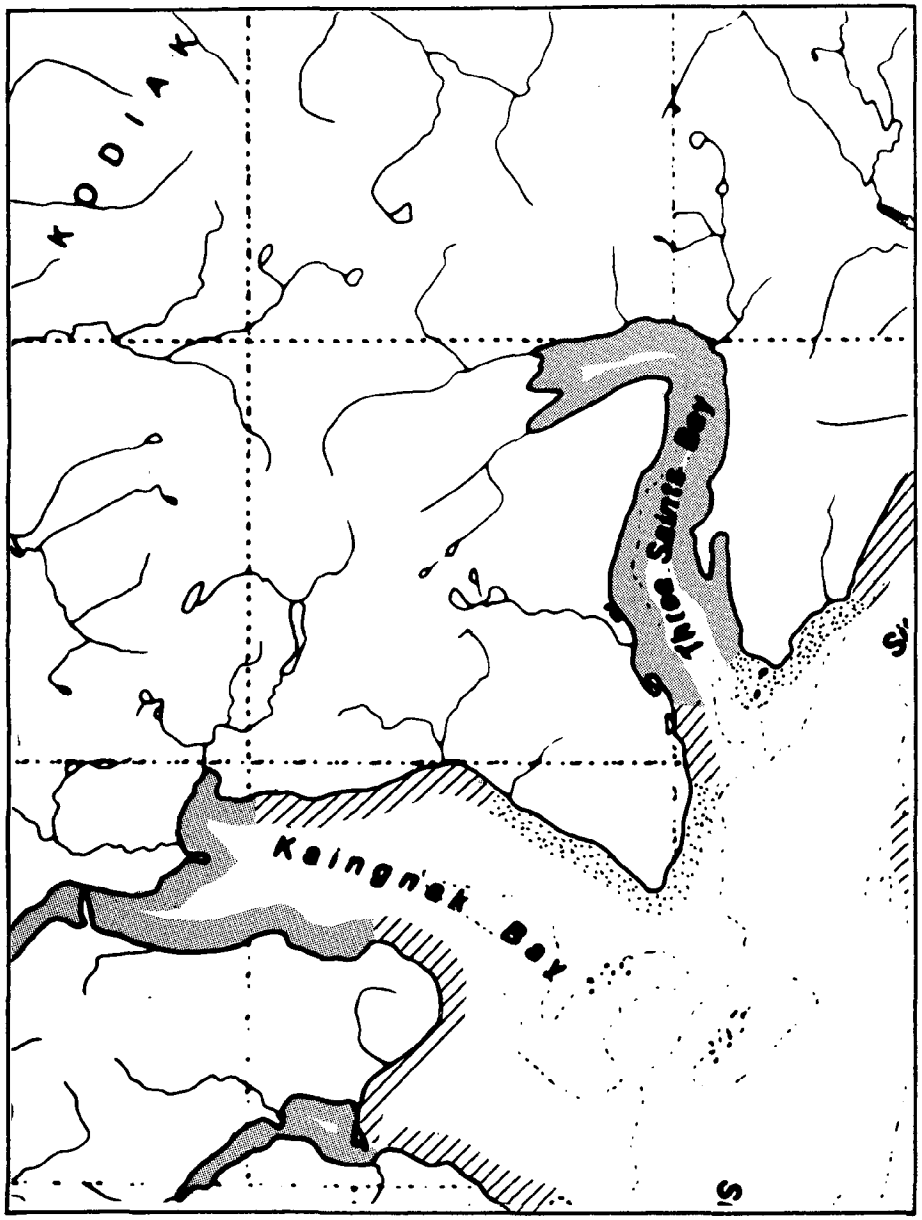


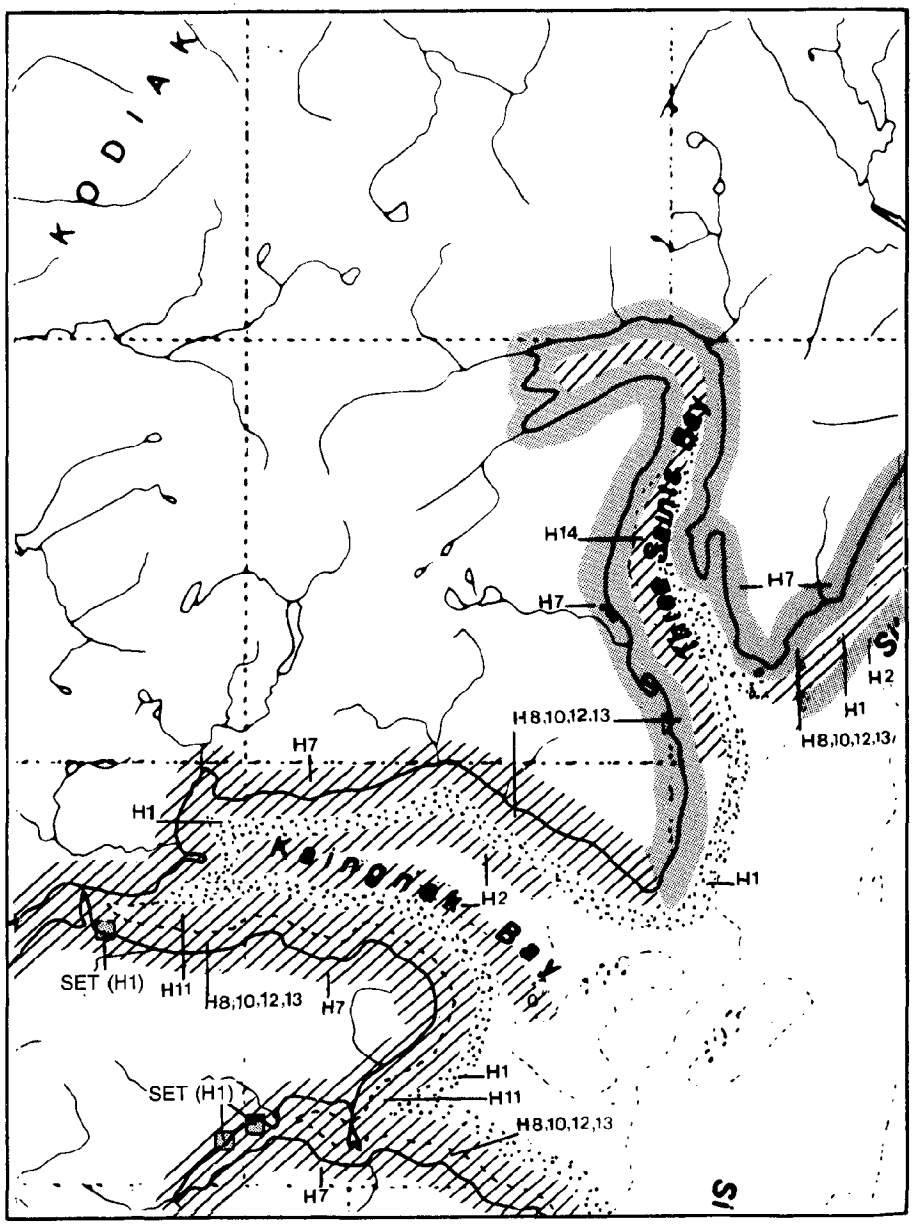
MAP NUMBER 36

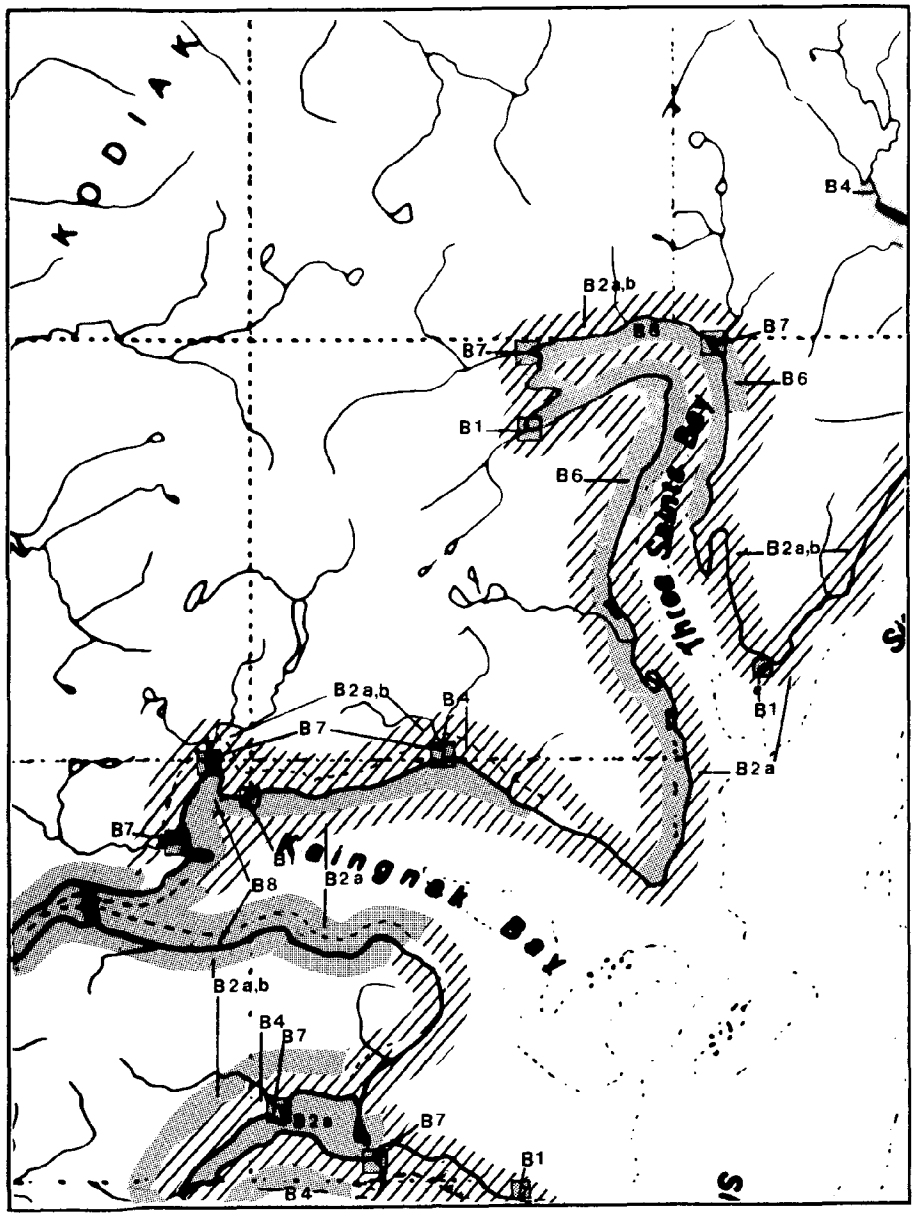
RESOURCE		Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE													
R-1	Rocky Headlands												
R-2	Wave-Cut Platforms												
R-3	Sand Beaches/Exposed Tidal Flats												
R-4	Mixed Sand and Gravel Beaches												
R-5	Gravel Beaches												
R-6	Sheltered Rocky and Gravel Shores												
R-7	Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX													
Commercial Fisheries													
H-1	Salmon												
H-2	Roe Herring												
H-3	Crab												
H-4	Shrimp												
H-5	Halibut												
H-6	Whitefish												
Subsistence													
H-7	Deer/Elk/Reindeer												
H-8	Marine Mammal												
H-9	Crab												
H-10	Waterfowl												
H-11	Clams												
H-12	Halibut/Marine Fish												
H-13	Salmon												
Recreation													
H-14	Recreation Use Area												
H-15	Recreation Facility												
Infrastructure													
H-16	Boat Harbor												
H-17	Dock												
H-18	Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX													
Onshore													
B-1	Seabird Colony												
B-2a	Waterfowl (overwintering)												
B-2b	Waterfowl (summer use)												
B-3	Sea Lion Haul-out												
B-4	Black Tail Deer												
B-5	Elk												
B-6	Brown Bear												
Offshore													
B-2a	Waterfowl (overwintering)												
B-2b	Waterfowl (summer use)												
B-7	Anadromous Fish Streams												
	Salmon - Adults												
	Salmon - Juveniles												
	Char/Dolly Varden - Adults												
	Char/Dolly Varden - Juveniles												
	Steelhead - Adults												
	Steelhead - Juveniles												
B-8	Herring Spawning Area												
B-9	Razor Clam Beach												
B-10	Sea Otters												

29 30
35 36 37
41 42

HIGH MEDIUM LOW



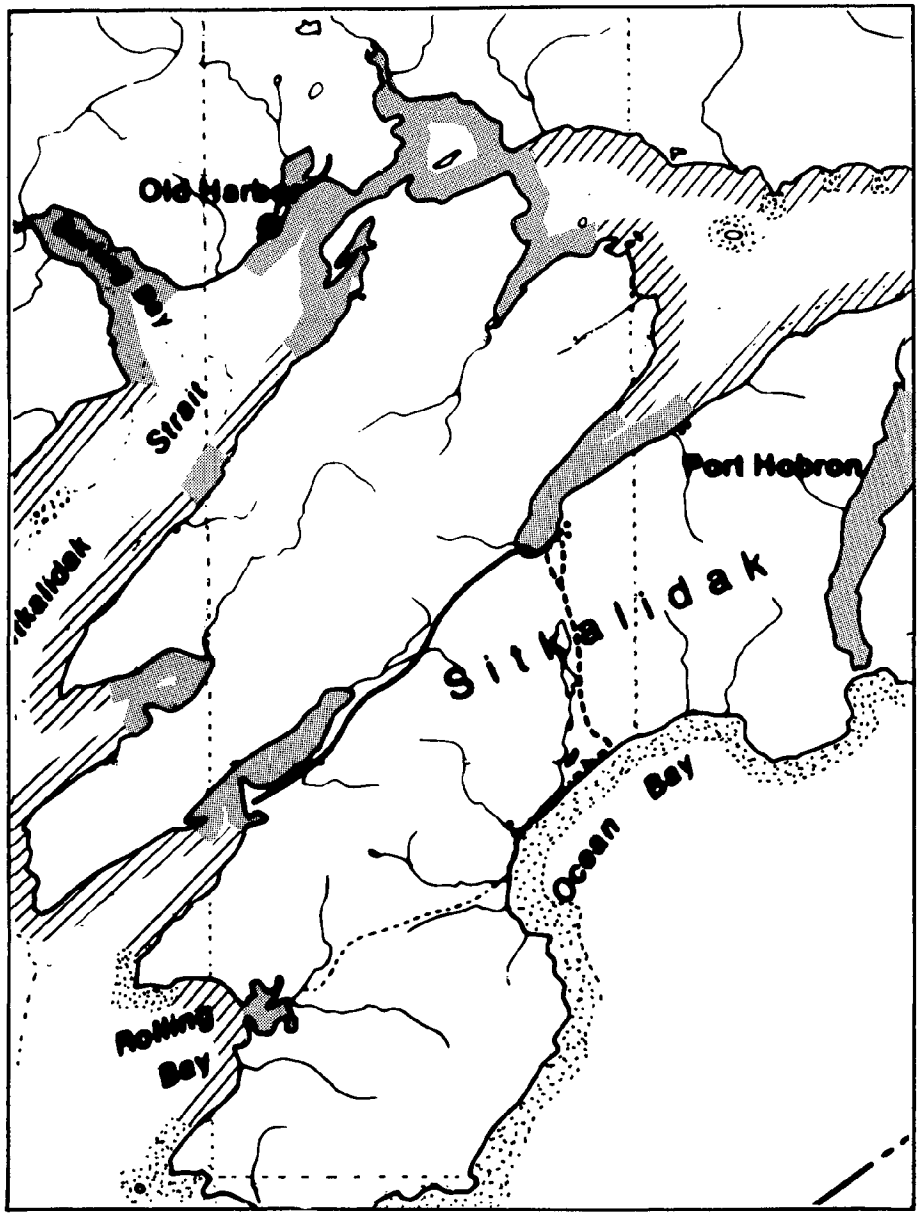


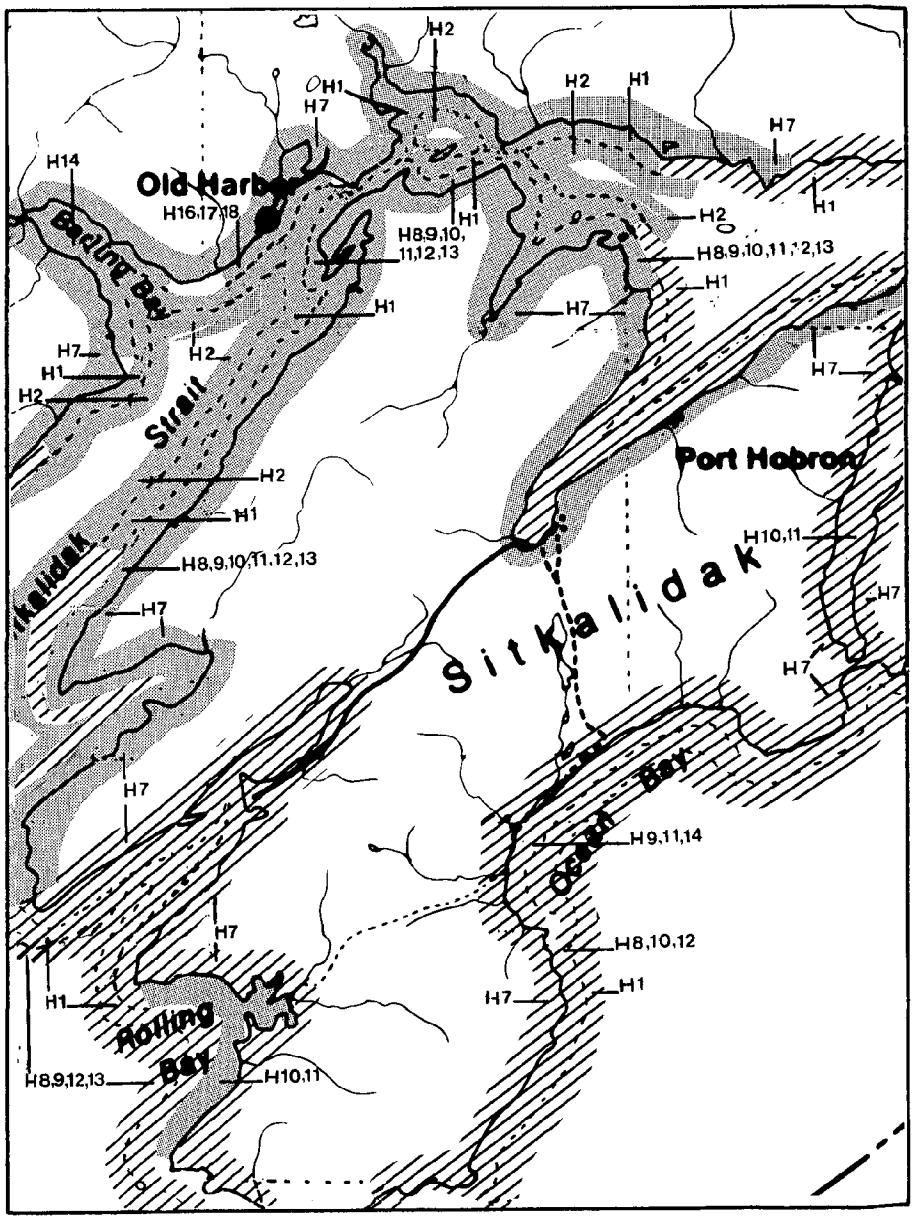


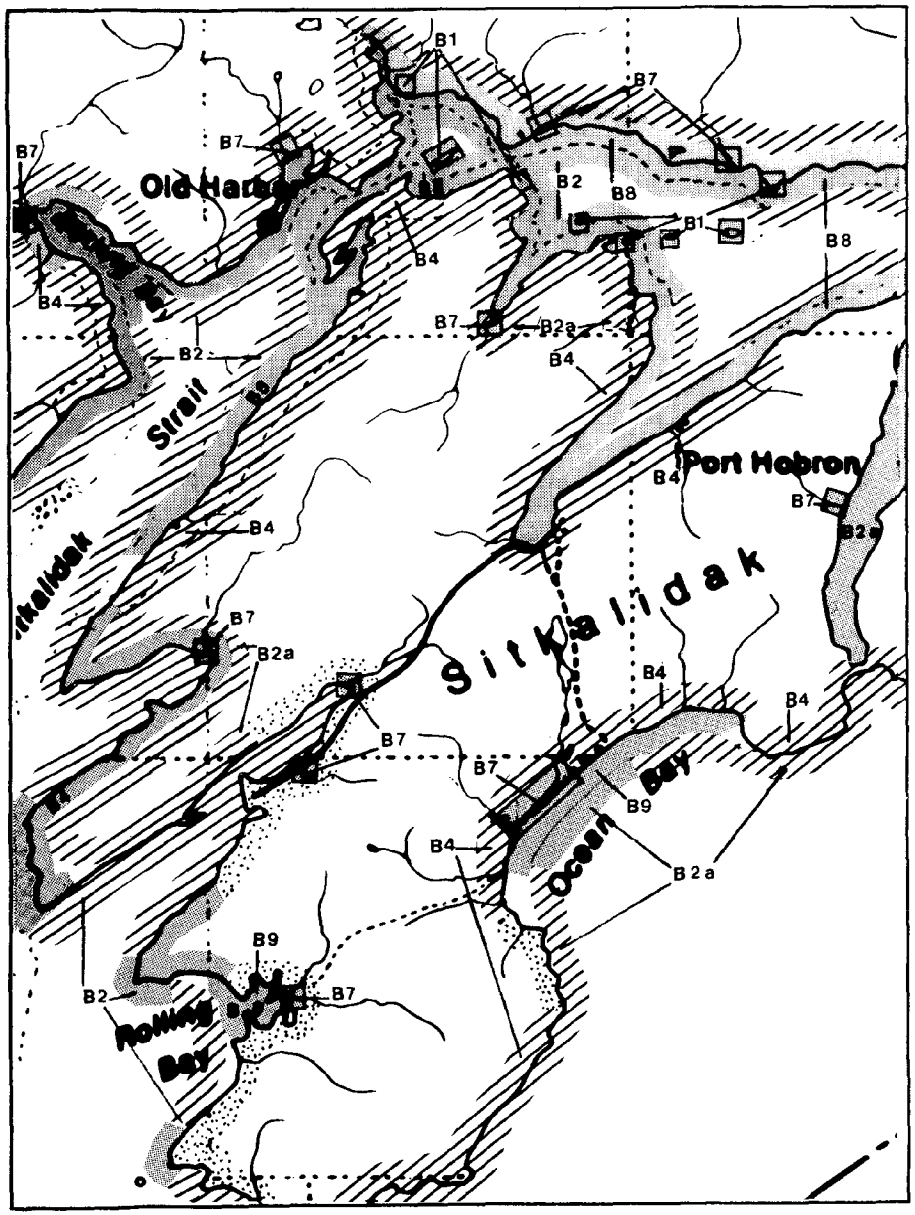
MAP NUMBER 37

RESOURCE	Winter			Spring			Summer			Fall		
	D	J	F	M	A	M	J	J	A	S	O	N
OIL RESIDENCE												
R-1 Rocky Headlands												
R-2 Wave-Cut Platforms												
R-3 Sand Beaches/Exposed Tidal Flats												
R-4 Mixed Sand and Gravel Beaches												
R-5 Gravel Beaches												
R-6 Sheltered Rocky and Gravel Shores												
R-7 Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon												
H-2 Roe Herring												
H-3 Crab												
H-4 Shrimp												
H-5 Halibut												
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer												
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon												
Recreation												
H-14 Recreation Use Area												
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer												
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults												
Salmon - Juveniles												
Char/Dolly Varden - Adults												
Char/Dolly Varden - Juveniles												
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area												
B-9 Razor Clam Beach												
B-10 Sea Otters												

HIGH MEDIUM LOW



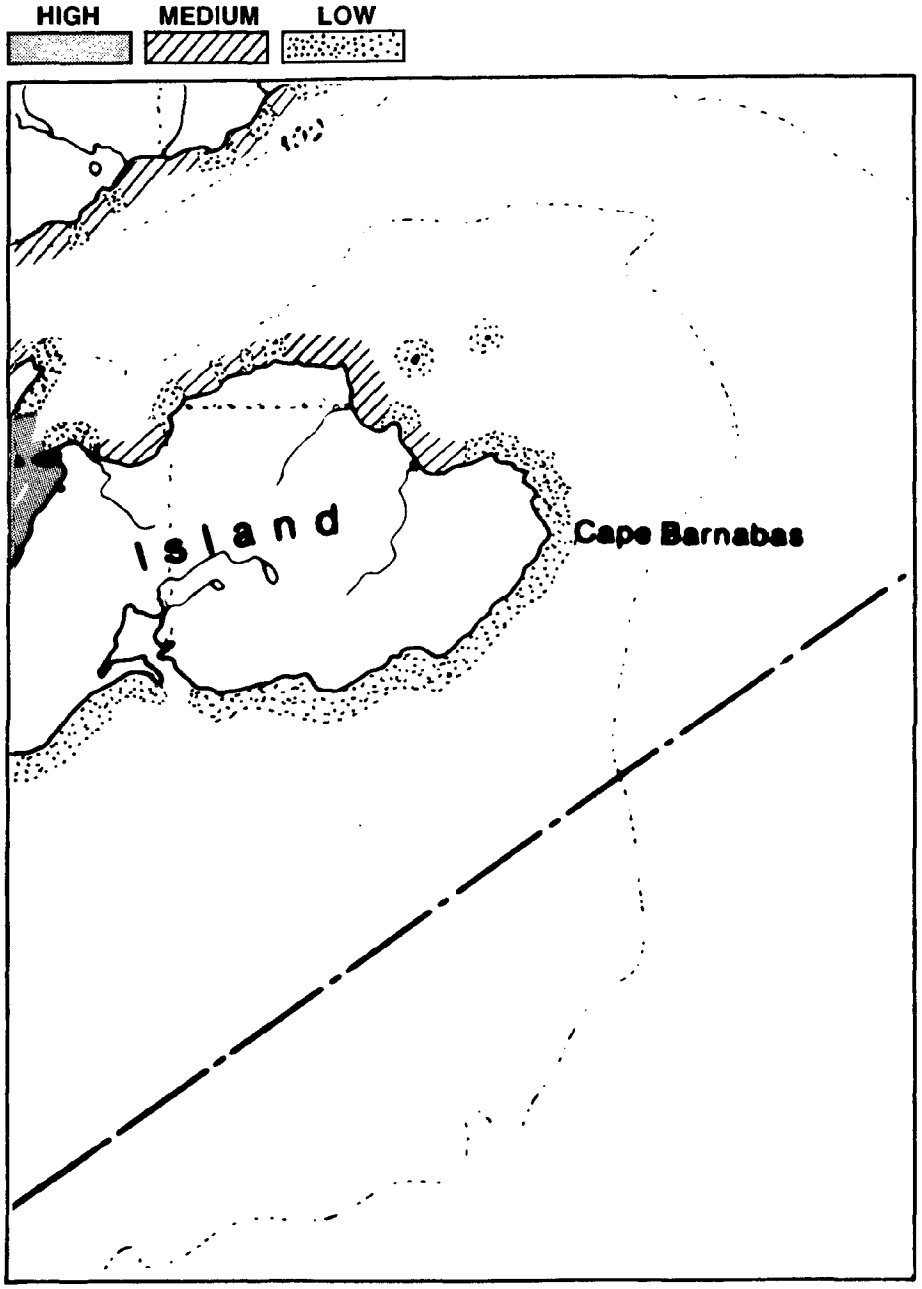


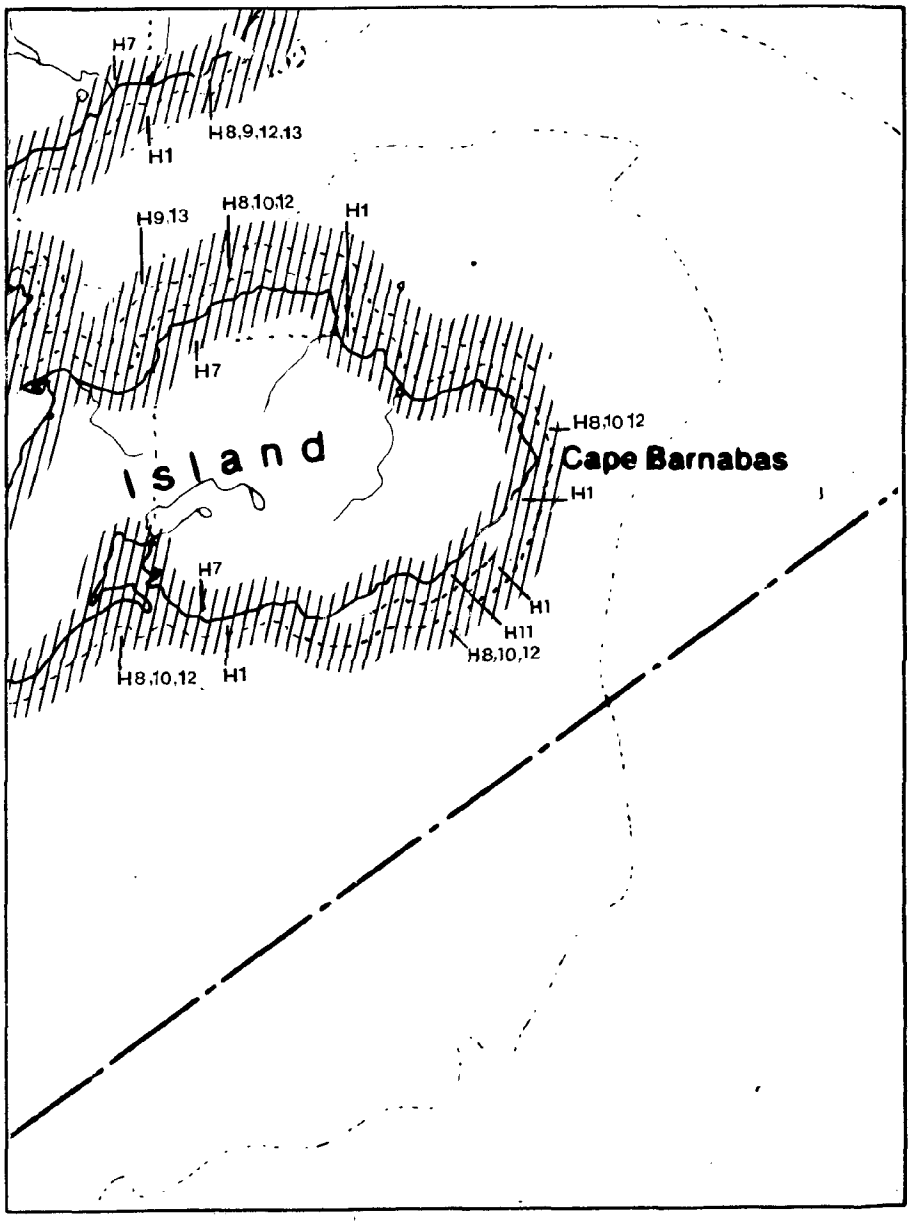


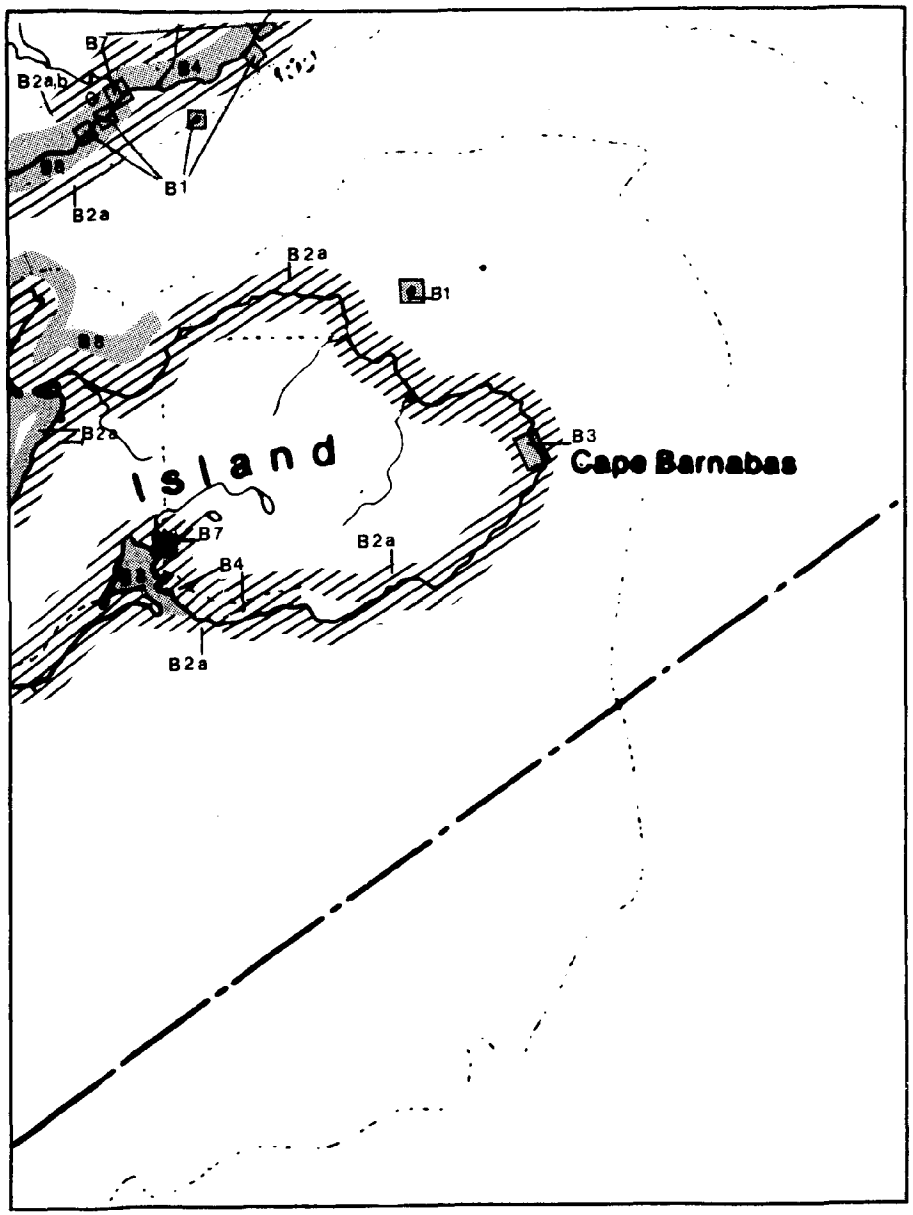
MAP NUMBER 38

RESOURCE		Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE													
R-1	Rocky Headlands												
R-2	Wave-Cut Platforms												
R-3	Sand Beaches/Exposed Tidal Flats												
R-4	Mixed Sand and Gravel Beaches												
R-5	Gravel Beaches												
R-6	Sheltered Rocky and Gravel Shores												
R-7	Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX													
Commercial Fisheries													
H-1	Salmon												
H-2	Roe Herring												
H-3	Crab												
H-4	Shrimp												
H-5	Halibut												
H-6	Whitefish												
Subsistence													
H-7	Deer/Elk/Reindeer												
H-8	Marine Mammal												
H-9	Crab												
H-10	Waterfowl												
H-11	Clams												
H-12	Halibut/Marine Fish												
H-13	Salmon												
Recreation													
H-14	Recreation Use Area												
H-15	Recreation Facility												
Infrastructure													
H-16	Boat Harbor												
H-17	Dock												
H-18	Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX													
Onshore													
B-1	Seabird Colony												
B-2a	Waterfowl (overwintering)												
B-2b	Waterfowl (summer use)												
B-3	Sea Lion Haul-out												
B-4	Black Tail Deer												
B-5	Elk												
B-6	Brown Bear												
Offshore													
B-2a	Waterfowl (overwintering)												
B-2b	Waterfowl (summer use)												
B-7	Anadromous Fish Streams												
	Salmon - Adults												
	Salmon - Juveniles												
	Char/Dolly Varden - Adults												
	Char/Dolly Varden - Juveniles												
	Steelhead - Adults												
	Steelhead - Juveniles												
B-8	Herring Spawning Area												
B-9	Razor Clam Beach												
B-10	Sea Otters												

30 31
37 38 39
42 43


HIGH
MEDIUM
LOW
Island
Cape Barnabas

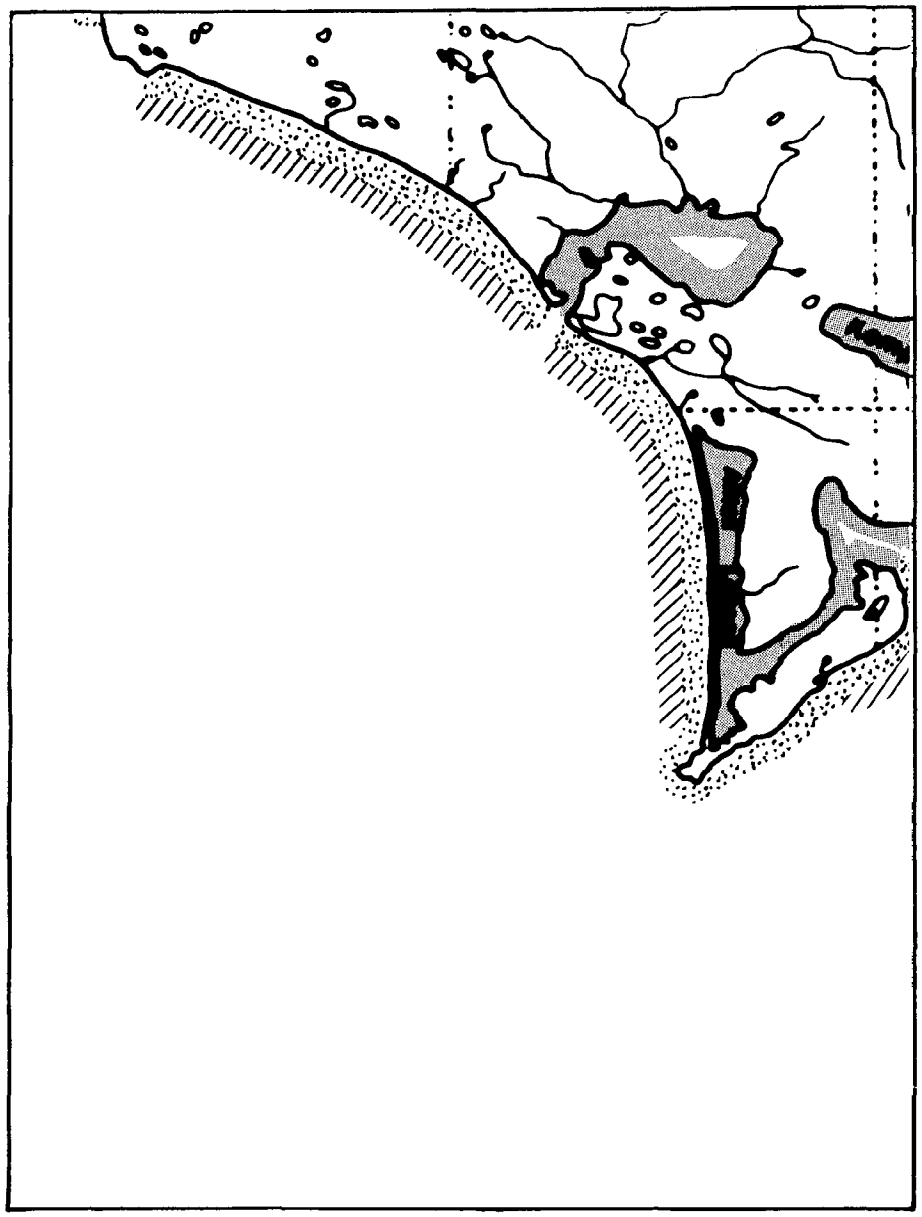

H7
H8,9,12,13
H1
H9,13
H8,10,12
H1
H7
H8,10,12
Island
Cape Barnabas
H1
H7
H1
H11
H8,10,12
H8,10,12
H1

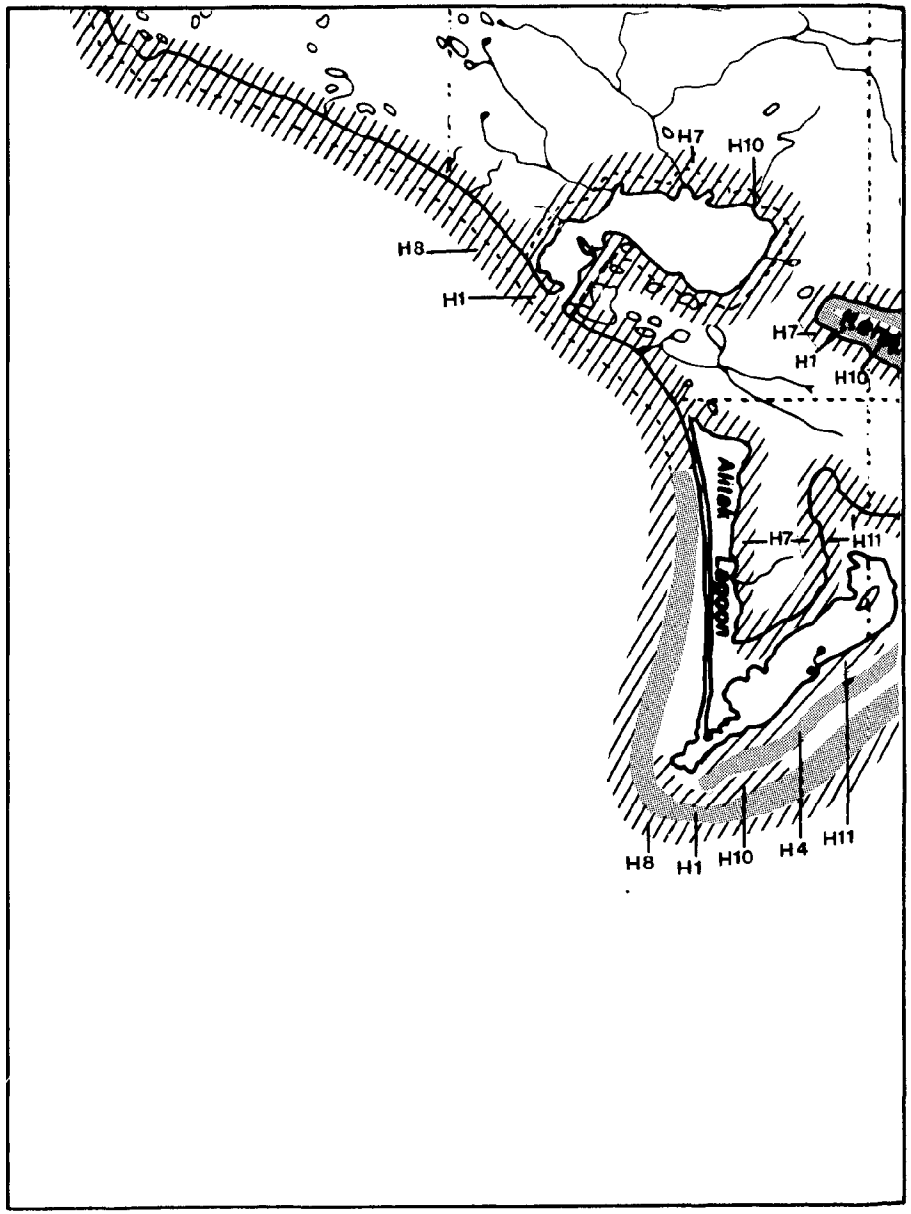


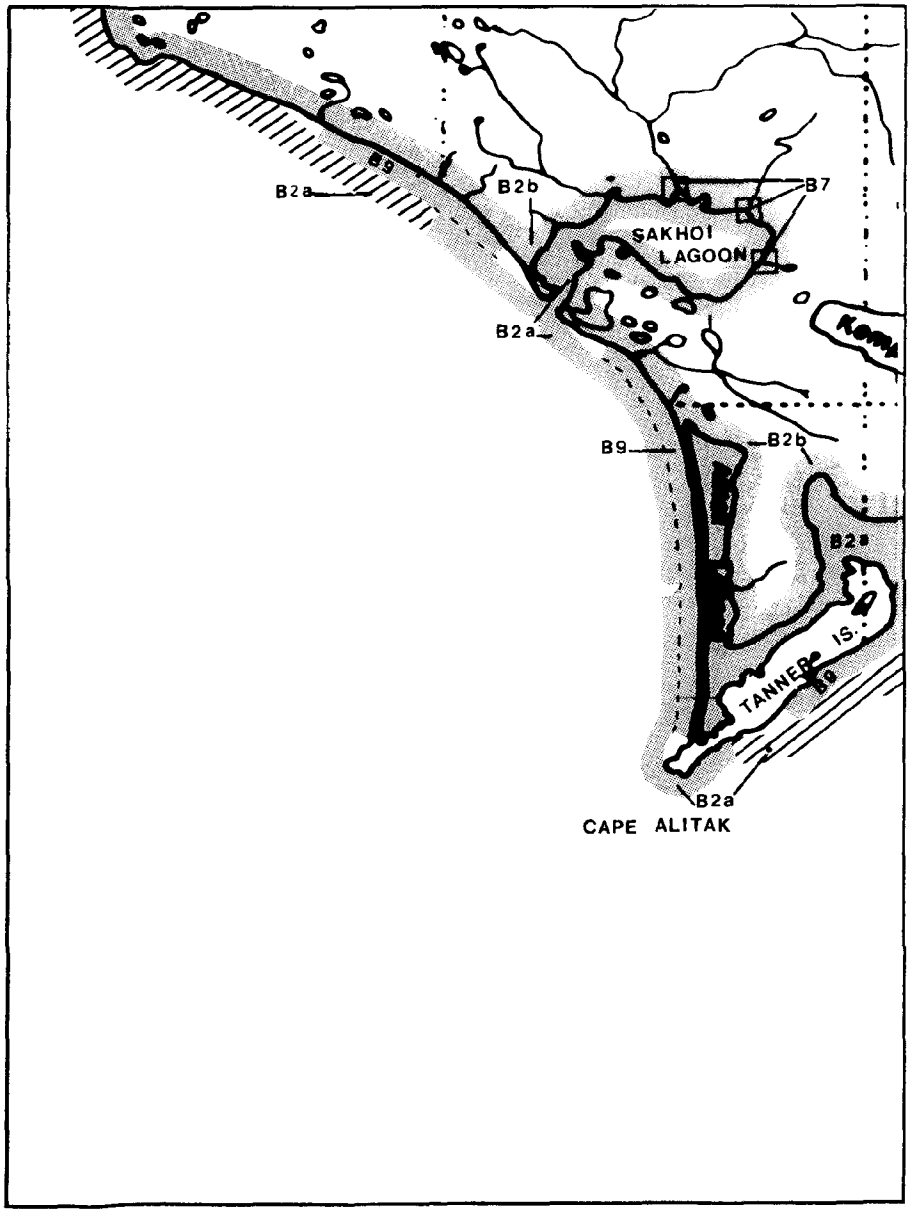
MAP NUMBER 39

RESOURCE	Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE												
R-1 Rocky Headlands												
R-2 Wave-Cut Platforms												
R-3 Sand Beaches/Exposed Tidal Flats												
R-4 Mixed Sand and Gravel Beaches												
R-5 Gravel Beaches												
R-6 Sheltered Rocky and Gravel Shores												
R-7 Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon							—	—	—	—		
H-2 Roe Herring												
H-3 Crab		—	—	—	—	—						
H-4 Shrimp												
H-5 Halibut							—	—				
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer	—											—
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon												
Recreation												
H-14 Recreation Use Area												
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony						—	—	—	—			
B-2a Waterfowl (overwintering)	—	—	—	—							—	—
B-2b Waterfowl (summer use)						—	—	—	—			
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer	—	—	—	—								—
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)	—	—	—	—							—	—
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults						—	—	—	—	—		
Salmon - Juveniles						—	—	—	—	—		
Char/Dolly Varden - Adults	—								—	—	—	—
Char/Dolly Varden - Juveniles					—	—	—					
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area						—	—					
B-9 Razor Clam Beach												
B-10 Sea Otters												

HIGH MEDIUM LOW





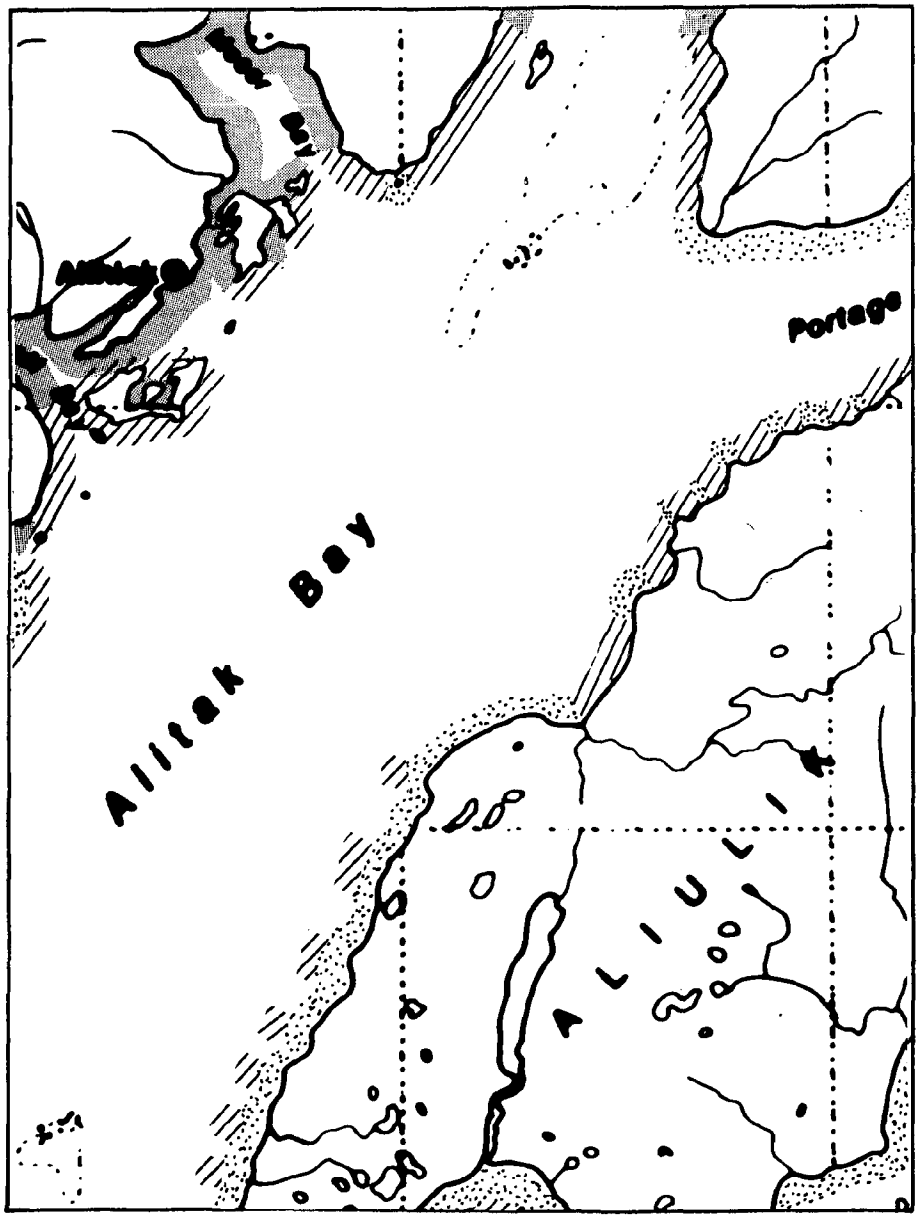


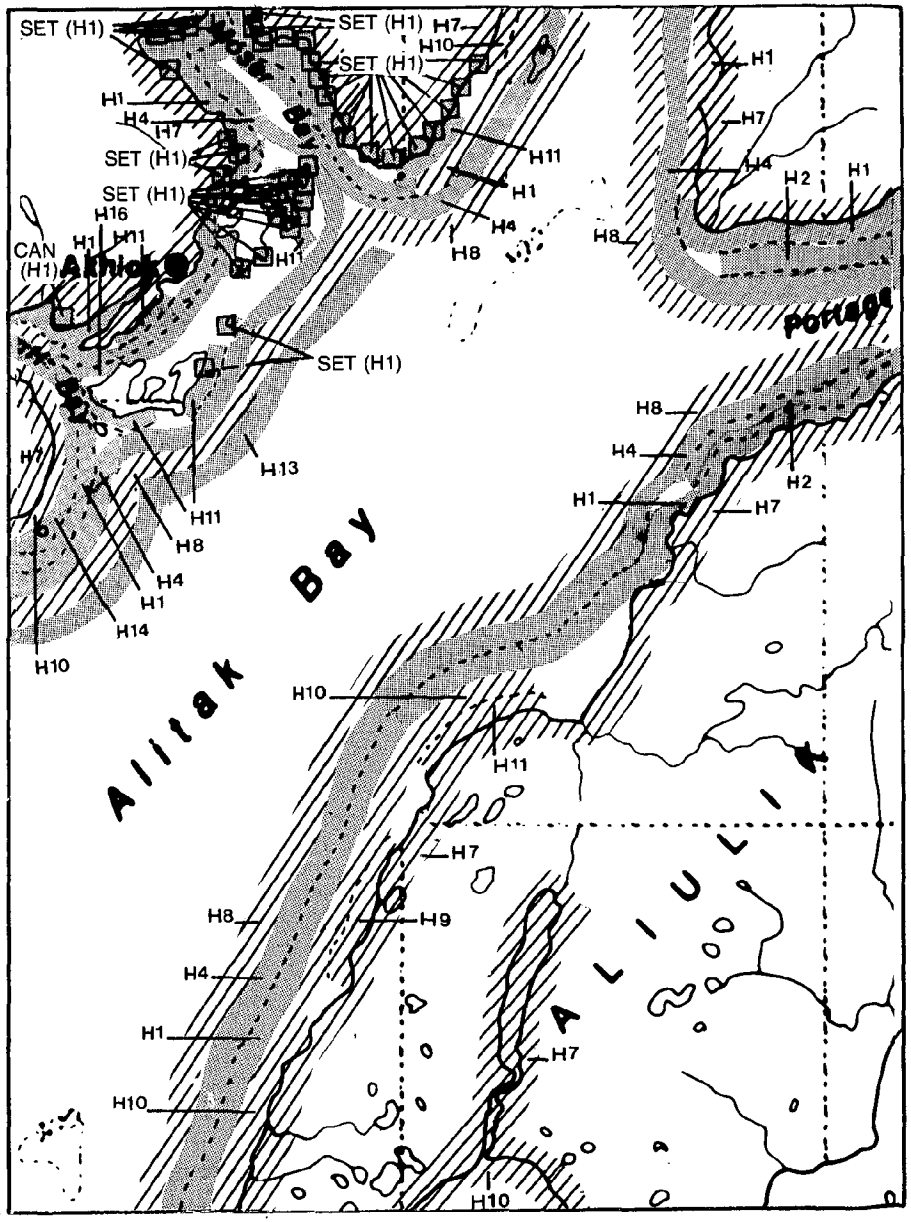
MAP NUMBER 40

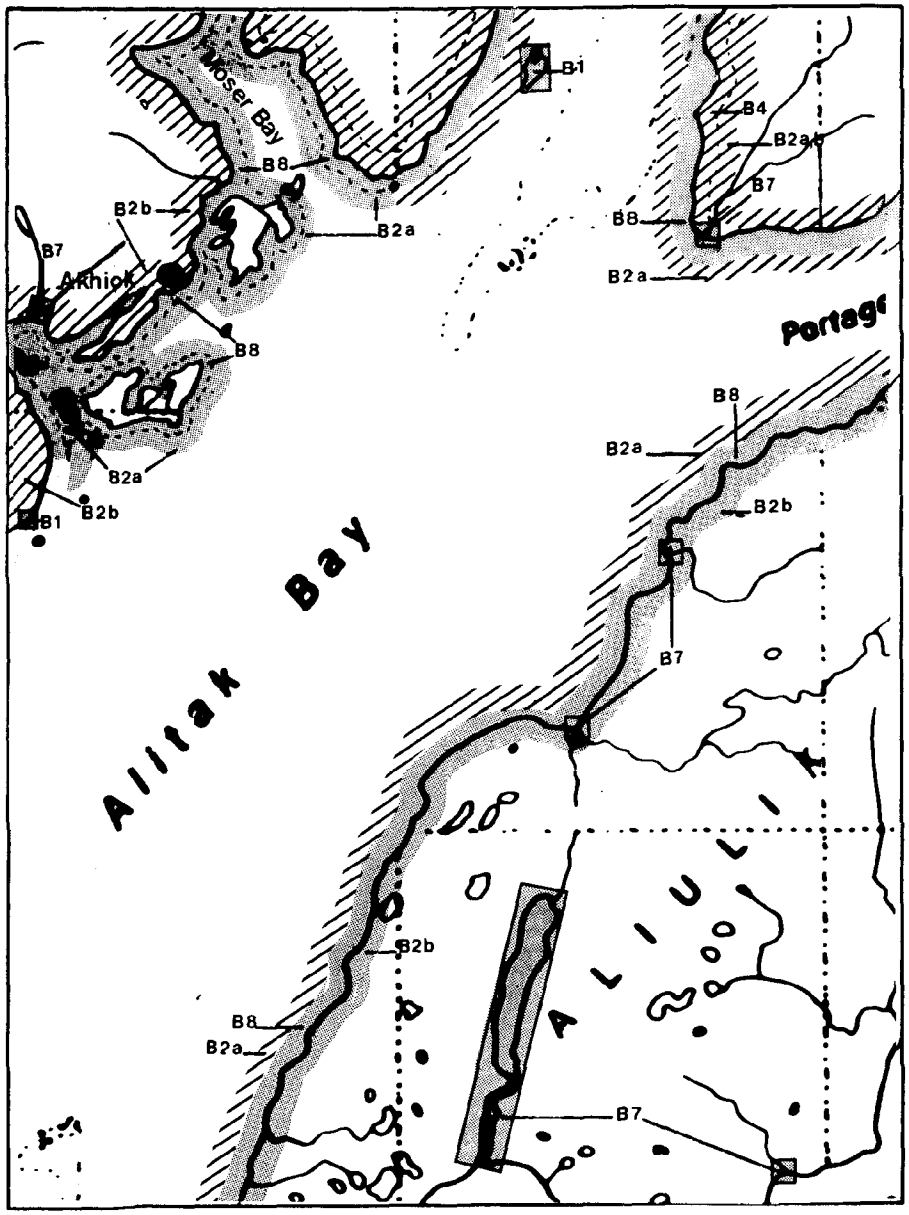
RESOURCE	Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE												
R-1 Rocky Headlands												
R-2 Wave-Cut Platforms												
R-3 Sand Beaches/Exposed Tidal Flats												
R-4 Mixed Sand and Gravel Beaches												
R-5 Gravel Beaches												
R-6 Sheltered Rocky and Gravel Shores												
R-7 Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon												
H-2 Roe Herring												
H-3 Crab												
H-4 Shrimp												
H-5 Halibut												
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer												
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon												
Recreation												
H-14 Recreation Use Area												
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer												
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults												
Salmon - Juveniles												
Char/Dolly Varden - Adults												
Char/Dolly Varden - Juveniles												
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area												
B-9 Razor Clam Beach												
B-10 Sea Otters												

34 35 36
40 41
44 45 46

HIGH MEDIUM LOW





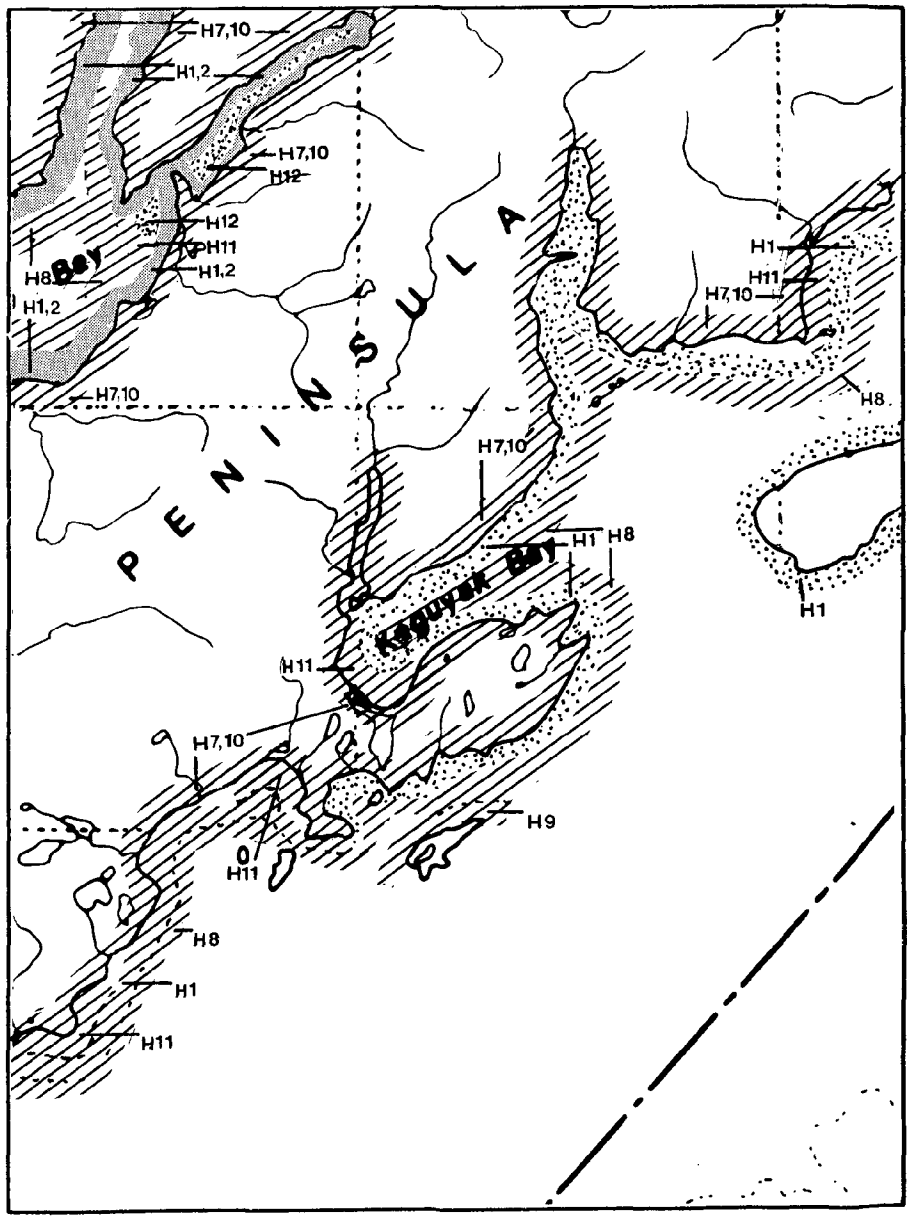


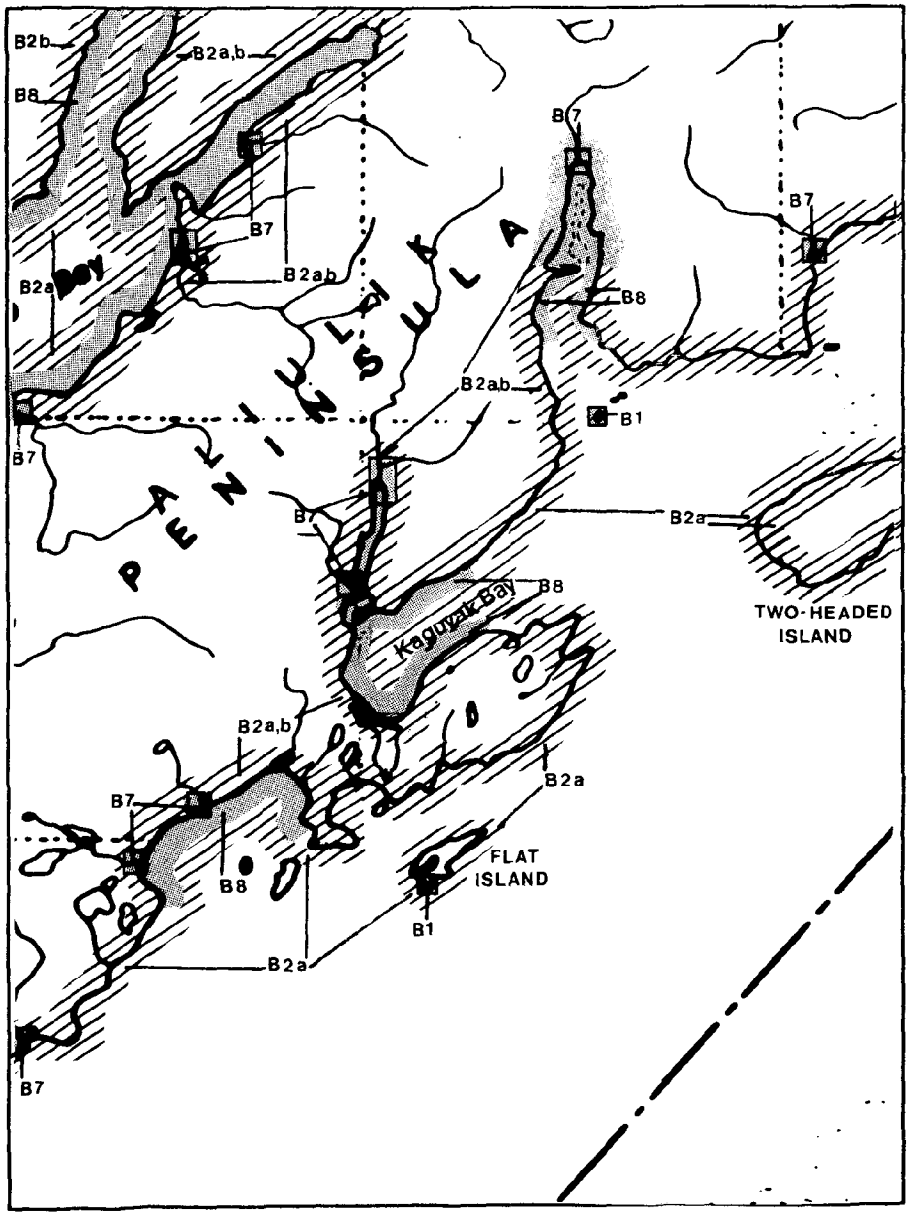
MAP NUMBER 41

RESOURCE	Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE												
R-1 Rocky Headlands	—	—	—	—	—	—	—	—	—	—	—	—
R-2 Wave-Cut Platforms	—	—	—	—	—	—	—	—	—	—	—	—
R-3 Sand Beaches/Exposed Tidal Flats	—	—	—	—	—	—	—	—	—	—	—	—
R-4 Mixed Sand and Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-5 Gravel Beaches	—	—	—	—	—	—	—	—	—	—	—	—
R-6 Sheltered Rocky and Gravel Shores	—	—	—	—	—	—	—	—	—	—	—	—
R-7 Protected Estuarine Tidal Flats and Marshes	—	—	—	—	—	—	—	—	—	—	—	—
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon							—	—	—	—		
H-2 Roe Herring						—	—					
H-3 Crab						—					—	
H-4 Shrimp	—	—	—	—	—	—	—	—	—	—	—	—
H-5 Halibut							—	—				
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer	—											—
H-8 Marine Mammal	—	—	—	—	—	—	—	—	—	—	—	—
H-9 Crab	—	—	—	—	—	—	—	—	—	—	—	—
H-10 Waterfowl	—	—	—	—	—	—				—	—	—
H-11 Clams	—	—	—	—	—	—	—	—	—	—	—	—
H-12 Halibut/Marine Fish												
H-13 Salmon	—	—	—			—	—	—	—	—	—	—
Recreation												
H-14 Recreation Use Area						—	—	—	—	—	—	—
H-15 Recreation Facility						—	—	—	—	—	—	—
Infrastructure												
H-16 Boat Harbor	—	—	—	—	—	—	—	—	—	—	—	—
H-17 Dock												
H-18 Concentration of Commercial & Residential Property	—	—	—	—	—	—	—	—	—	—	—	—
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony						—	—	—	—	—		
B-2a Waterfowl (overwintering)	—	—	—	—								—
B-2b Waterfowl (summer use)						—	—	—	—	—		
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer	—	—	—	—								—
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)	—	—	—	—								—
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults						—	—	—	—	—	—	
Salmon - Juveniles	—	—	—	—	—	—	—	—	—	—	—	—
Char/Dolly Varden - Adults	—								—	—	—	—
Char/Dolly Varden - Juveniles					—	—	—					
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area					—	—	—					
B-9 Razor Clam Beach												
B-10 Sea Otters												

35 36
40 41 42
45 46

HIGH MEDIUM LOW

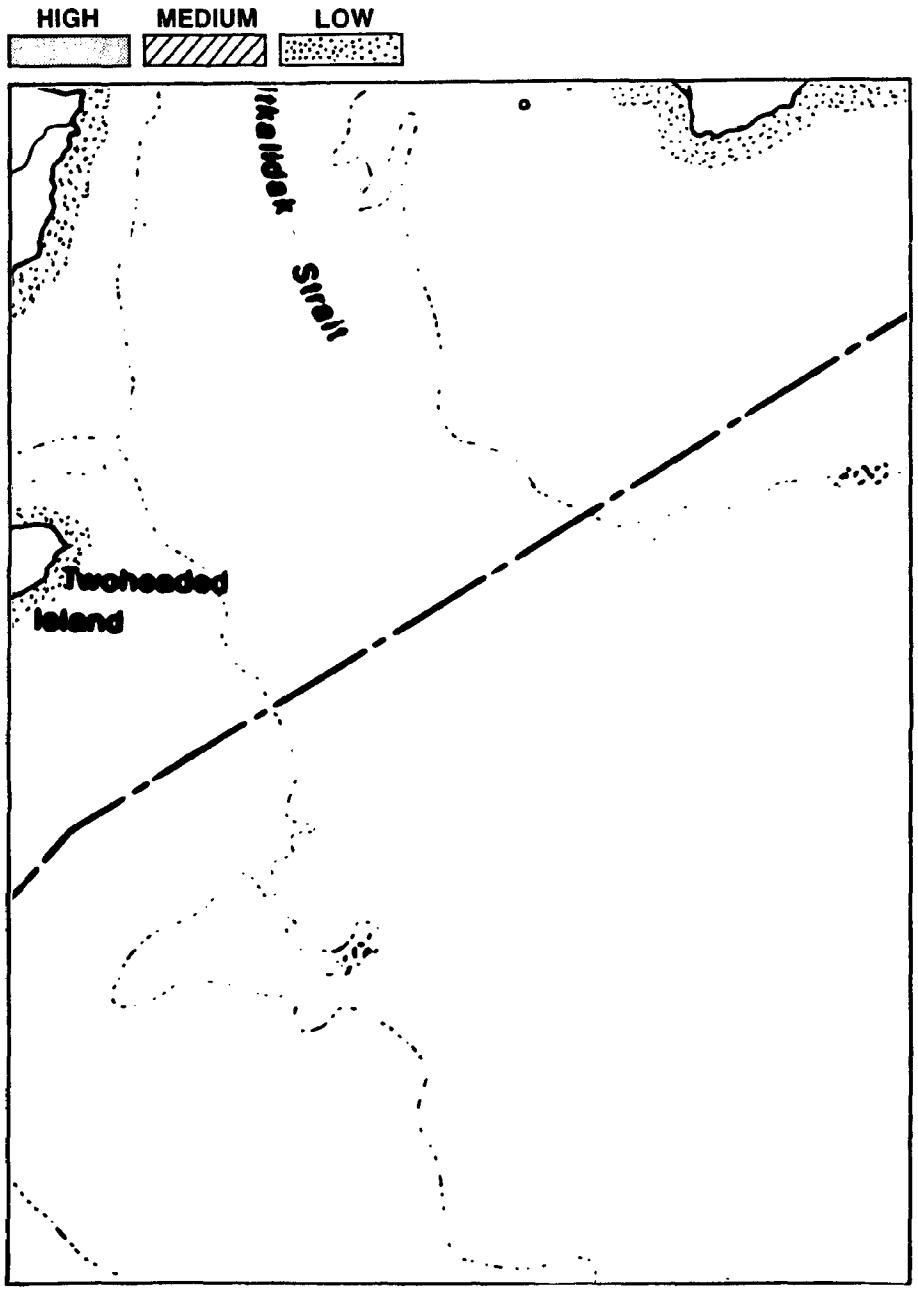


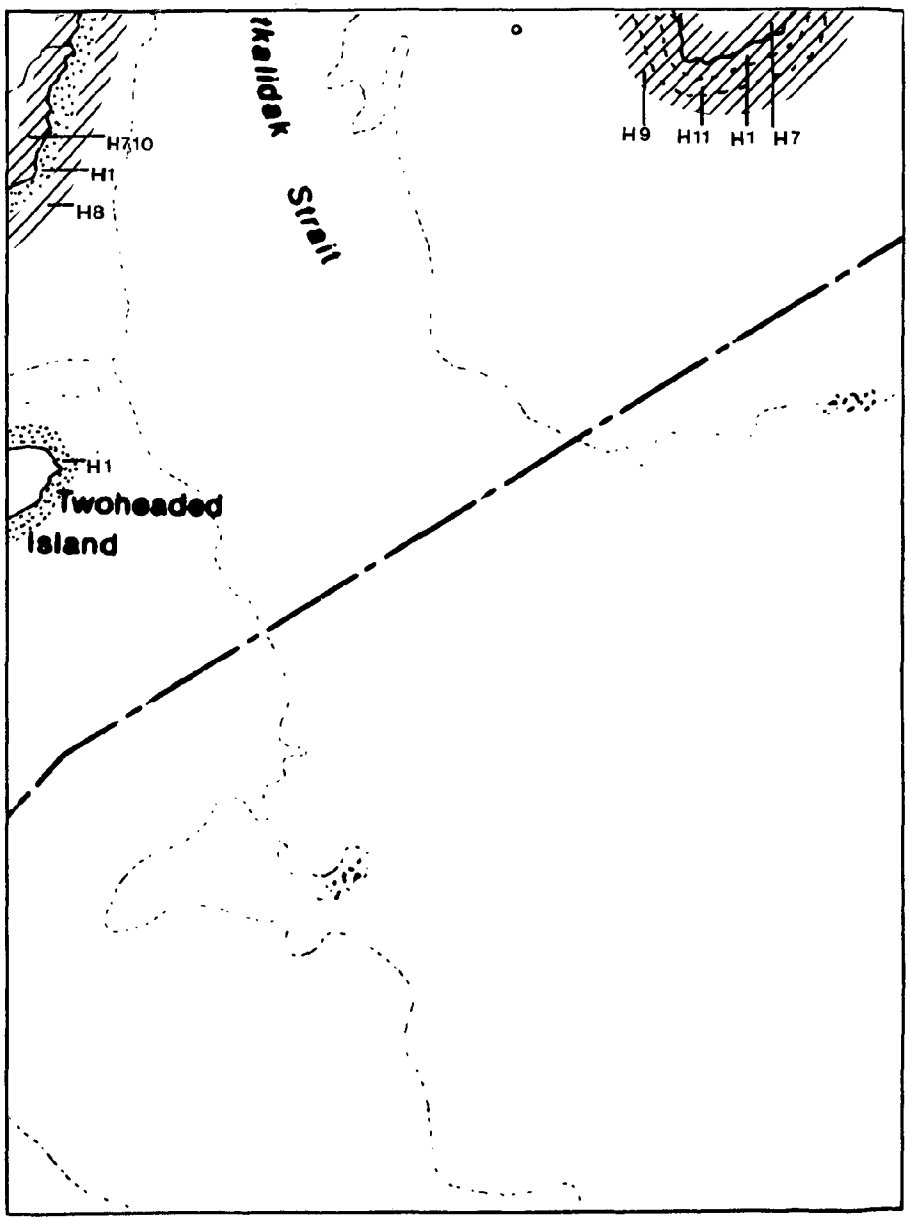


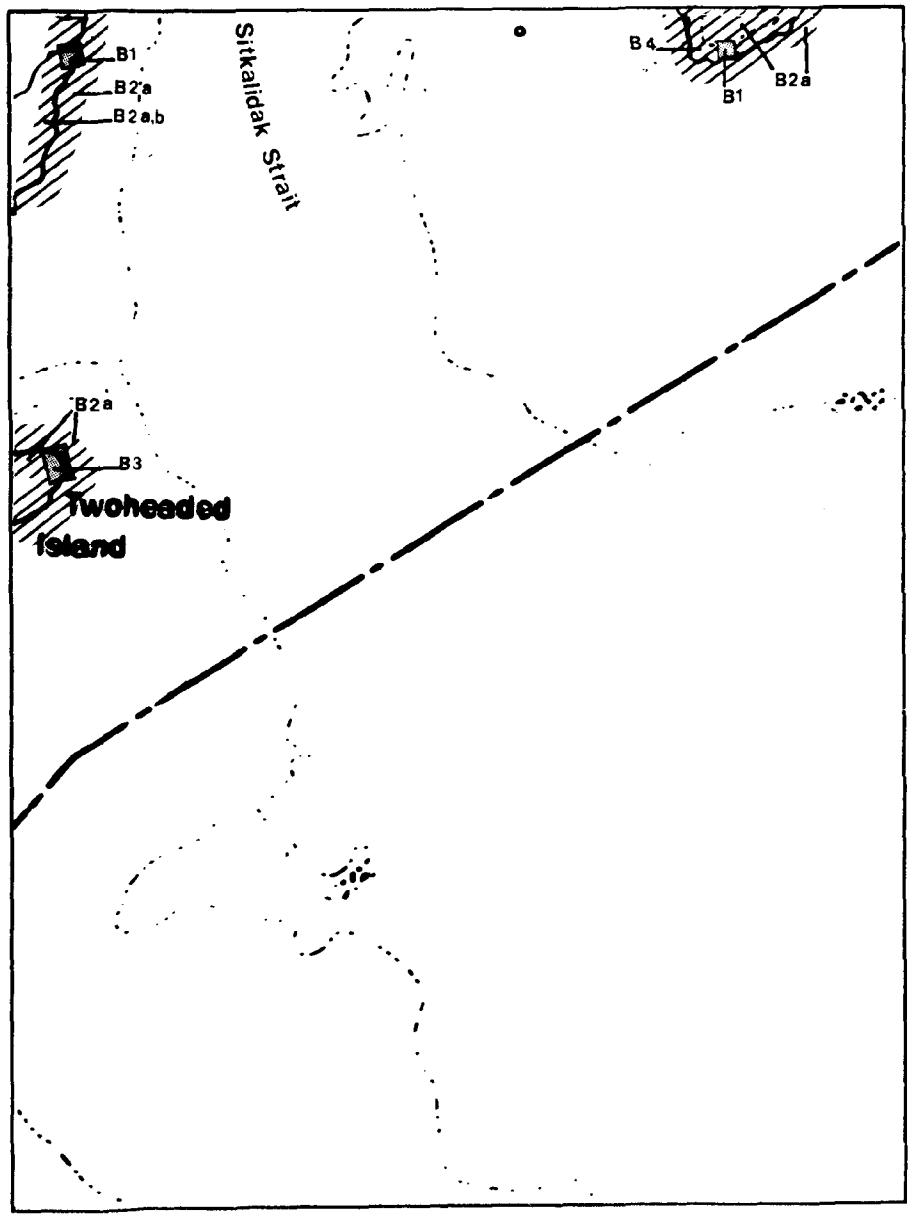
MAP NUMBER 42

RESOURCE	Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE												
R-1 Rocky Headlands												
R-2 Wave-Cut Platforms												
R-3 Sand Beaches/Exposed Tidal Flats												
R-4 Mixed Sand and Gravel Beaches												
R-5 Gravel Beaches												
R-6 Sheltered Rocky and Gravel Shores												
R-7 Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon												
H-2 Roe Herring												
H-3 Crab												
H-4 Shrimp												
H-5 Halibut												
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer												
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon												
Recreation												
H-14 Recreation Use Area												
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer												
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults												
Salmon - Juveniles												
Char/Dolly Varden - Adults												
Char/Dolly Varden - Juveniles												
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area												
B-9 Razor Clam Beach												
B-10 Sea Otters												

35 36 37
41 42 43
45 46


HIGH
MEDIUM
LOW
Ikalidek
Strait
Twoheaded
Island


Ikalidek
Strait
H710
H1
H8
H9
H11
H1
H7
H1
Twoheaded
Island

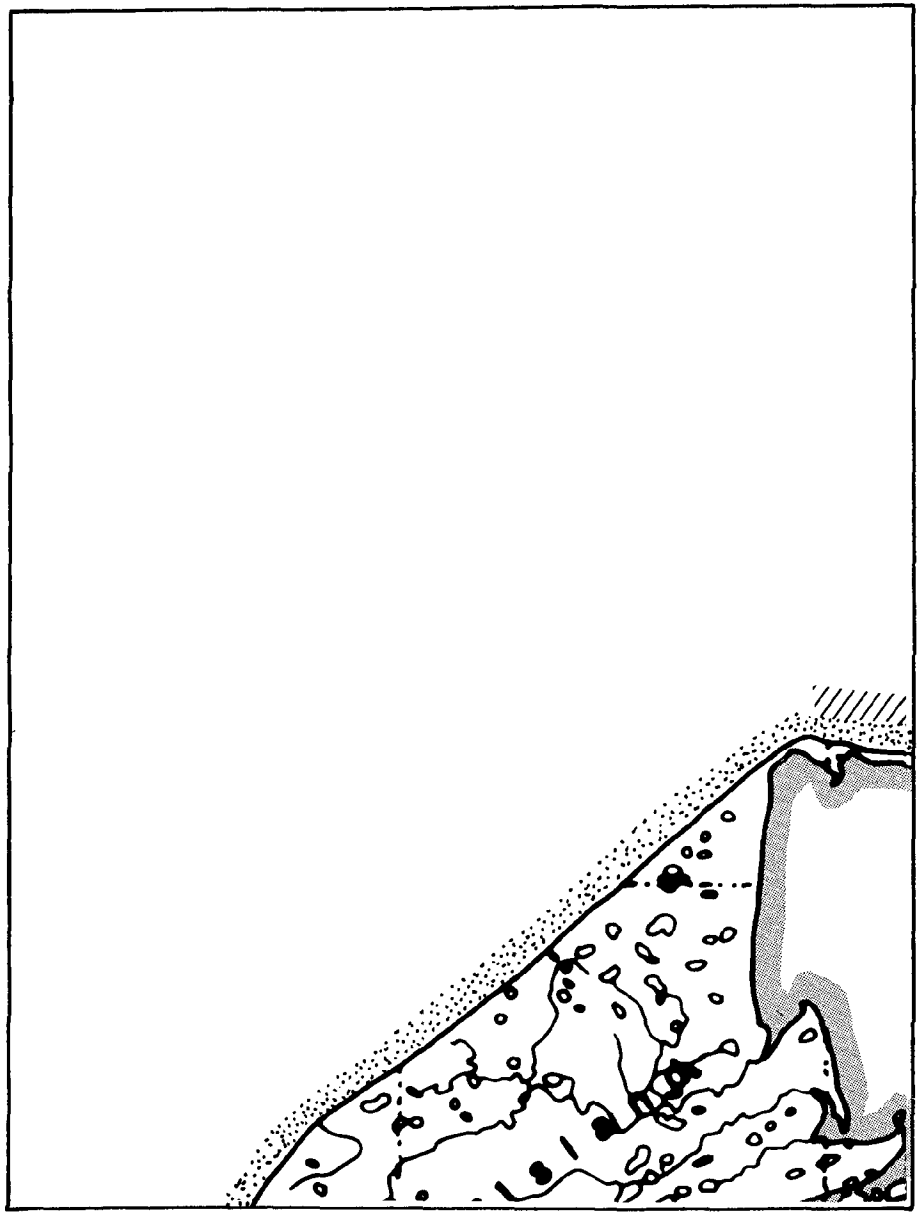


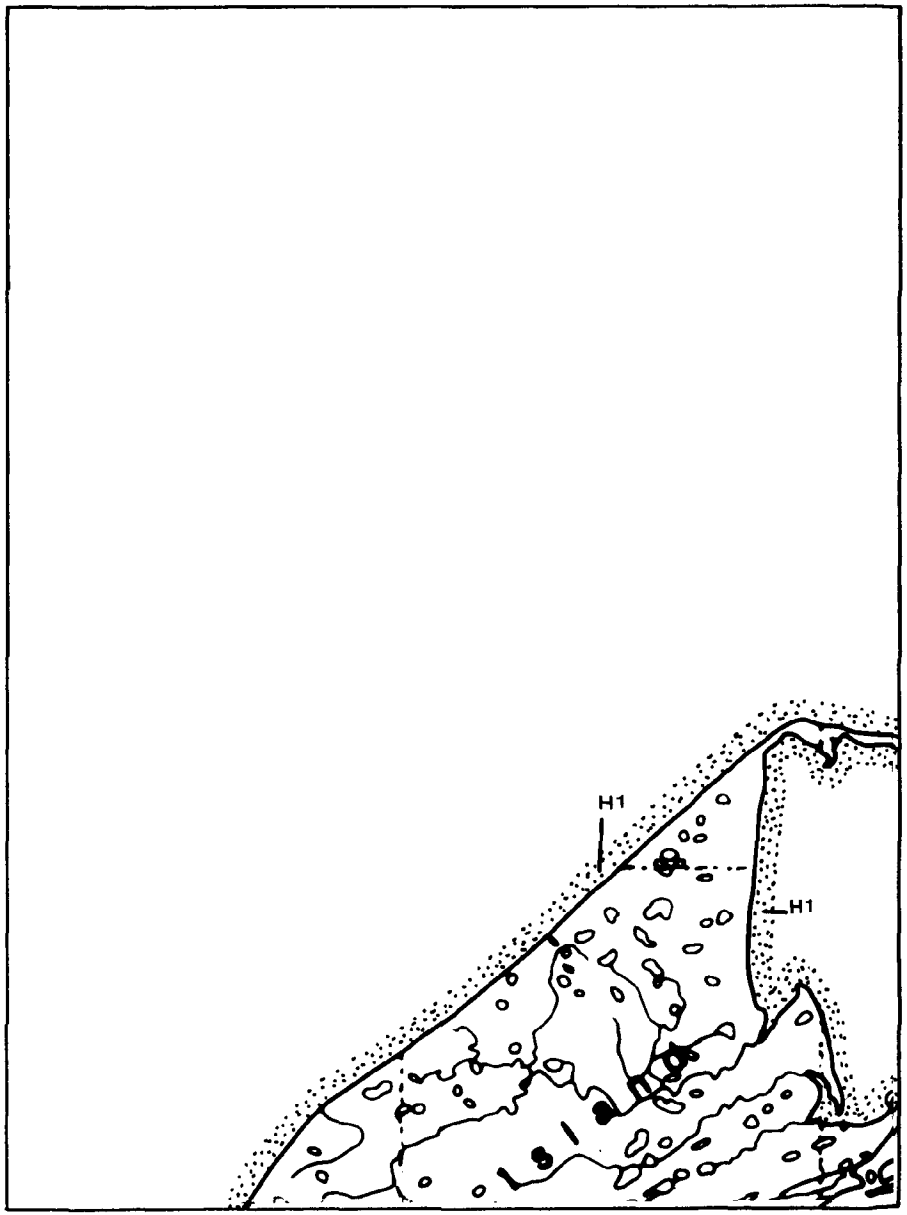
MAP NUMBER 43

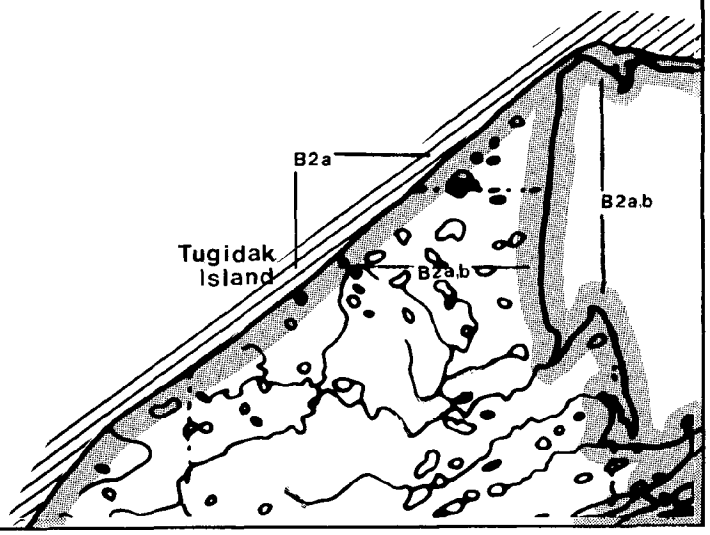
RESOURCE	Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE												
R-1 Rocky Headlands												
R-2 Wave-Cut Platforms												
R-3 Sand Beaches/Exposed Tidal Flats												
R-4 Mixed Sand and Gravel Beaches												
R-5 Gravel Beaches												
R-6 Sheltered Rocky and Gravel Shores												
R-7 Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon												
H-2 Roe Herring												
H-3 Crab												
H-4 Shrimp												
H-5 Halibut												
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer												
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon												
Recreation												
H-14 Recreation Use Area												
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer												
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults												
Salmon - Juveniles												
Char/Dolly Varden - Adults												
Char/Dolly Varden - Juveniles												
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area												
B-9 Razor Clam Beach												
B-10 Sea Otters												

36 37 38 39
42 43
46

HIGH MEDIUM LOW





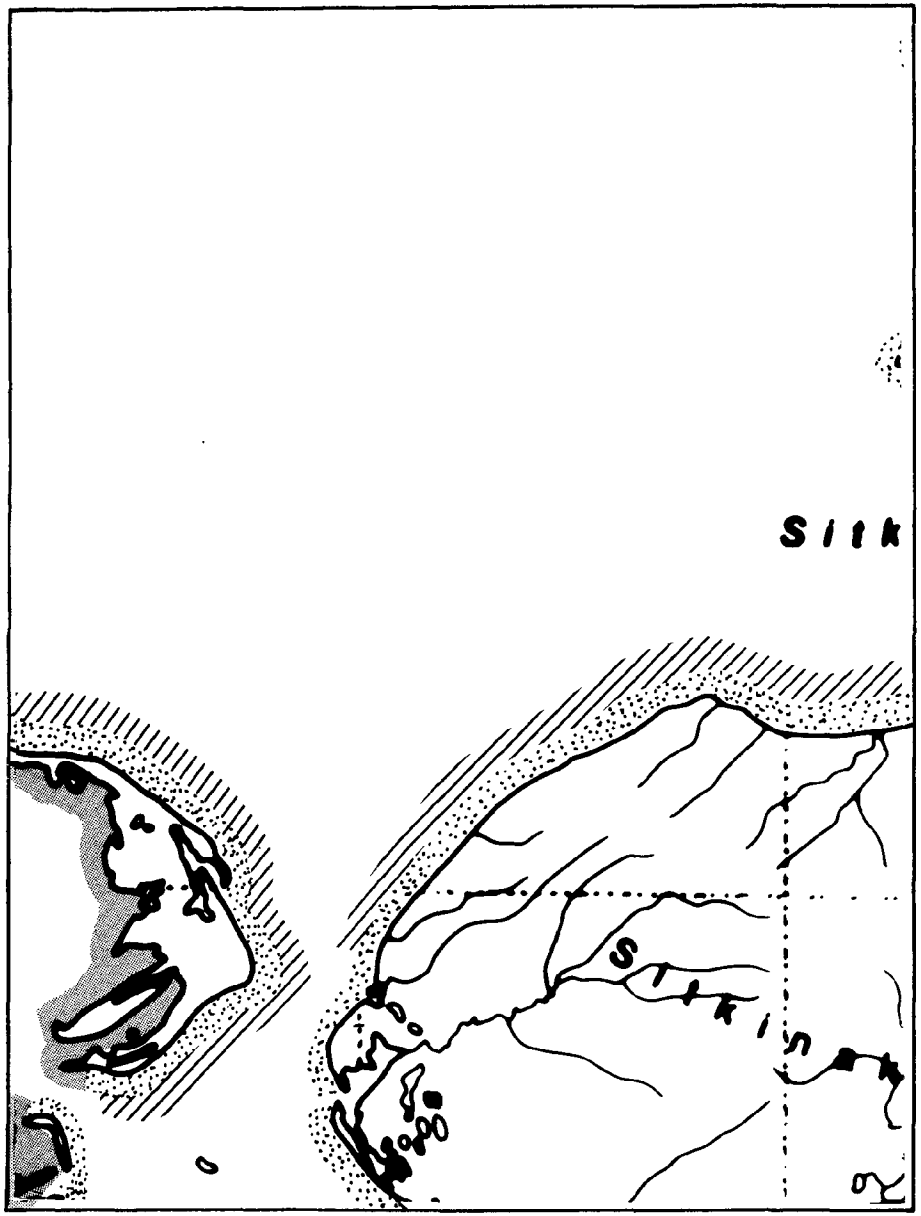


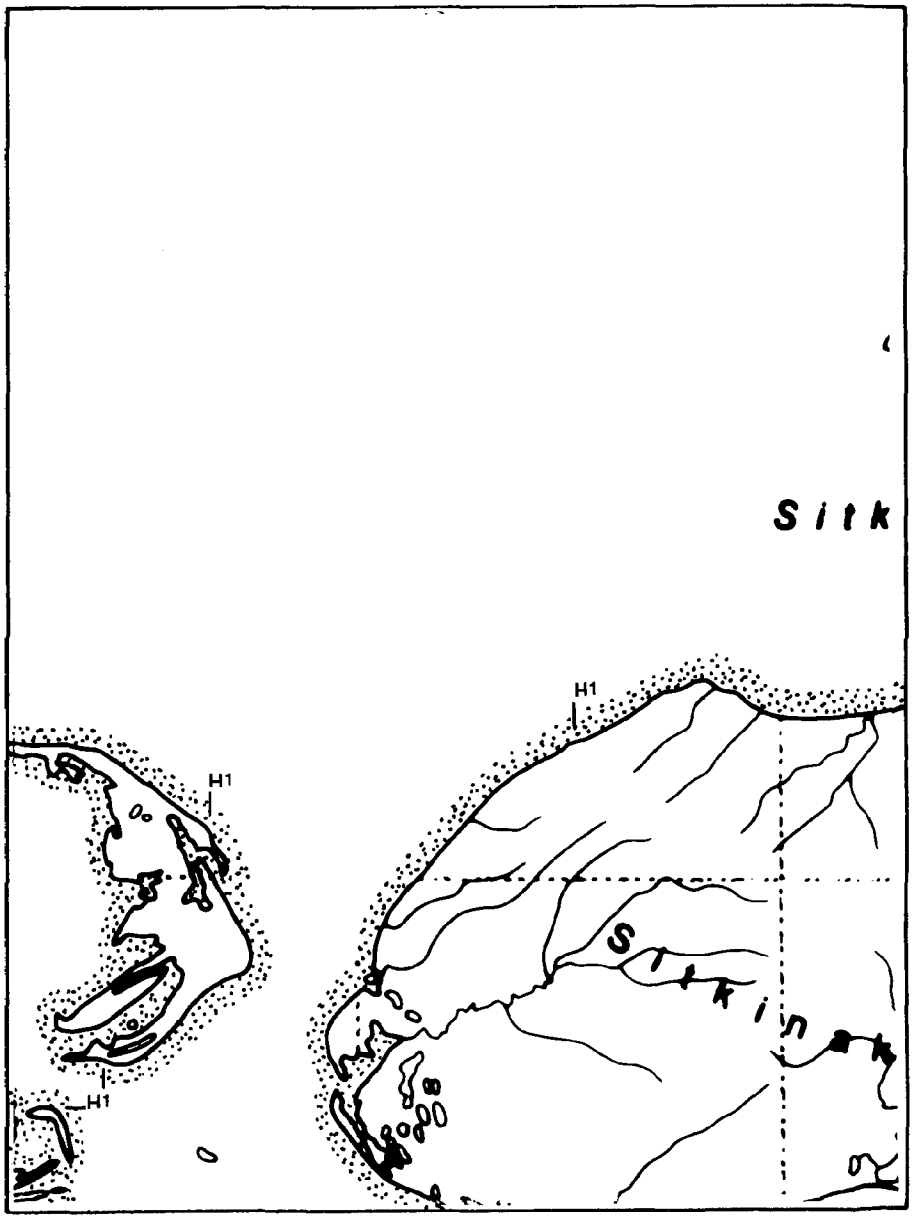
MAP NUMBER 44

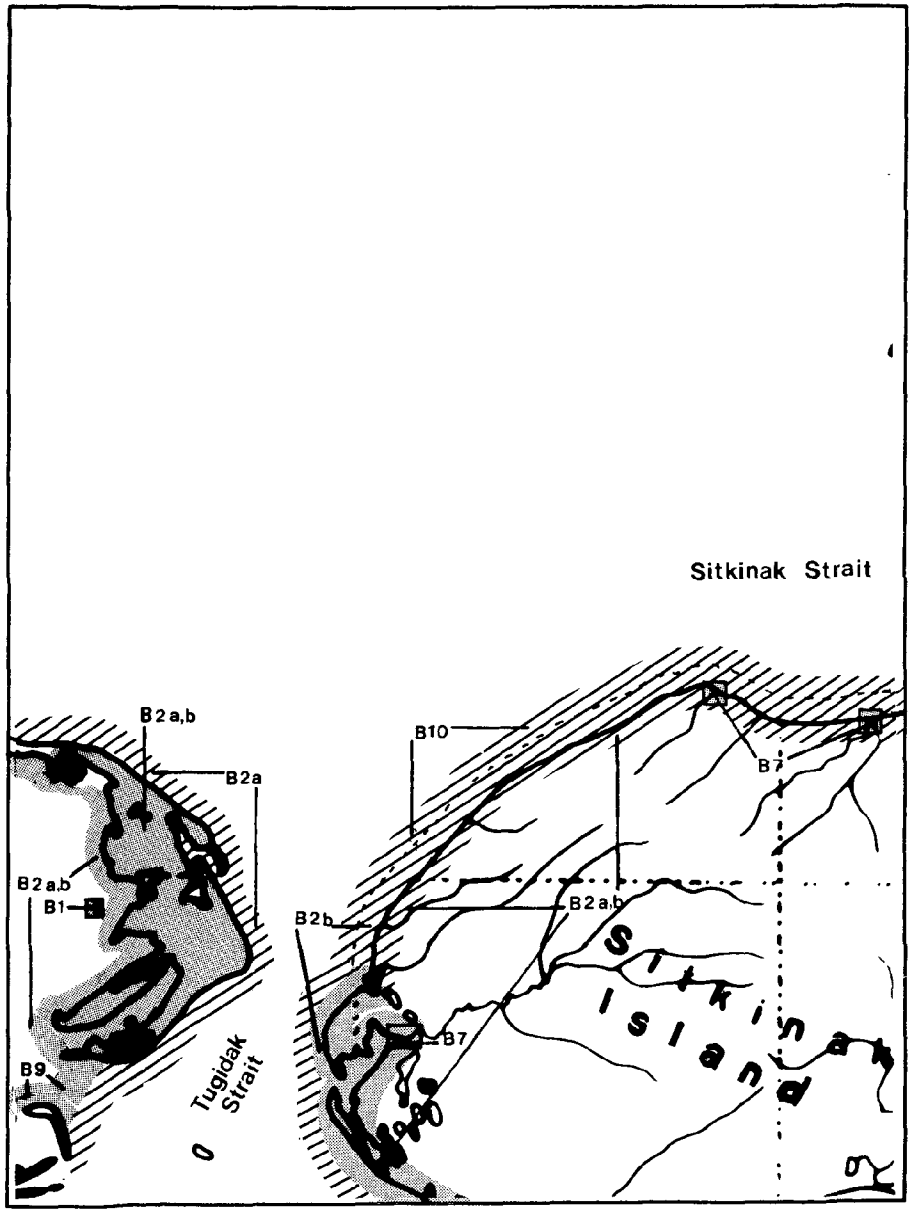
RESOURCE	Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE												
R-1 Rocky Headlands												
R-2 Wave-Cut Platforms												
R-3 Sand Beaches/Exposed Tidal Flats												
R-4 Mixed Sand and Gravel Beaches												
R-5 Gravel Beaches												
R-6 Sheltered Rocky and Gravel Shores												
R-7 Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon												
H-2 Roe Herring												
H-3 Crab												
H-4 Shrimp												
H-5 Halibut												
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer												
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon												
Recreation												
H-14 Recreation Use Area												
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer												
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults												
Salmon - Juveniles												
Char/Dolly Varden - Adults												
Char/Dolly Varden - Juveniles												
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area												
B-9 Razor Clam Beach												
B-10 Sea Otters												

40 41
44 45 46
47 48 49

HIGH MEDIUM LOW



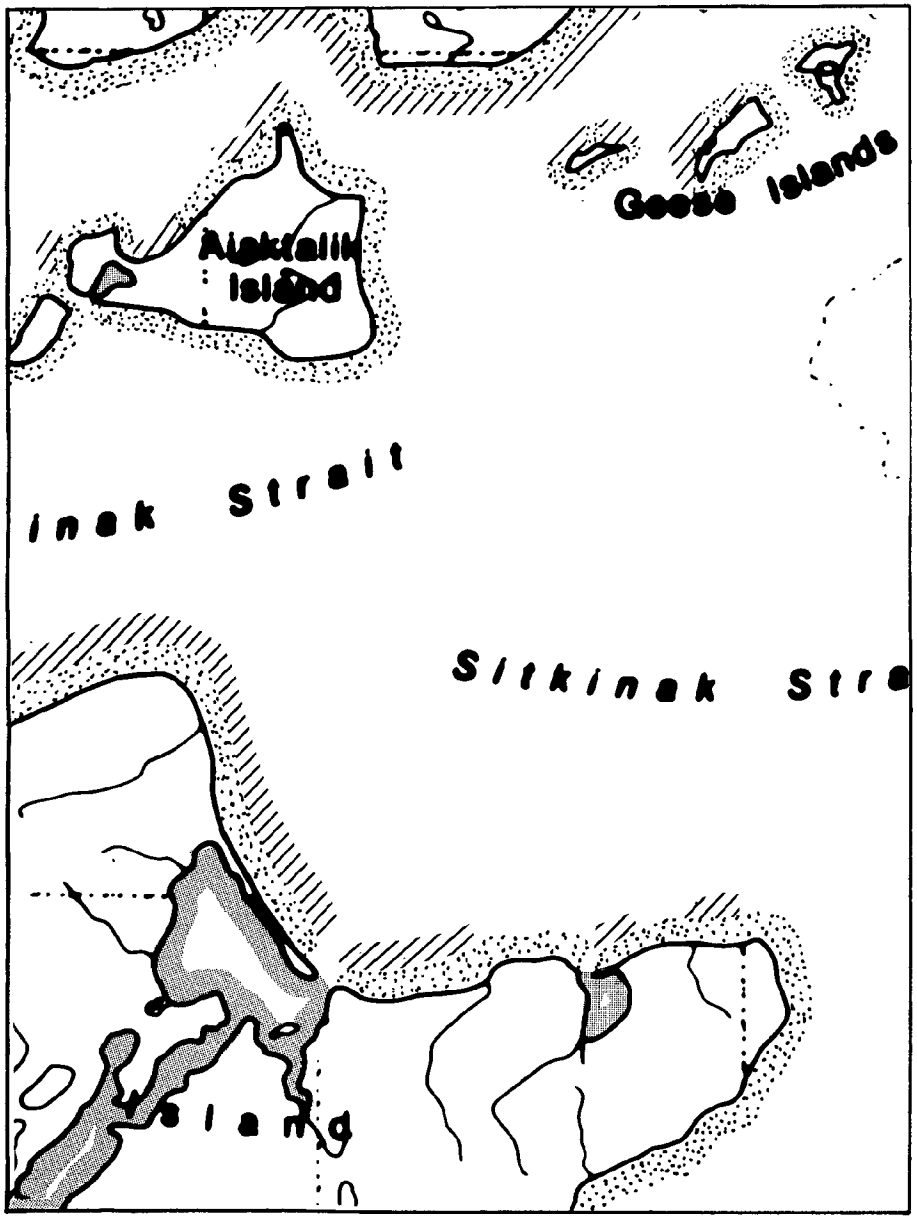


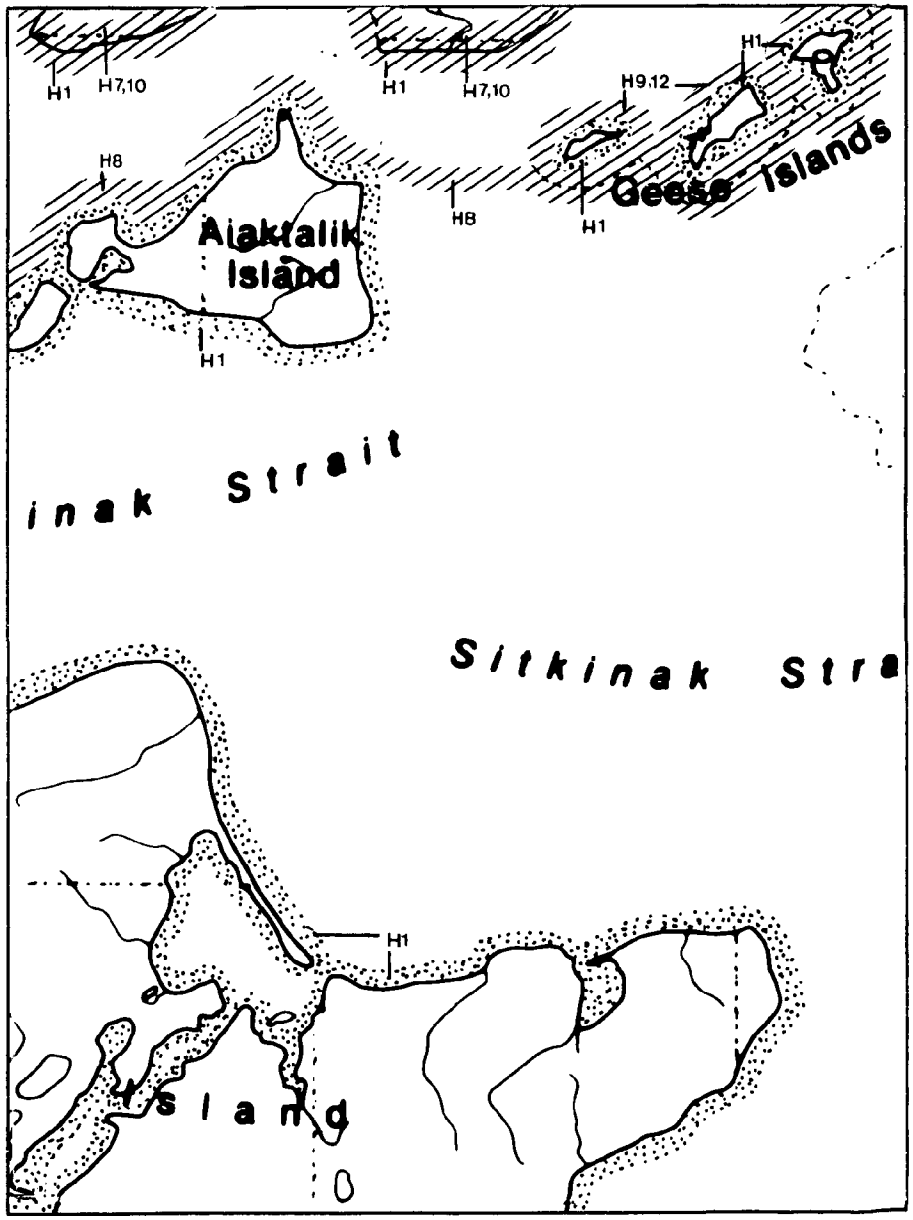


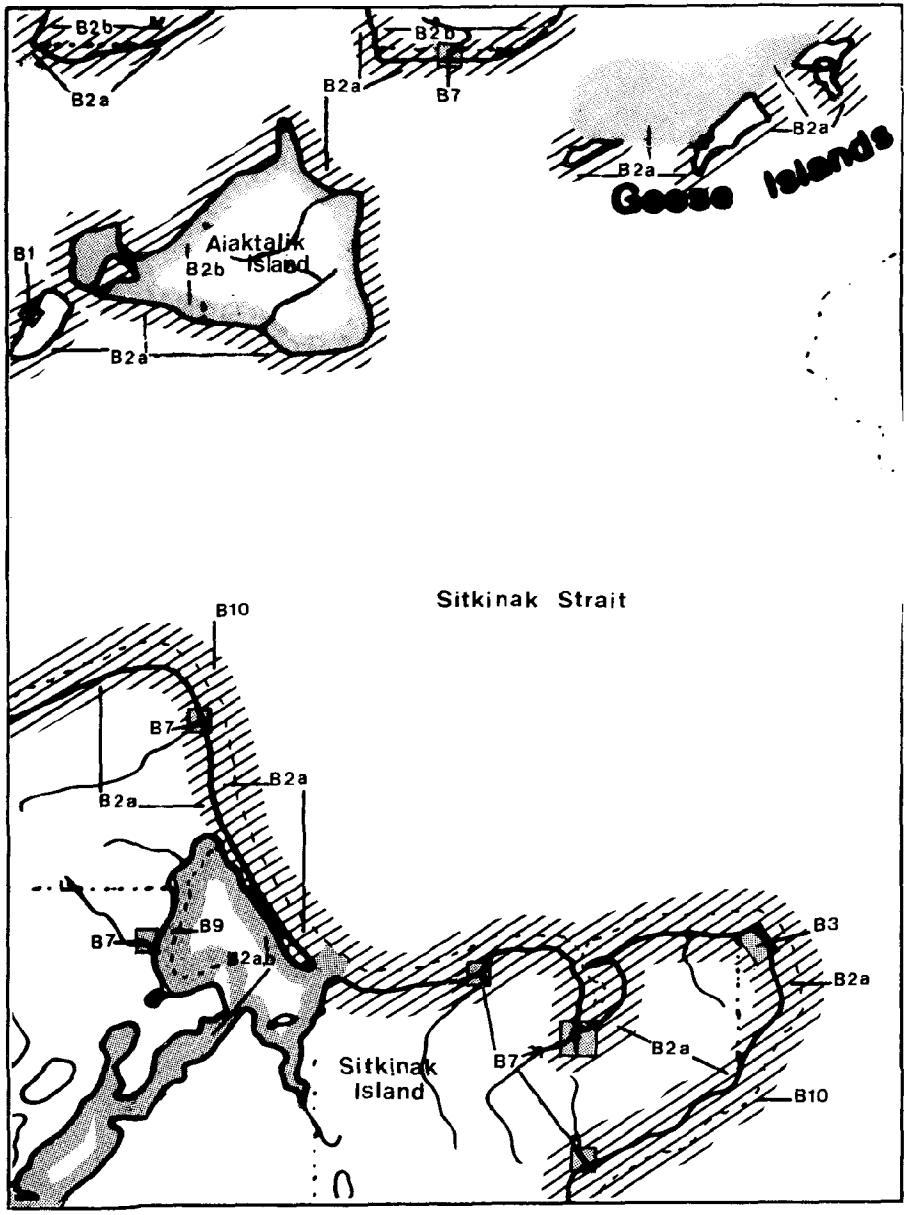
MAP NUMBER 45

RESOURCE	Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE												
R-1 Rocky Headlands												
R-2 Wave-Cut Platforms												
R-3 Sand Beaches/Exposed Tidal Flats												
R-4 Mixed Sand and Gravel Beaches												
R-5 Gravel Beaches												
R-6 Sheltered Rocky and Gravel Shores												
R-7 Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon												
H-2 Roe Herring												
H-3 Crab												
H-4 Shrimp												
H-5 Halibut												
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer												
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon												
Recreation												
H-14 Recreation Use Area												
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer												
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults												
Salmon - Juveniles												
Char/Dolly Varden - Adults												
Char/Dolly Varden - Juveniles												
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area												
B-9 Razor Clam Beach												
B-10 Sea Otters												

HIGH MEDIUM LOW

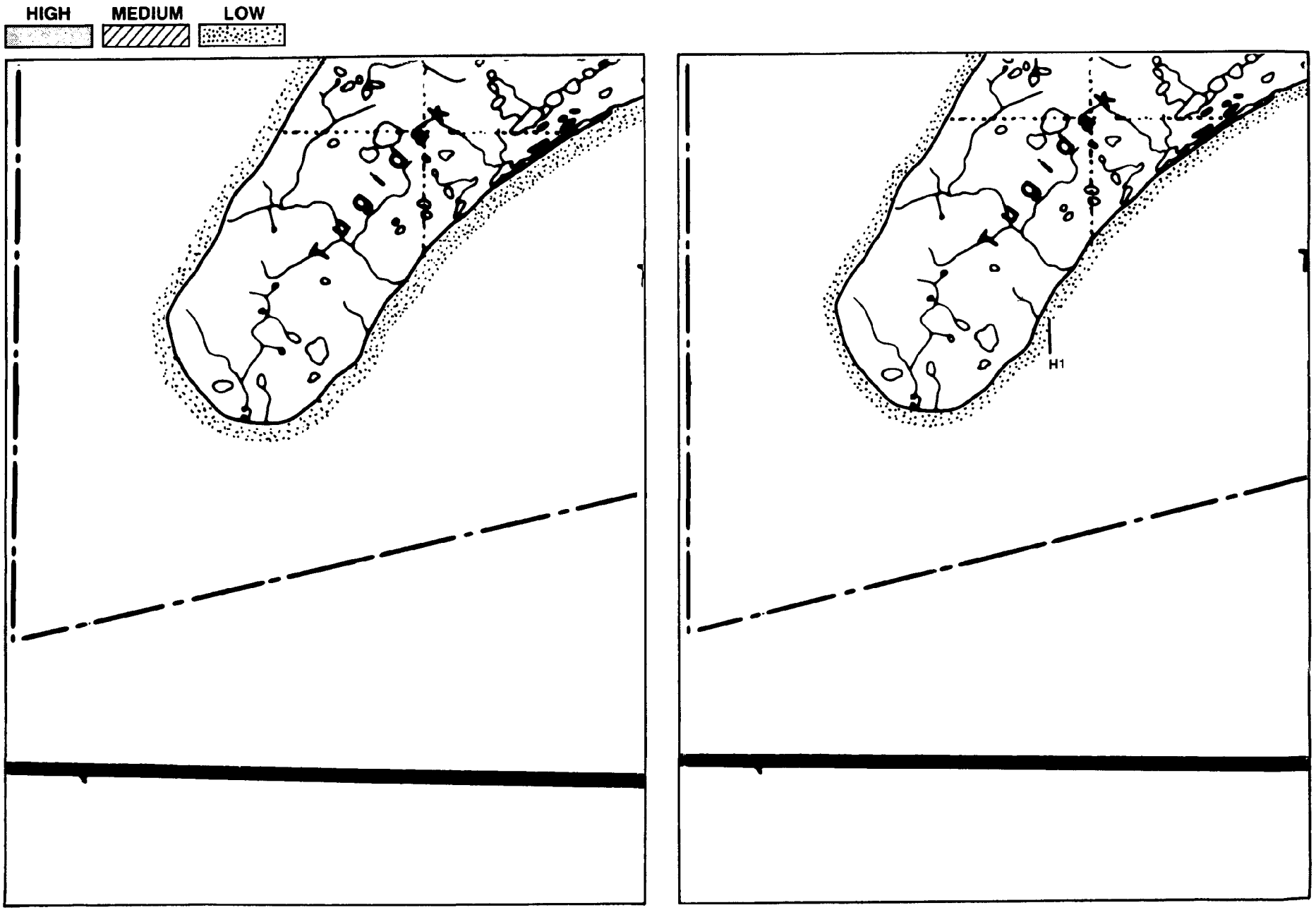


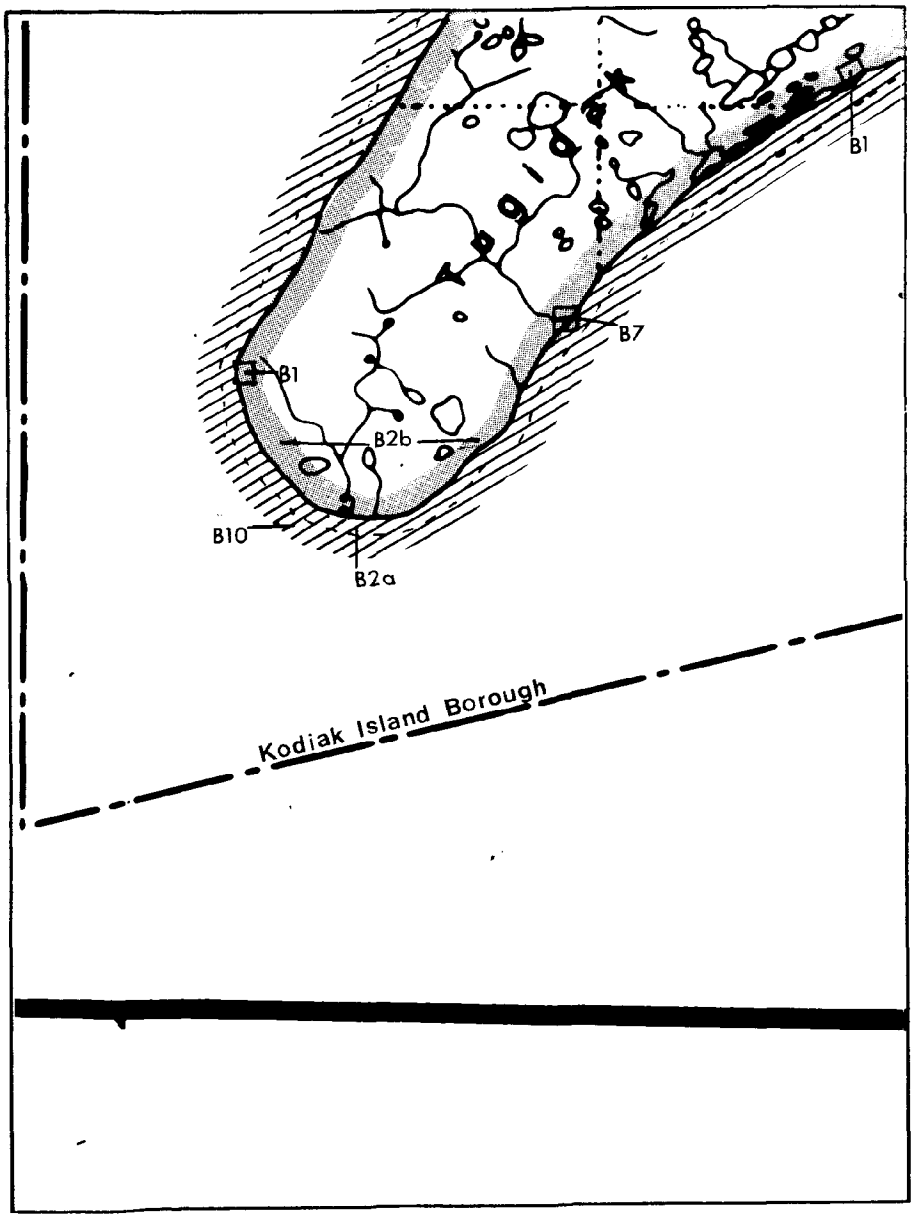




MAP NUMBER 46

RESOURCE	Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE												
R-1 Rocky Headlands												
R-2 Wave-Cut Platforms												
R-3 Sand Beaches/Exposed Tidal Flats												
R-4 Mixed Sand and Gravel Beaches												
R-5 Gravel Beaches												
R-6 Sheltered Rocky and Gravel Shores												
R-7 Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon												
H-2 Roe Herring												
H-3 Crab												
H-4 Shrimp												
H-5 Halibut												
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer												
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon												
Recreation												
H-14 Recreation Use Area												
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer												
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults												
Salmon - Juveniles												
Char/Dolly Varden - Adults												
Char/Dolly Varden - Juveniles												
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area												
B-9 Razor Clam Beach												
B-10 Sea Otters												

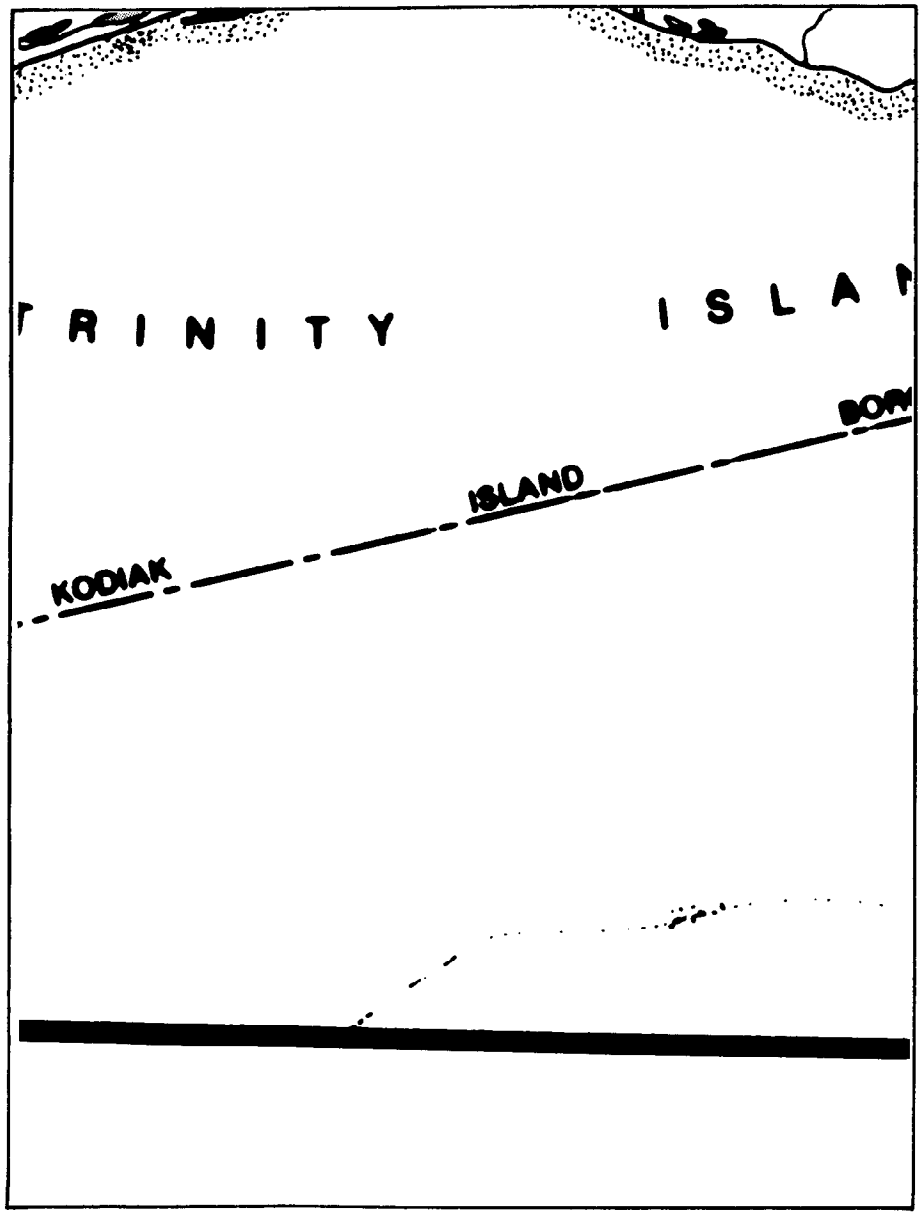

HIGH
MEDIUM
LOW
H1

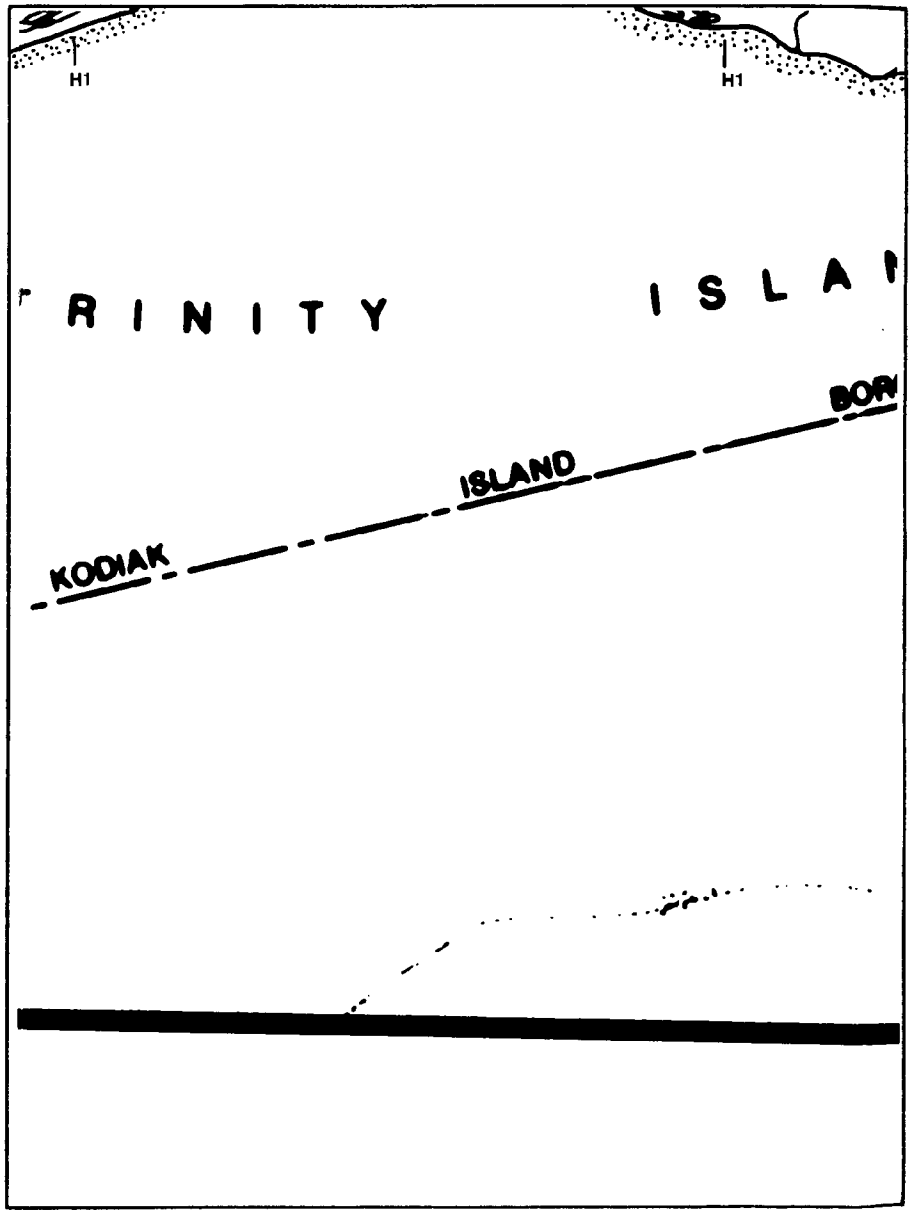


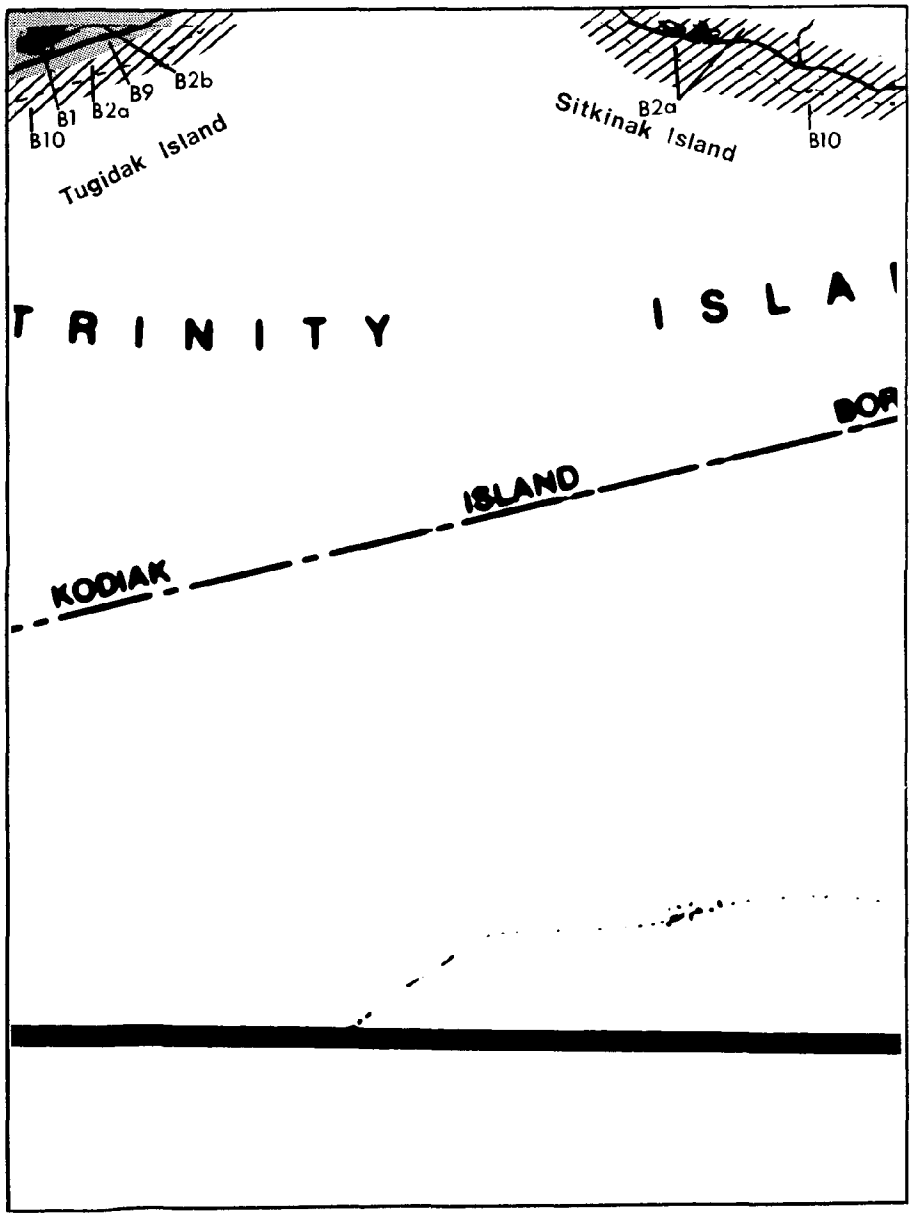
MAP NUMBER 47

RESOURCE	Winter			Spring			Summer			Fall		
	D	J	F	M	A	M	J	J	A	S	O	N
OIL RESIDENCE												
R-1 Rocky Headlands												
R-2 Wave-Cut Platforms												
R-3 Sand Beaches/Exposed Tidal Flats												
R-4 Mixed Sand and Gravel Beaches												
R-5 Gravel Beaches												
R-6 Sheltered Rocky and Gravel Shores												
R-7 Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon												
H-2 Roe Herring												
H-3 Crab												
H-4 Shrimp												
H-5 Halibut												
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer												
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon												
Recreation												
H-14 Recreation Use Area												
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer												
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults												
Salmon - Juveniles												
Char/Dolly Varden - Adults												
Char/Dolly Varden - Juveniles												
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area												
B-9 Razor Clam Beach												
B-10 Sea Otters												

HIGH MEDIUM LOW

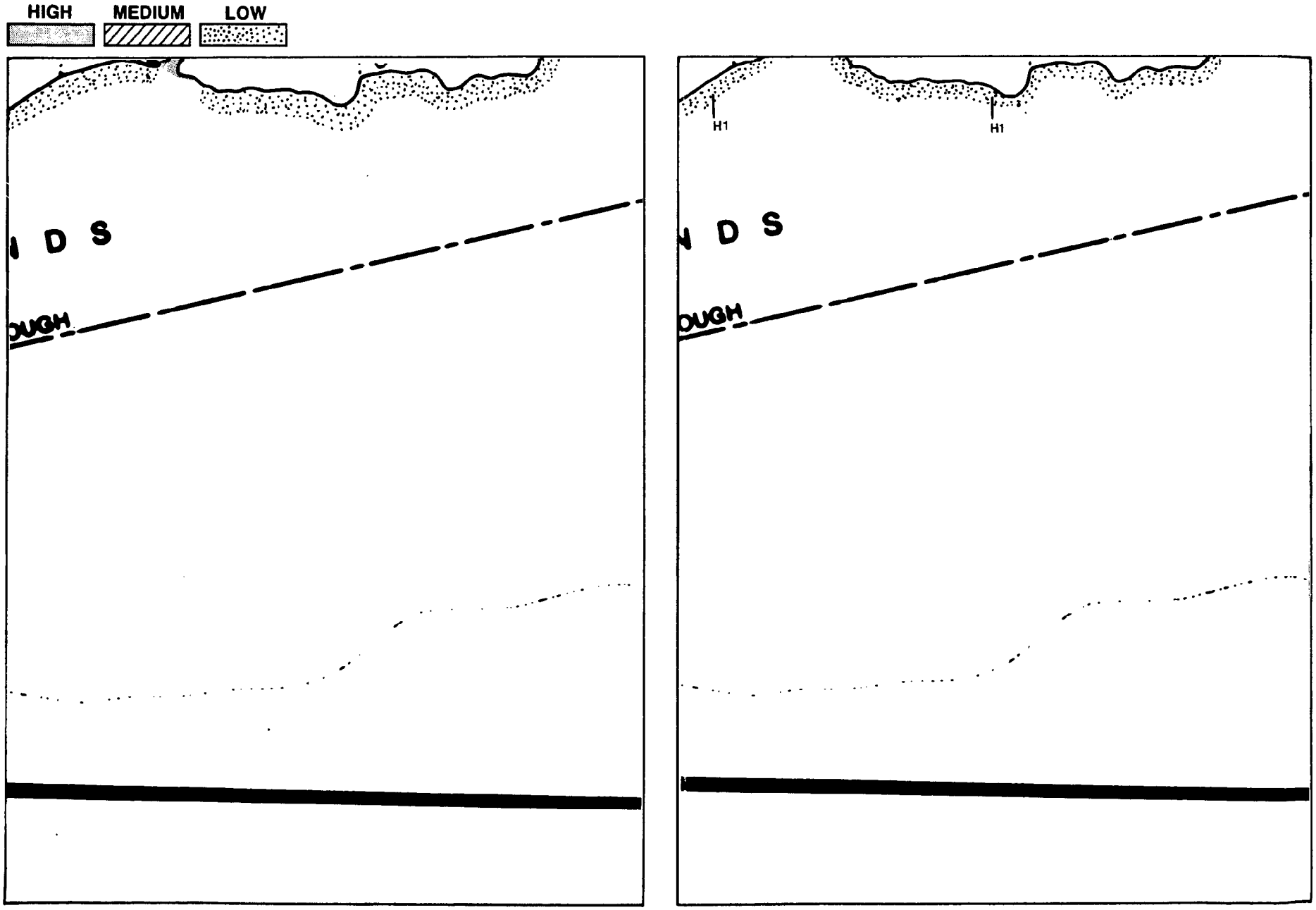


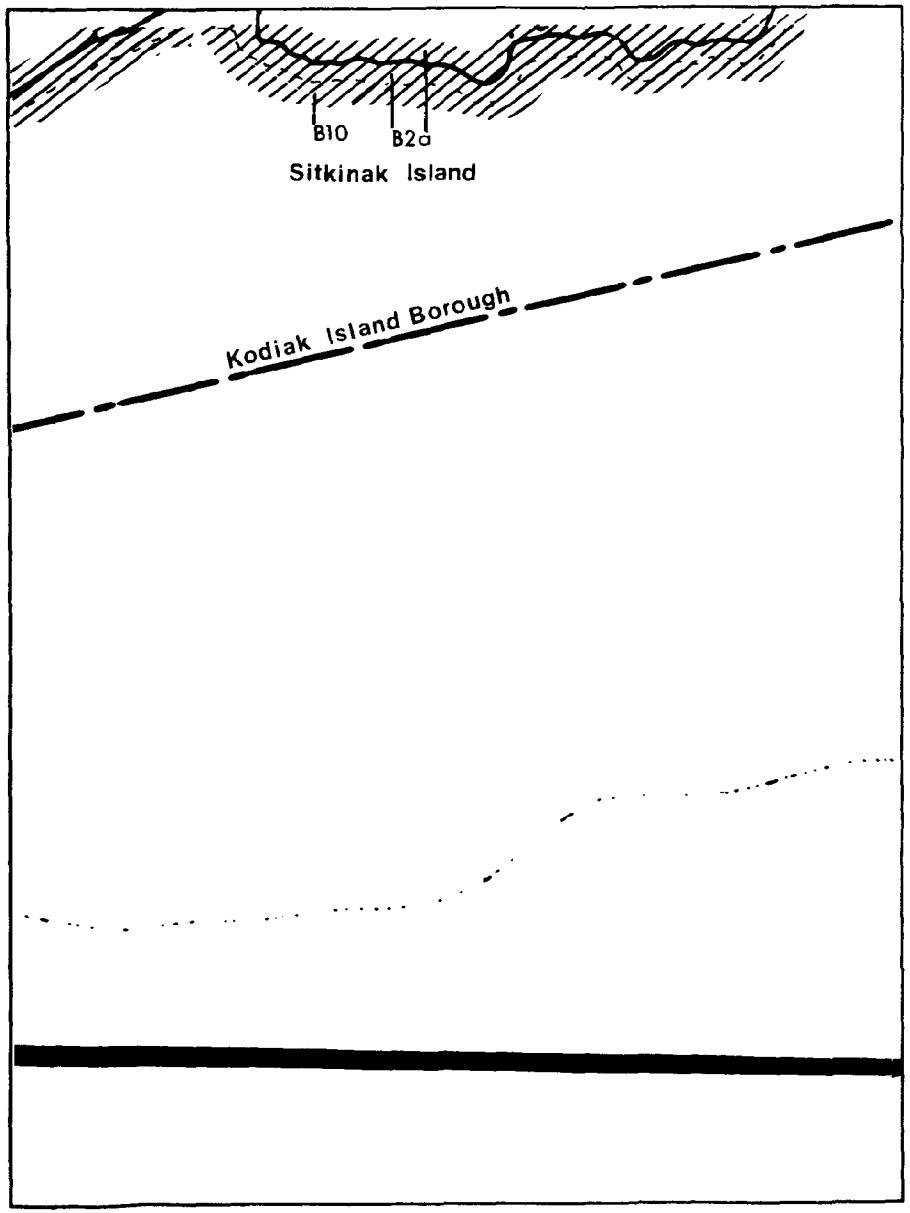




MAP NUMBER 48

RESOURCE	Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE												
R-1 Rocky Headlands												
R-2 Wave-Cut Platforms												
R-3 Sand Beaches/Exposed Tidal Flats												
R-4 Mixed Sand and Gravel Beaches												
R-5 Gravel Beaches												
R-6 Sheltered Rocky and Gravel Shores												
R-7 Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon												
H-2 Roe Herring												
H-3 Crab												
H-4 Shrimp												
H-5 Halibut												
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer												
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon												
Recreation												
H-14 Recreation Use Area												
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer												
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults												
Salmon - Juveniles												
Char/Dolly Varden - Adults												
Char/Dolly Varden - Juveniles												
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area												
B-9 Razor Clam Beach												
B-10 Sea Otters												


HIGH
MEDIUM
LOW
D S
OUGH
H1
H1
D S
OUGH



MAP NUMBER 49

RESOURCE	Winter D	Winter J	Winter F	Spring M	Spring A	Spring M	Summer J	Summer J	Summer A	Fall S	Fall O	Fall N
OIL RESIDENCE												
R-1 Rocky Headlands												
R-2 Wave-Cut Platforms												
R-3 Sand Beaches/Exposed Tidal Flats												
R-4 Mixed Sand and Gravel Beaches												
R-5 Gravel Beaches												
R-6 Sheltered Rocky and Gravel Shores												
R-7 Protected Estuarine Tidal Flats and Marshes												
HUMAN USE INDEX												
Commercial Fisheries												
H-1 Salmon												
H-2 Roe Herring												
H-3 Crab												
H-4 Shrimp												
H-5 Halibut												
H-6 Whitefish												
Subsistence												
H-7 Deer/Elk/Reindeer												
H-8 Marine Mammal												
H-9 Crab												
H-10 Waterfowl												
H-11 Clams												
H-12 Halibut/Marine Fish												
H-13 Salmon												
Recreation												
H-14 Recreation Use Area												
H-15 Recreation Facility												
Infrastructure												
H-16 Boat Harbor												
H-17 Dock												
H-18 Concentration of Commercial & Residential Property												
BIOLOGICAL INDEX												
Onshore												
B-1 Seabird Colony												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-3 Sea Lion Haul-out												
B-4 Black Tail Deer												
B-5 Elk												
B-6 Brown Bear												
Offshore												
B-2a Waterfowl (overwintering)												
B-2b Waterfowl (summer use)												
B-7 Anadromous Fish Streams												
Salmon - Adults												
Salmon - Juveniles												
Char/Dolly Varden - Adults												
Char/Dolly Varden - Juveniles												
Steelhead - Adults												
Steelhead - Juveniles												
B-8 Herring Spawning Area												
B-9 Razor Clam Beach												
B-10 Sea Otters												

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