TUGIDAK ISLAND
CRITICAL HABITAT AREA
MANAGEMENT PLAN

JUNE 1995

Prepared by the Divisions of
Habitat and Restoration
and
Wildlife Conservation

Alaska Department of Fish and Game
333 Raspberry Road
Anchorage, AK 99518-1599

Frank Rue, Commissioner

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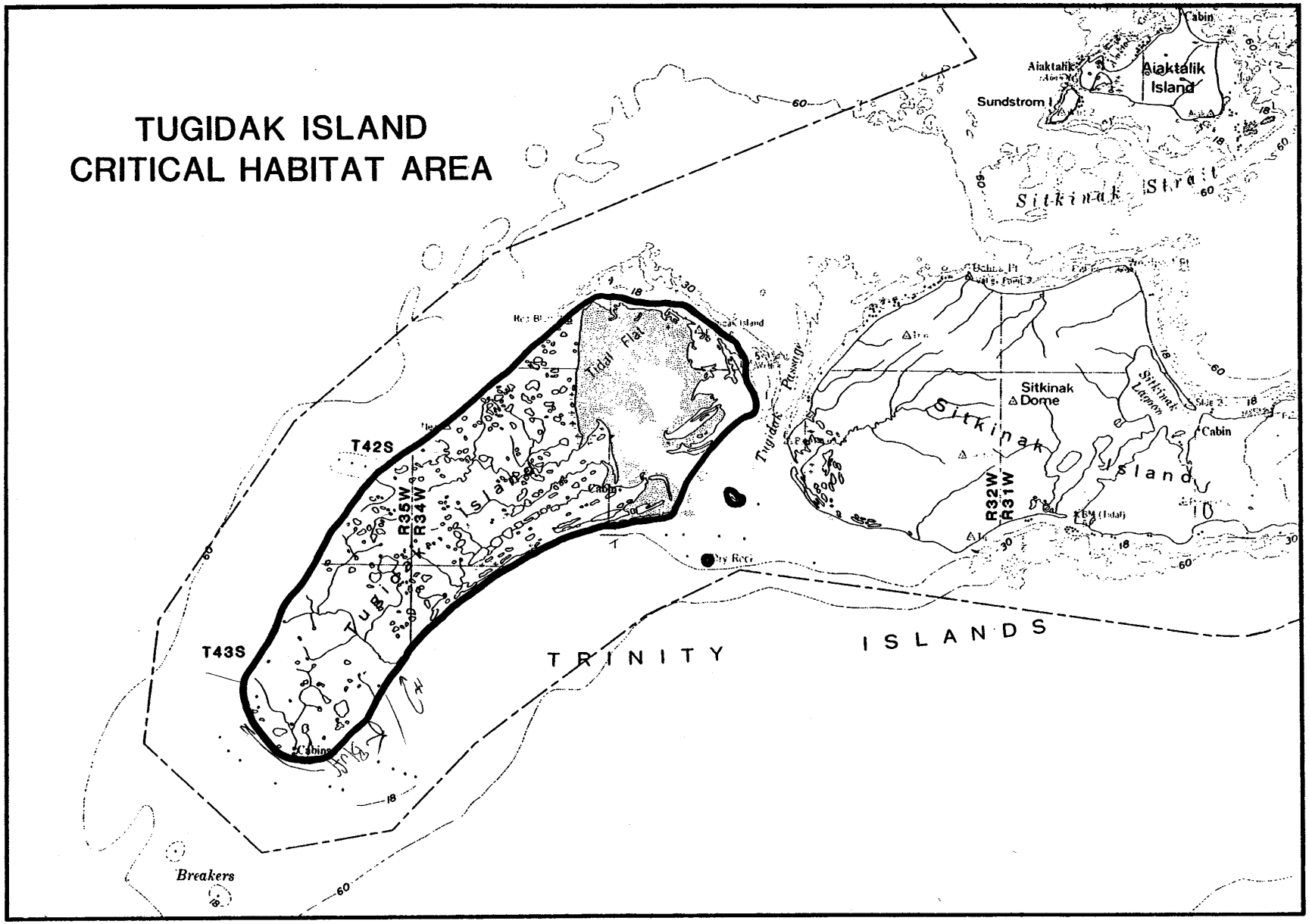
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INTRODUCTION

The Tugidak Island Critical Habitat Area was established in 1988 to ensure the protection and enhancement of fish and wildlife habitat and populations, especially marine mammals, birds, fish, and shellfish; the continuation of fish and wildlife harvest; and public use and enjoyment of the area in a high quality environment.

The statute establishing the Tugidak Island Critical Habitat Area directs the department to develop a management plan for the area (AS 16.20.615(c)). The purpose of the Tugidak Island Critical Habitat Area Management Plan is to provide consistent long-range guidance to the Alaska Department of Fish and Game (ADF&G) and other agencies involved in managing the critical habitat area.

The plan presents management goals for the critical habitat area and its resources, and identifies policies to be used in determining whether proposed activities within the critical habitat area are compatible with the protection of fish and wildlife, their habitats, and public use of the critical habitat area. The plan will be reviewed every five years and, if appropriate, updated as funding permits. Public participation will be solicited during the update process. The plan does not address hunting or fishing regulations which are the authority of the Boards of Fish and Game.

This plan is the result of a public planning process led by the ADF&G. The plan has been developed by the planning team representing state, federal, and municipal agencies including: the Alaska Departments of Fish and Game (ADF&G), Natural Resources (DNR), and Environmental Conservation (DEC); the U.S. Fish and Wildlife Service (USFWS); the National Marine Fisheries Service (NMFS); and the Kodiak Island Borough (KIB).

At the beginning of the public planning process, public meetings were held in Anchorage and Kodiak to explain the planning process and solicit citizens' opinions regarding the issues, interests, and concerns pertinent to critical habitat area management. The meetings' results and written comments received were used by the planning team to identify a list of issues to be addressed in the plan. At the same time, resource information on fish and wildlife populations, other natural resources, existing land use, and land ownership was being collected and synthesized. This information, presented in both map and narrative form, comprises the plan's resource inventory presented in the Appendix.

Management goals and policies for the critical habitat area were developed by the planning team to address the identified issues. All policies were developed with consideration of their ability to meet the plan's management goals. In addition, other applicable laws and the Public Trust Doctrine were considered.
The draft plan was distributed for public review. Based on comments received during the review, appropriate changes were made and the Commissioner of Fish and Game adopted the plan for use by the department in managing the critical habitat area.

The plan is implemented by the ADF&G in several ways. A special area permit is required for any habitat altering activity, including any construction work, in a designated state critical habitat area (5 AAC 95). A special area permit application form can be obtained from any ADF&G office and should be submitted to the Habitat and Restoration Division regional office in Anchorage. The Habitat and Restoration Division will review all proposed activities for consistency with the goals and policies outlined in the plan. Activities will be approved, conditioned, or denied based on the direction provided in the plan as well as other applicable state laws and regulations.

Future Tugidak Island Critical Habitat Area management activities of the ADF&G will also be directed by this plan. Research programs, public use facilities, and other department projects will be consistent with the goals and policies presented in this plan.

Other state, federal, and local agencies have management responsibilities within the critical habitat area as well. Any use, lease, or disposal of resources on state land in the critical habitat area requires DNR authorization. DNR will be developing a Kodiak Area Plan to guide those decisions. Activities affecting air or water quality require authorization from DEC. The U.S. Army Corps of Engineers (COE) evaluates applications for discharging dredged and fill material in waters of the United States including wetlands. Federal and state agencies, including the USFWS, NMFS, and Environmental Protection Agency (EPA), along with local governments, review proposals for COE permits, pursuant to the Fish and Wildlife Coordination Act (16 USC 661-666 et. seq.). U.S. Coast Guard approval is required for certain kinds of work in navigable waters. The KIB exercises land use regulatory authority under Title 29 and requires permits for some types of land use activities. The KIB reviews and comments on all permit proposals within the coastal zone, including the Tugidak Island Critical Habitat Area. Review of activities requiring more than one type of authorization will be coordinated through the Division of Governmental Coordination (Office of the Governor) for a finding of consistency with the Alaska Coastal Management Program.

STATUTES

Alaska statutes which pertain specifically to the establishment and management of Tugidak Island Critical Habitat Area are as follows:

AS 16.20.615 Tugidak Island Critical Habitat Area. *(a) The state land above the mean high tide line within the following described area is established as the Tugidak Island Critical Habitat Area:*

(1) Township 41 South, Ranges 33 - 34 West, Seward Meridian;
(2) Township 42 South, Range 33 West, Seward Meridian
Sections 1 - 11,
Sections 14 - 23,
Sections 25 - 36;
(3) Township 42 South, Ranges 34 - 35 West, Seward Meridian;
(4) Township 43 South, Ranges 34 - 35 West, Seward Meridian.

(b) In addition to the area described in (a) of this section, the water and the land below the mean high tide line in the lagoon at the northeast end of Tugidak Island are included within the Tugidak Island Critical Habitat Area.

(c) The Tugidak Island Critical Habitat Area described in (a) and (b) of this section shall be managed under a management plan prepared by the department.

(d) The department shall permit existing cabins to remain, subsistence and recreational uses to continue, and commercial uses such as seal hunting and placer mining to continue, if appropriate under the management plan adopted under (c) of this section to the extent that the activities are compatible with the establishment of the Tugidak Island Critical Habitat Area.

(e) The department shall permit entry within the Tugidak Island Critical Habitat Area for the exploration and development of oil and gas resources when compatible with the purposes for which the critical habitat area was established. An oil and gas lease of state land within the Tugidak Island Critical Habitat Area is valid and continues in full force according to its terms.

Cross references. - For legislative purpose in establishing the Tugidak Island Critical Habitat Area, see § 1 ch 116 SLA 1988 in the Temporary and Special Acts as follows:

The Tugidak Island Critical Habitat Area is established to ensure the protection and enhancement of fish and wildlife habitat and populations, especially marine mammals, birds, fish and shellfish; the continuation of fish and wildlife harvest; and public use and enjoyment of the area in a high quality environment.

Section 3 chapter 116 SLA 1988 provides: After completion of plans for the area including the Tugidak Island Critical Habitat Area as enacted in Sec. 2 of this Act, the commissioners of natural resources and fish and game may recommend an adjustment in the boundaries of the critical habitat area to the legislature.

REGULATION

5 AAC 95.620. TUGIDAK ISLAND CRITICAL HABITAT AREA MANAGEMENT PLAN. The Tugidak Island Critical Habitat Area Goals and Policies stated in the Tugidak Island Critical Habitat Area Management Plan dated June 1995 are adopted by reference. The plan presents management goals and policies for the critical habitat area and its resources that the department will use in determining whether proposed activities in the critical habitat area are compatible with the protection of fish and wildlife, their habitats, and public use of the critical habitat area. Under 5 AAC 95.420, a special area permit is required for certain activities occurring in a designated state critical habitat area. The department will review each special area permit application for consistency with the Tugidak Island Critical Habitat Area Goals and Policies adopted by reference in this section. A special area permit for an activity in the Tugidak Island Critical Habitat Area will be approved, conditioned, or denied based on the criteria set out in the Tugidak Island Critical Habitat Area Goals and Policies stated in the Tugidak Island Critical Habitat Area Management Plan and on the standards contained elsewhere in 5 AAC 95. (Eff. 11/5/95, Register 136)

Authority: AS 16.05.020 AS 16.20.520
AS 16.05.050 AS 16.20.530
AS 16.20.500 AS 16.20.615

Editor's note. A copy of the Tugidak Island Critical Habitat Area Management Plan dated June 1995 is available at the Alaska Department of Fish and Game, Habitat and Restoration Division, 333 Raspberry Road, Anchorage, AK 99518-1599.

GOALS

Activities which occur within the Tugidak Island Critical Habitat Area will reflect the following goals in accordance with the purpose for which the area was established. All department management decisions in the Tugidak Island Critical Habitat Area, whether affecting activities undertaken by the department, other agencies, or the public, will be in accordance with these goals. It is the intent of these goals that to the maximum extent possible, uses and activities which pre-date establishment of the critical habitat area be allowed to continue.

I. **Fish and Wildlife Populations and Their Habitat** - Manage the critical habitat area to maintain and enhance fish and wildlife populations and their habitat.

   A. Maintain, protect, and if appropriate, enhance the quality and quantity of habitat for historically occurring resident and migrant fish and wildlife, particularly nesting, rearing, staging and wintering habitat for waterfowl; nesting habitat for raptors; critical harbor seal pupping and molting habitat; and important fish and shellfish rearing and spawning habitat.

   B. Minimize harmful disturbance to fish and wildlife, with special attention to Endangered and Threatened Species and Species of Special Concern.

II. **Public Use** - Manage the critical habitat area to maintain public use compatible with other goals of this management plan.

   A. Maintain public access to the critical habitat area.

   B. Maintain opportunities for hunting, fishing, wildlife viewing, and general recreation in a high quality environment.

   C. Provide information about the critical habitat area to the public.

Explanation of Terms

Minimize: To reduce harmful effects to a level which does not have a significant adverse impact on fish or wildlife populations or their habitats within the critical habitat area or significantly reduce public opportunity for successful harvest or non-consumptive use of fish and wildlife.

Harmful Disturbance: Activities which displace animals from their natural habitat or interrupt their seasonal activities at a frequency or duration which causes significant impact to fish and/or wildlife populations. Harmful disturbance does not refer to the legal harvest of fish and/or wildlife.

High Quality Environment: Includes a natural landscape containing native plant communities; a full complement of native fish and wildlife species in their naturally occurring diversity and abundance; pristine air and water quality; an absence or only incidental occurrence of man-made noise and structures; and dispersed, low-intensity, seasonal public use.

Compatible: Where two or more activities co-exist and interact harmoniously without undesirable impacts.

POLICIES

ACCESS AND USE - Maintain existing public access to the Tugidak Island Critical Habitat Area. Restrict access during sensitive seasons or in sensitive habitats, including May 1 to October 1 on the shores of Tugidak Island which are sensitive harbor seal habitat as shown on the attached map to preclude disturbance to harbor seals in critical pupping and molting areas, and in sensitive raptor habitat as shown on the attached map March 1 to September 1 to preclude disturbance to ground-nesting raptors.

MOTORIZED VEHICLES - General Permits: To ensure the protection of sensitive habitats and avoid harmful disturbance to fish and wildlife, the department will not issue general permits for the off-road use of wheeled, tracked or other ground-effect motorized vehicles, including aircraft, above mean high water within the critical habitat area except that 1) aircraft access may be allowed at designated lakes and Pick-up Point, and after August 9 each year in designated areas, and 2) access for vehicles under 1,000 pounds gross vehicle weight may be allowed in non-vegetated portions of non-sensitive beaches. Individual Permits: The department will also, in its discretion, issue an individual special area permit under 5 AAC 95 for the off-road use of a wheeled, tracked or other ground-effect motorized vehicle if the use is consistent with the goals and policies of this management plan and fulfills a demonstrable need for which there is no feasible alternative. Prohibited Activities: The department will not issue a special area permit for use of motorized vehicles in sensitive areas during sensitive seasons. Aircraft landing and take-off and boat access on sensitive harbor seal beaches within the critical habitat area is prohibited during sensitive seasons.

INFORMATION/EDUCATION - Provide information to critical habitat area users regarding resource values and rules, including boat and aircraft use, low impact use and the wilderness ethic. Encourage compatible research of fish, wildlife and habitat resources.

RECREATIONAL ACTIVITIES - Low intensity recreational activities including wildlife watching, hunting, sport fishing, photography, and camping, may be allowed within the critical habitat area under terms and conditions consistent with the goals and policies of this management plan and the purposes for which the critical habitat area was established.

CULTURAL/ARCHEOLOGICAL RESOURCES - Protect cultural and archeological resources located within the critical habitat area. Where appropriate, allow legal investigation of cultural and archeological resources on the island through a special area permit under terms and conditions consistent with the goals and policies of this plan and the purpose for which the critical habitat area was established.

ECOSYSTEM INTEGRITY - Allow only those uses and activities which will not compromise the integrity of the island ecosystem. Do not allow the introduction of exotic plant or animal species, whether wild, feral, or domestic, except that dogs may be allowed under appropriate conditions by individual special area permit including proof of current

vaccinations for rabies and canine distemper, and a requirement that a dog remains under the direct control of its master at all times.

OIL AND GAS - To avoid damage to fish and wildlife habitats, disturbance to fish and wildlife populations, and displacement of public use in a high quality environment, surface entry for oil and gas exploration or development, including supplies and equipment storage for off-shore exploration, will not be allowed in the Tugidak Island Critical Habitat Area since it is not consistent with the purpose for which the critical habitat area was established.

CABINS - Allow continued use and maintenance of cabins in existence at the time Tugidak Island Critical Habitat Area was established where consistent with other state statutes and regulations through special area permit under terms and conditions consistent with the goals and policies of this management plan and the purpose for which the critical habitat area was established. Do not permit new cabins to be built on the island and require removal or take possession of unauthorized structures.

COMMERCIAL FACILITIES/STRUCTURES - To protect fish and wildlife habitat, conserve fish and wildlife populations, and maintain public use opportunities in a high quality environment, permanent commercial facilities, including float structures, will not be allowed in the critical habitat area. Temporary structures may be allowed only if they meet a public need for which there is no feasible alternative. Solid waste disposal is not allowed within the critical habitat area, except that outhouses and burning of trash may be allowed. Ashes and unburned garbage must be removed from the critical habitat area.

CAMPING - Stays in excess of 14 days on the island require a special area permit. May 1 to October 1, camping will be allowed at permitted campsites only. Ashes and unburned garbage must be removed from the critical habitat area.

MINING - Keep the critical habitat area closed to new locatable mineral entry and mineral leasing under AS 38.05.185 - AS 38.05.275. Recreational mining of beach sands using hand tools or a suction dredge with an intake hose having an inside diameter not exceeding 4 inches and a motor not exceeding 8 horsepower, may be allowed by individual special area permit under terms and conditions consistent with the purpose for which the area was established and the goals and policies of this management plan.

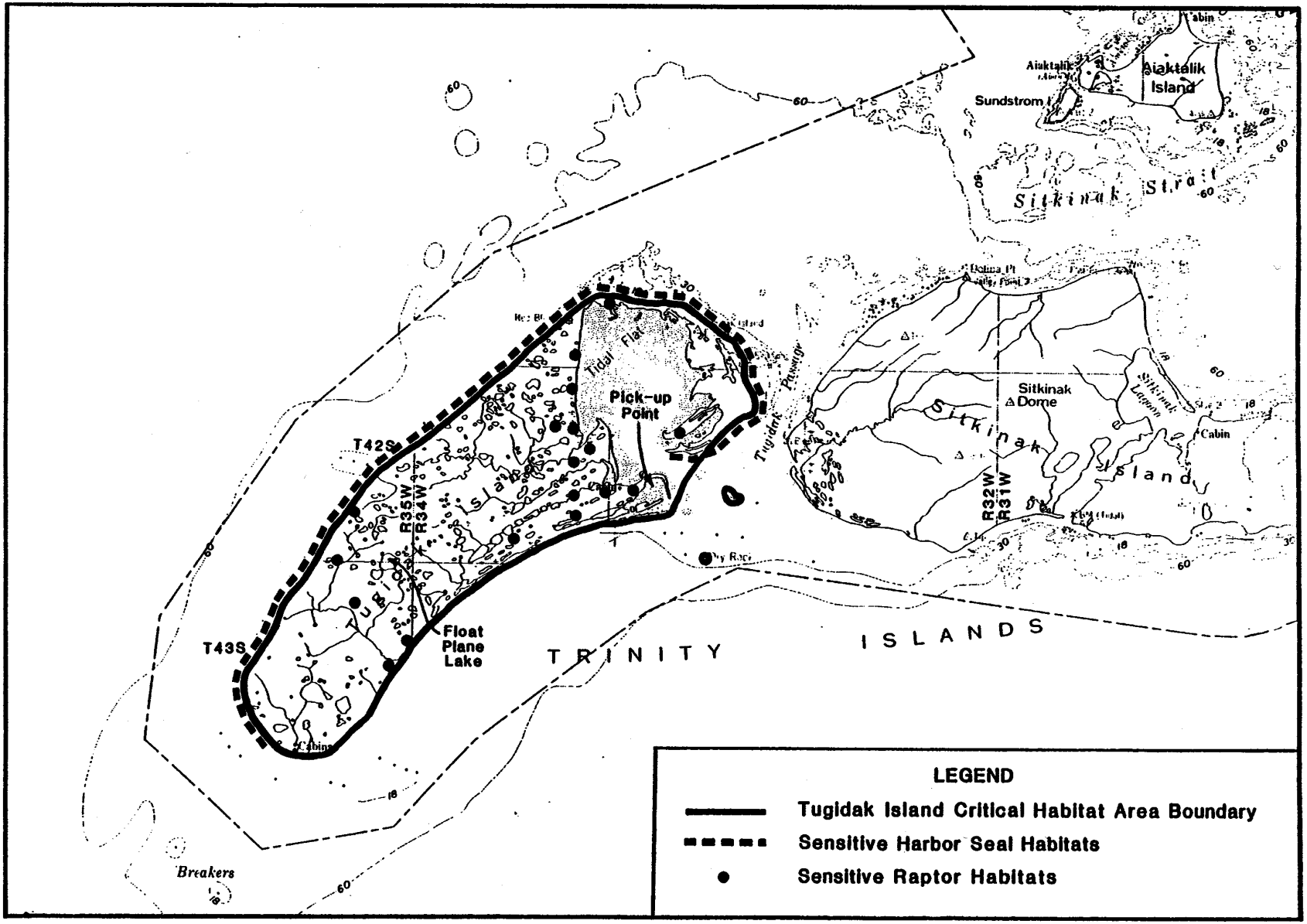
GRAZING - The grazing of domestic or feral animals within the critical habitat area is prohibited.

HAZARDOUS SUBSTANCES AND PETROLEUM-BASED FUEL - Hazardous substances may not be stored or deposited in the critical habitat area. Temporary personal fuel supplies less than twenty gallons are allowed in the critical habitat area without a special area permit and greater amounts may be allowed by special area permit.

BOUNDARY ADJUSTMENTS - To protect critical harbor seal haul out, pupping, molting, and feeding habitat, recommend to the legislature expansion of the boundaries of the Tugidak Island Critical Habitat Area to, at a minimum, include tide lands and waters and, at a maximum, include nearshore lands and waters within ¼ mile of shore along the portion of Tugidak Island shoreline which supports critical harbor seal habitat as shown on the attached map. It is not the intent of legislation to restrict or exclude navigation, temporary safe anchorage, or commercial fishing in nearshore waters.

OTHER USES - To protect fish and wildlife populations and their habitats in the critical habitat area, the department will, in its discretion, allow by permit* only those activities consistent with the purposes for which the critical habitat area was established, terms and standards of 5 AAC 95, and the goals and policies of the plan. Any activity which is not consistent with the purposes for which the critical habitat area was established, terms and standards of 5 AAC 95, and the goals and policies of this plan will not be allowed.

* Activities requiring a special area permit are listed in 5 AAC 95.420.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Float Plane Lake
TRINITY ISLANDS
Breakers
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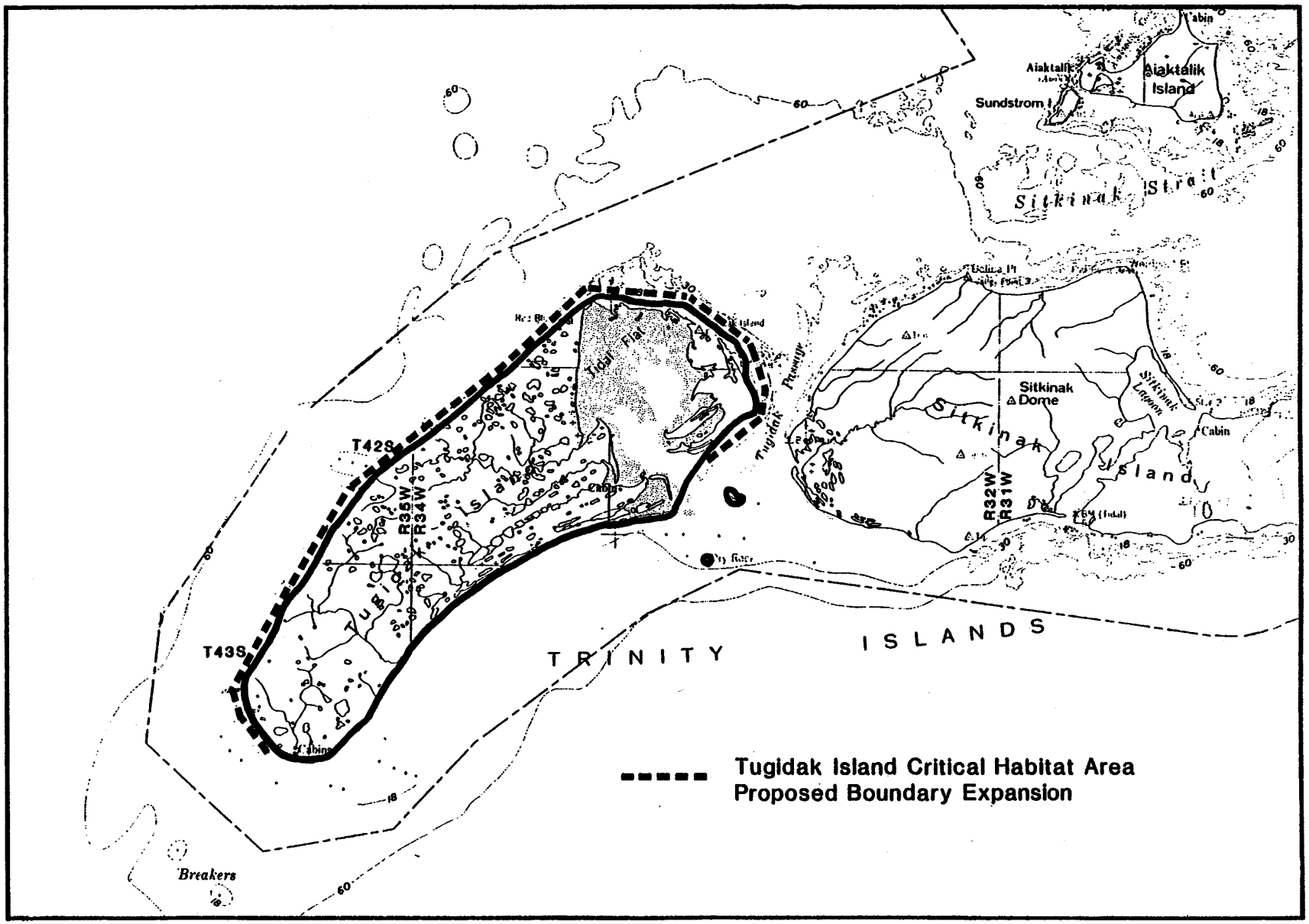
Tugidak Island Critical Habitat Area Boundary
Sensitive Harbor Seal Habitats
Sensitive Raptor Habitats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R34W
R32W
R31W
TRINITY ISLANDS
Breakers
Tugidak Island Critical Habitat Area
Proposed Boundary Expansion

IMPLEMENTATION

The Tugidak Island Critical Habitat Area Management Plan will be implemented by the ADF&G through its day-to-day, on-the-ground management activities, through its annual budgetary process, and through special area permits issued for land use activities.

Special Area Permits - A special area permit is required for any habitat-altering activity, including construction work, in the Tugidak Island Critical Habitat Area. A special area permit application form can be obtained from any ADF&G office and should be submitted to the Habitat and Restoration Division regional office in Anchorage (5 AAC 95).

Information/Education - Work with government agencies and private groups to develop an information/education program for the critical habitat area which will inform the public about resource values, rules, and recreational opportunities. Work with air charter operators and the Federal Aviation Administration to explain aircraft access limitations in sensitive habitats during sensitive seasons.

Mining Claims and Leasehold Locations - Work with the Alaska Department of Natural Resources to review the status of mining claims, close out all lapsed claims, and extend mineral closing orders.

Cultural/Archaeological Resources - Encourage a comprehensive inventory of archaeological resources on Tugidak Island by appropriate qualified authorities.

Cabins - Work with the Alaska Department of Natural Resources and the Kodiak Island Borough to bring cabins on Tugidak Island into compliance with state and local laws and regulations and require removal or take possession of all unauthorized cabins.

Kodiak Island Borough - Work with the Kodiak Island Borough to re-zone the critical habitat area Natural Use.

Boundary Adjustment - Coordinate with the Alaska Department of Natural Resources a recommendation to the legislature to expand the boundaries of the critical habitat area to encompass critical harbor seal habitats.

Other Agencies' Activities - This plan will also be used by other state, federal, and local decision makers in making management decisions for the critical habitat area under their respective statutory authorities.

APPENDIX

TUGIDAK ISLAND CRITICAL HABITAT AREA
RESOURCE INVENTORY

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AREA DESCRIPTION

Tugidak Island is named for the way it is shaped. "Tugidak" is a transliteration of the Aleut name, published in 1852 by Sarychev, which means "moon" or "mouth" (R. H. Geoghegan, in Orth 1971) and refers to its large, distinctive lagoon.

Tugidak Island is part of the Trinity Islands, located in the southernmost part of the Kodiak Island archipelago. It is a remote island, located 108 miles southwest of the City of Kodiak and 26 miles from the nearest village, Akhiok. Tugidak Island is 18 miles long (Orth 1971) and about 71 mi^2 in area (Capps 1937).

It is a low, undulating island of wet tundra, grasslands, and marshes. Much of the island is "an intricate maze of lakes and ponds, many linked by channels" (Bruemmer 1984). Drainages are short. Low hills, 120-160 feet in elevation, support "islands" of dry tundra. A bluff from 25-125 feet high extends along most of the western side of the island, around the southern tip, and about one-third of the way up the eastern side (MacIntosh and Smith 1978). On the eastern side, south of the lagoon, a series of ancient beach ridges parallel the shoreline. Intertidal flats encircle the island and are a predominant feature inside the large lagoon on the north end. The flat, low-lying terrain and large intertidal area are unique features in the mountainous Kodiak Archipelago.

The Tugidak Island Critical Habitat Area was created in 1988. The critical habitat area, which includes all land and water above mean high tide and the tide flats and submerged lands in the lagoon (see Land Status Map), encompasses about 50,240 acres.

ARCHAEOLOGY AND HISTORY

During the 1890 census, Porter (1893) found no permanent settlements on Tugidak or nearby Sitkinak Island. However, Tugidak Island was certainly occupied by Koniags, either temporarily or by small numbers of more permanent inhabitants. Small groups of barabara depressions have been found on the north and east sides of the island. Artifacts have been found along the western side, but extensive erosion of the coastal bluff may have removed barabara depressions.

Larger and more permanent settlements were located on nearby islands. An Aleut settlement existed on the northeast side of the western most Sitkinak Island in the late 18th or early 19th century (Teben'kov 1981). Another village, Ayaktalik, on Ayaktalik Island, 14 miles northeast of Tugidak, was still inhabited during the 1890 census. It was

> established upon a site most dismal and exposed, solely for the convenience of sea-otter hunting. The people, though successful in the

> chase, still live in wretched semisubterranean sod huts, bereft of the comfort of fire a great part of the time, owing to the great scarcity of fuel. (Porter 1893)

A scarcity of wood for fuel may have also limited the number of inhabitants on Tugidak Island, although currently there is an abundant supply of logs on its beaches.

Tugidak Island, with its abundant sea otters, seals, waterfowl, salmon streams, and shellfish must have attracted considerable attention from the Koniags. Middens and barabara pits indicate that people occupied the island (Klingler 1988), at least temporarily. Historical records provide some tantalizing insights. Perhaps the first written record of a Tugidak inhabitant was by Lt. Sarychev, with Commodore Joseph Billings in the Glory of Russia. On July 8, 1790, having anchored overnight in the vicinity of "Tugudock" Island, their vessel was approached by

> several islanders [who] came in their double-seated baiders [kayaks] to our ship, without betraying any symptoms of fear. They offered nothing to sale, but soon after returned to their habitations" (Sarychev 1969, Vol. II, pp. 16-17).

Several years later, in 1796, Father Juvenal, a prominent Russian Orthodox missionary on Kodiak Island, was visiting nearby Three Saints Bay when he encountered some

> strangers who came from Tugidak Island to trade. They asked me if I could cure a man when he was very sick, and I answered that with the help of God I might. At this they shrugged their shoulders, and one man said: "We have a shaman at home who once brought a dead man back to life; and he did it all alone" (cited in Bancroft 1959:366).

In the late 18th and early 19th centuries, parties of Koniags under the control of a few Russians or creoles fanned out from the main settlements on Kodiak Island to hunt for sea otters and other furbearers. Their primary destination was the northern Gulf of Alaska coast. Each year a party comprised of hundreds of the most seaworthy kayaks and strongest Koniags travelled as far east as Sitka and, in some years, over a hundred Koniags drowned in rough water or when the stitches of their skin kayaks pulled apart under constant use. Tugidak Island attracted the second-largest parties. Davydov (1977) described a "Tugidak party" as

> made up of less than 200 baidarkas under the command of a *partovshchik* and his assistant...old baidarkas are used for this expedition and the hunters are old men and boys. The party assembles on Tugidak in the first days of April and on calm days makes trips to the sea for otters.

Later, the assistant took the baidarkas in the best condition and continued on to Chirikof and even Unga Island, while the remainder of the party stayed on Tugidak. The Tugidak contingent left the island in August to return to Kodiak.

In the late 19th century, Tugidak and Sitkinak islands were visited during the winter by hunting parties of whites and Natives, "who combine sea-otter hunting with trapping for foxes [probably on Sitkinak Island] and land otters" (Porter 1893:78). On Tugidak, "occasionally the watchful hunter is rewarded by finding the carcass of a [sea] otter killed on the Shumagin hunting grounds to the southward and carried northward by friendly ocean currents" (Porter 1893:78).

The local hunting-gathering lifestyle developed a new wrinkle when salmon canneries were established in the area. Several large vessels supplying the canneries wrecked on the treacherous coast, which "brought temporary prosperity to the people of Ayaktalik, who made what seemed to them small fortunes from wreckage strewn along the shores of Tugidak and other islands" (Porter 1893:78). Unfortunately, modern vessels also contributed to the decline of the local Native population. Porter (1893:78) speculated that the 106 inhabitants of Ayaktalik

> probably in the near future will be obliged to search for new homes, as the practice lately adopted by the trading companies of hunting the otter with fast steam launches has well nigh exterminated their principal source of revenue.

Many of the early Russian explorers saw Tugidak Island on their journeys to and from Kodiak, but there is no record of the first non-Native to actually set foot. Bering apparently had a close encounter with one or both of the Trinity Islands, without ever sighting land. After leaving their first landfall on Kayak Island, the crew of the St. Peter were blown across the Gulf of Alaska to Kodiak Island. Steller (1988:80) reported sailing in the vicinity of Tugidak in mid-August 1741, but no one saw the island due to "continuously stormy, wet weather." As they scudded along the coast from one near-disaster to the next, Bering's second-in-command, Lt. Waxell, noted in his journal

> I particularly remember one occasion. It was a dark night and we had not made a landfall for several days; about midnight we had a bad fright on finding ourselves in only 20 fathoms of water and not having any idea what sort of a bank or shallows it might be. We tried every thing possible to escape from there, but in whatever direction we sailed, we found only shallow water. I had no idea what was the best thing to do; nor would it have been advisable to have dropped anchor without knowing whether we were a long or short distance from land; especially not as there was a strong

> wind and the seas were running high. I decided to sail due south. For a long time the depth remained the same, but fortunately we eventually came out into deep water. (Waxell 1952:107-108).

The dates and vessel course mapped in Steller's journal, and the extensive shoals reported by Waxell, suggest that Bering and Steller were close enough to have sighted Tugidak on this occasion, under more advantageous conditions. Under the circumstances, it was only a matter of luck that the crew of the St. Peter did not find themselves marooned on one of the Trinity Islands instead of Bering Island nearly two thousand miles farther west.

Captain Cook visited the area in 1778 (Cook 1967) and Captain Vancouver in 1778 (with Cook) and 1794 (Vancouver 1967). Cook assigned the name "Trinity" to Sitkinak Island. Neither explorer mentioned nearby Tugidak Island, either because it was so low and may have been blocked by the mountainous Sitkinak Island or because they considered it a part of the larger island.

In the meantime, the Billings expedition had discovered Cook's error. Anchored near "Tugudock" Island in mid-July 1790, Sarychev noted

> During the whole night the wales [sic] swam around our ship, and perpetually occasioned, by their violent lashing of the waves, a report very similar to that from the discharge of a cannon. (Vol. II, pp. 16-17)

The island's discovery was not documented in two subsequent atlases. Galiano (1802, in Orth 1971) called the islands "Trinidad Island." Sauer (1802, in Orth 1971) named them Kightak Sichtunak (Sichtunak Island), documenting the Native name for Sitkinak Island, but still apparently unaware of that will-o-the-wisp, Tugidak. Finally, in 1847, both islands were charted by the Russian Hydrographic Department as "O[strovy] Troitsy" (Trinity Islands). The name was re-anglicized on a U. S. Coastal and Geodetic Survey (USC&GS) chart in 1868 (Orth 1971).

Captain Golovnin, on the sloop Kamchatka, anchored about three miles from Tugidak Island in July 1818. Golovnin (1979: 108, 128) wrote

Tugidok [sic] is a low, almost completely flat, rocky island...

> We searched [Tugidak Passage] closely from the crosstrees but nowhere observed a possible passage for a large vessel among the rocks that were covered by a high surf although there was no wind or choppiness.

He also remarked on Cook's error in lumping Tugidak with Sitkinak Island.

Tugidak Passage was reported as "Tugidak Slue" by W. C. Hodgkins, USC&GS, in 1906. The USC&GS renamed it Tugidak Passage in 1934 (Orth 1971).

Four shipwrecks are documented in the vicinity of Tugidak Island. In 1889, the "Lizzie Williams" struck a shoal. In September 1896, the "James A. Borland" carrying a load of salmon was caught in heavy swells, winds, and thick fog, blown onto shore, and struck a reef extending from the island, immediately breaking up. In 1899, the NAT & T Co. #3 barge went down; and in 1916, the wood cannery steamer "Pavlof" struck an uncharted rock, was stranded wrecked, and declared a total loss (Tornfelt 1992).

PHYSICAL ENVIRONMENT

CLIMATE AND WEATHER

The climate and typical weather conditions of the area are described in detail by Buck et al. (1975). Apparently, the U. S. Weather Bureau has collected some data on Sitkinak Island (Johnson 1976a). Nault (1980) condensed the weather of Tugidak Island into a few words: "Fog, gray. Rainy, cold. Lots of wind." Bruemmer (1984) described an extensive blanket of fog that came up so fast and was so thick that he became completely disorientated. Other, less colorful, visitors have found the weather to be better, on average, than that in Kodiak. Daily weather conditions recorded during the summer of 1978 indicate less than one-quarter of the days had drizzle, rain, or heavy fog, and most of these occurred when the wind was from the southeast (D. McAllister, pers. commun.).

GEOLOGY AND SOILS

Unlike neighboring Sitkinak, Tugidak Island is underlain with sedimentary rocks, with interbedded volcanic lava (Selkregg 1974). Surficial deposits on the bulk of Tugidak Island are poorly sorted glacial moraine and associated drift deposits (Selkregg 1974). Capps (1937) speculated that the morainal material had been deposited by a great glacier that emerged from Alitak Bay. Most of the spit that encompasses the large bay was formed by longshore drift.

Tugidak Island has well-exposed and abundantly fossiliferous outcrops of marine Pliocene sediments (Moore 1969, Marincovich 1990). The outcrops are exposed in the coastal bluffs that extend along the west coast of the island. Fossil molluscs in these outcrops are diverse and well-preserved. They probably date from the late Pliocene and Pleistocene (Allison 1978). These outcrops have not been visited by paleontologists, and they have great potential for increasing understanding of high-latitude North Pacific climates during the Pliocene (Marincovich 1990). The Tugidak Formation has probably not been surveyed for

microfossils, although they are likely to be found in the abundant, closed bivalve and gastropod fossils.

The island's beaches are heavy shingle, gravel, and in some places fine sand (National Ocean Service 1989).

The soils of Tugidak Island are similar to those of nearly level coastal plains in southern Kodiak Island and the southwestern parts of the Alaska Peninsula (Rieger et al. 1979). Upland soils are loamy, well-drained, and comprised mostly of fine thixotropic volcanic ash. Soils in depressions are very poorly drained fibrous peat, with the water table always at the surface. There is a substratum of gravelly waterlaid material, cinders, or weathered rock.

There are few limitations to construction on the well-drained soils (Rieger et al. 1979), but activities such as concentrated recreation and off-road vehicle use are generally unsuitable on the saturated, organic soils (Buck et al. 1975). Landslides were generated along the bluff on southwestern Tugidak Island during the 1964 Alaska Earthquake (Buck et al. 1975).

OCEANOGRAPHY

The region's oceanographic conditions are described in Buck et al. (1975). The United States Coast Pilot has a detailed description of Tugidak's offshore waters (National Ocean Service 1989). Pertinent sections are cited below:

> **Tugidak Passage,** between Sitkinak and Tugidak Islands, has very strong and freakish tidal currents and rips. Only the N approach has been surveyed. The S approach is apparently blocked by shoals. Tide rips in the middle of the passage are extremely dangerous to small boats and should be avoided by hugging the Tugidak Island shore. [Note: local knowledge reports that the south approach is not blocked by shoals (unattributed)].
>
> **Tugidak Island,** in its N part, is chiefly sandflats, but little above high water. A level boulder patch that uncovers is 0.5 mile off the N coast of Tugidak Island, 5 miles W of Tugidak Passage.
>
> The lagoon is reported to bare, except near the SW side of the entrance where there is a pocket or basin of about 5 to 6 fathoms, sand bottom. The basin is a suitable anchorage for small boats, and is protected from the sea by a long sandspit that extends E from the entrance point on the SW side. A narrow channel follows the SE side of Tugidak Island, however, it is almost bare at low water so passage in or out is possible only at half or greater tide.

In 1909, Mr. S. Applegate located the foul and broken area which extends about 10 miles S from the S end of Tugidak Island, as shown on the chart, by compass bearings on Tugidak Island and the summit of Sitkinak Island. Until a survey is available it is considered unsafe for vessels to cross this area. The bottom is very uneven, the depths changing abruptly from 2 to 4 fathoms in places, and boulder reefs with little depth may be expected. There are strong currents and heavy rips and overfalls.

The waters off the N end of Tugidak Island have been surveyed. The general absence of kelp in this comparatively shoal area may be taken as an indication of the existence of but little if any ledge rock. The bottom apparently is composed of loose material including boulders leveled down by the action of the sea to form the more or less flat area of this region of 5 to 7 fathoms. Slight shoaling occurs in patches where apparently there is a predominance of boulders resisting the general leveling action of the sea.

The N and W sides of Tugidak Island may be generally approached as close as 1.5 miles in good weather by a careful use of the lead. Care should be exercised near the middle of the W side of the island, as an unsurveyed bank reported to be covered as little as 2 fathoms is possibly 2 or 3 miles off. Anchorage can be found on the E side of the island between the entrance to the lagoon and the foul area extending off the S end.

The wide passage between Chirikof Island and Tugidak Island has not been adequately surveyed. From widely scattered soundings taken in this locality, it appears that a submarine ridge with depths less than 19 fathoms extends from one island to the other. Foul and broken bottom extends about 10 miles S from Tugidak Island. Fairly regular depths across the ridge are indicated in the more closely sounded area 10 miles SW of Chirikof Island. Tugidak island is low and featureless and cannot be used as a navigational guide in the passage.

Landings are easy with offshore winds, but with any change the sea makes up rapidly.

Winds and tidal currents continuously replenish Tugidak's beaches with "firewood, lumber, buoys, and interesting if useless junk" (Nault 1980).

BIOLOGICAL RESOURCES

MARINE VEGETATION

Almost nothing is known about marine vegetation, either phytoplankton or macrophytes (seaweeds), in this area. Eelgrass (Zostera marina) has been found in the lagoon (Hensel 1960, Mercer 1987), but the extent of the bed is unknown. It is probably safe to surmise that, outside of the lagoon, seaweeds are scarce due to the shallow, unconsolidated bottom.

TERRESTRIAL VEGETATION

On a gross scale, the southern third of the island is moist tundra and the northern two- thirds is wet tundra. Wetland areas have been categorized and mapped by Fish and Wildlife Service's National Wetlands Inventory (see Vegetation Map).

There are no trees on the island. Common plants that have been identified (MacIntosh and Smith 1978) include crowberry (Empetrum nigrum), sedges (Carex spp.), cow parsnip (Heracleum lanatum), fireweed (Epilobium), Ranunculus spp., salmonberry, mosses, lichens, and grasses. Dwarf willows and birches are two to four feet high. Some small ponds are covered with yellow pond lily (Nuphar sp.).

MARINE INVERTEBRATES

Little is known of marine invertebrates in the vicinity of Tugidak Island. Numerous dungeness crabs (Cancer magister) exoskeletons and razor clam (Siliqua patula) and weathervane scallop (Pecten caurinus) shells have been found in the lagoon and adjacent beaches (Clausen and Dolezal 1988). Nault (1980) observed the crabs themselves one day in the mid-1960s, finding "millions" of them filling a long, 30-foot-wide inlet in the lagoon until the next ebb tide washed them away. Lagoons such as this are often important nursery areas for crabs. Tugidak's lagoon may be critical to the economically valuable dungeness crab fishery in adjacent waters.

The only known concentrations of live razor clams are near the mouth of the lagoon (see Mammals and Fish Map).

TERRESTRIAL INVERTEBRATES

Insects and other invertebrates have not been scientifically surveyed on Tugidak. Bruemmer (1984) observed mosquitos, crane flies, spiders, and "flies."

FISH

Of marine fishes, sand lances (Ammodytes hexapterus) have been found dead and dying in tide pools (Mercer 1987), and Pacific herring (Clupea harengus)(Clausen and Dolezal 1988) feed and rear in the lagoon and to the north of Tugidak Island (see Mammals and Fish Map). Little else is known. The island has five documented salmon streams (Clausen and Dolezal 1988, Mammals and Fish Map). Coho salmon (Onchorhynchus kisutch) inhabit all five. The largest stream exiting the east side of the island is known to have supported chum (O. keta) and pink salmon (O. gorbushca). No one has attempted to estimate numbers of fry, smolt, or returning adult salmon in these streams.

Three-spine sticklebacks (Gasterosteus aculeatus) have been found in the anadromous fish streams (Clausen and Dolezal 1988).

BIRDS

At least 79 species of birds have been documented on Tugidak Island, including the lagoon and marine waters within about one-half mile from shore (Table 1). Based on 14 years of experience in the Kodiak Archipelago, Smith (1987) concluded that no other island could compare with Tugidak Island in sheer numbers and diversity of bird life. It is difficult to identify relative abundance and periods of occupancy because the observations are anecdotal and sporadic.

Significant numbers of emperor geese may occur in the Trinity Islands, including those displaced from nearby foraging areas by human activities (Forsell and Gould 1981). Various visitors have observed emperor geese arriving in the Tugidak Lagoon in late September and up to 2,000 have been observed in the lagoon in the months of October through mid May (D. Zwiefelhofer, pers. commun.). Emperors on Tugidak Island were easily disturbed by aircraft, flushing 2-3 miles ahead of an observer's Cessna 206 (Zwiefelhofer 1990).

Emperor geese numbers declined world-wide by about one-third between the 1960s and 1981. Increased concern led the Fish and Wildlife Service to begin annual surveys. Spring index counts of emperor geese in Alaska reached a historic low in 1986, but the population has begun to recover (Rothe 1992). Most emperor geese winter in the Aleutian Islands. An estimated 80-90% of the total breeding population nest on the Yukon-Kuskokwim Delta.

The decline was attributed to bird and egg harvests greater than the population could sustain (Hogan et al. 1988). Sport hunting of emperor geese was closed in 1986, and subsistence harvests have been reduced voluntarily to allow the population to recover.

Up to 2,000 black brant are known to concentrate in the lagoon in the spring (March - May) and migrating flocks of Canada geese pause in the fall. White-fronted geese and snow geese may come over from nearby lagoons on Kodiak in the fall (D. Zwiefelhofer, pers. commun.).

Duck nests--including mallards, pintails, green-winged teals, American wigeon, and greater scaup--are commonly spaced only a few feet apart in the narrow band of beach drift and beach rye grass along the lagoon and nearby freshwater ponds. Such densities are comparable to intensively managed waterfowl refuges in the contiguous 48 states (Smith 1987). The shallow continental shelf surrounding the Trinity Islands may support many thousands of king eiders, white-winged scoters, and Cassin's auklets (Forsell and Gould 1981).

Several thousand glaucous-winged gulls, several hundred mew gulls, and an estimated seven hundred arctic terns nest around the lagoon and on the southeastern shore of the island. A colony of cormorants nest on the northeastern end of the island (Sowls et al. 1978).

Individuals of many shorebird species are common to abundant on Tugidak Island. Short-billed dowitchers and red-necked phalaropes are particularly abundant (MacIntosh 1994b). Aleutian terns are fairly common, and they probably nest over the entire upland portion of the island (MacIntosh 1994b). The most common songbirds are probably two grassland species: the savannah sparrow and Lapland longspur (MacIntosh 1994b).

Willow ptarmigan are one of the most conspicuous birds on Tugidak Island, but their populations may be cyclic or vulnerable to certain weather conditions. Ptarmigan were abundant in 1960 (Lensink 1960b) and 1964 (Bishop and Lortie undated). In 1965 numbers declined drastically. Nault (1980), probably on the island in the mid to late 1960s, reported "so many ptarmigans nested and lived in the grass, we could have 'chicken' every day for the price of a short hike with a gun." They were relatively abundant in 1972 (K. Pitcher, pers. commun.) and very abundant in 1978 and 1979 (D. McAllister, pers. commun.) and in 1994 (L. Jemison, pers. commun.).

Bald eagles are common on Tugidak Island, where they typically nest on the ground. Several unusual nests have been found built upon the root wads of beached trees (Sease 1992b, 1993a). Nault (1980) described a towering nest structure 12 feet tall and 14 feet in diameter at the base that was built of driftwood on the tundra by the lagoon. A Native seal hunter told him in the mid-1960s that the nest had been there for five human generations.

Numerous nests sites have been documented on the island (MacIntosh 1993a, see Birds Map), although not all of these may still be active.

Other avian predators, such as short-eared owls, northern harriers, rough-legged hawks, and parasitic and long-tailed jaegers, are relatively numerous due to the abundance of voles and ground squirrels.

MARINE MAMMALS

Consiglieri et al. (1989) has a checklist of 25 marine mammal species that occur seasonally in the Gulf of Alaska. The species known to occur in the vicinity of Tugidak Island include humpback, gray, minke, and killer whales; Dall's porpoises; northern fur seals; northern sea lions; harbor seals; and sea otters (Consiglieri et al. 1989). Except for harbor seals and sea otters, little is known of marine mammal abundance in the area.

Harbor Seal

The harbor seal is the most numerous marine mammal, both onshore and offshore. In fact, more harbor seals used to haul out on Tugidak Island than anywhere else in the world (Vania 1965). Despite severe declines in recent decades, Tugidak still supports a major harbor seal haulout (Pitcher 1990). Sease (1992a) has summarized information on the behavior, biology, and population status of harbor seals in Alaska.

The Tugidak harbor seal population probably consisted of about 20,500 animals in the mid-1960s (Pitcher 1990), and may have been larger in the 1950s and early 1960s (Johnson 1976a). Tugidak's seal population declined 92% between 1976 and 1992 (Table 3).* The rate of decline appeared to be greater in the 1970s than in the 1980s. In 1992, only about 2,000 harbor seals used Tugidak Island as a haulout.

* The figures used in Table 3 are based on the maximum number counted during repetitive annual counts at the main concentration area on the southwestern beach of Tugidak Island. This number is an "index" which provides an estimate of population trends. Total numbers on Tugidak are greater than this, because seals haul out on other parts of the island. For example, an aerial survey of Tugidak Island on September 1, 1992, found 1,227 seals on the southwestern beach and an additional 631 seals on the north end of the lagoon, near the exposed wreck, and the sandy island south of the lagoon (Sease 1992). Also, there is tremendous variability in the number of hauled out seals between days and it is possible that the peak number was missed (Johnson 1976). Finally, counts or estimates typically include only the seals on the beach, because those in the water are impossible to count accurately (Johnson 1976).

The cause or causes of the decline are not clear. It does not appear to be due to hunting, food shortages, disease, or entanglement in marine debris or nets (Pitcher 1990, Sease 1992a). Steller sea lions and northern fur seals have also declined precipitously since the mid-1970s. Declines in the three species have some similarities, particularly in the geographic area involved (i.e., southeastern Bering Sea, eastern Aleutian Islands, and western and central Gulf of Alaska) and timing. However, the magnitude of the declines have differed somewhat and entanglement has been implicated as a possibly significant mortality factor in northern fur seals, but not harbor seals (Pitcher 1990, Sease 1992a).

A little is known about the geographical scope and timing of movements. Harbor seals also haul out on nearby islands. For example, on September 2, 1976, an aerial survey tallied 12,300 seals on Tugidak, 1,014 on Sitkinak, 364 on Aiaktalik, and 916 on the Geese Islands (Johnson 1976a). Pitcher and McAllister (1981) radio-tagged 35 seals on Tugidak Island in summer 1978. These seals were monitored throughout the summer. Twenty-three (74%) of all relocated seals were found only at the capture site on the southwestern end of Tugidak and 8 (26%) were found at least once on another haulout. Other haulouts included northern Tugidak Island, Sitkinak, Geese Islands, Chirikof, and the southwest shore of Kodiak Island. The farthest documented movement was to Ugak Island. Four of the 35 seals were not relocated, possibly due to moving beyond the range of the aerial surveys, transmitter failure, or mortality. It is likely that other movements were not recorded, as some of the seals were absent for extended periods. Pitcher and McAllister (1981) concluded that Tugidak's seals generally use few haulout sites, at least in summer.

The radio-tagged seals that used only the southwestern beach of Tugidak were hauled out on an average of 50 $\pm$ 7% of the days in June and 41 $\pm$ 5% of the days between August 1 and September 5. If the resident radio-tagged animals were representative of the population, the average number of seals hauled out during the daily radio checks probably represented between about 35 and 60% of the total population.

Harbor seals on Tugidak prefer to haul out adjacent to high bluffs and on relatively smooth beaches without large rocks. Thus, the best sites are on the west side of the island (Bishop 1967). Typically, about two-thirds of the seals haul out on a three-mile stretch of beach on the southwestern end of the island. Most of the remaining seals haul out on exposed spits and bars on the north end, mostly outside but a few inside the lagoon. A small group (predominantly females with pups) uses a short stretch of beach about halfway down the west side from mid-June through July (Johnson 1976a). In 1994, this beach had an equal number of seals as the beach on the southwestern end of the island (L. Jemison, pers. commun.) Few seals are seen on the south or east beaches (Bishop 1967); however, a few individuals and small

groups haul out on the south end in late May and early June (Johnson 1976a). Harbor seals are numerous offshore on all sides of Tugidak (Johnson 1976a).

Weather conditions and tides affect haul-out behavior. Harbor seals avoid Tugidak's beaches during very rainy and windy periods (Johnson 1976a, D. McAllister, pers. commun.). Large numbers of seals abandon the beach at the onset of heavy rain. Seals tend not to haul out when high tides leave little or no beach exposed, and there are usually more seals ashore at low tide than other periods (Johnson 1976a). Sease (1992a) believes that time of day is probably more important than tide in determining the number of seals on Tugidak beaches, with the number of seals tending to increase during the day to peak numbers late in the day, because tidal fluctuation is not great. High tides pushed seals off the beach, and tides greater than about 9 feet completely flooded the beach and drove all seals off.

Peak numbers of seals haul out on the island's beaches during pupping and molting. Pups are born from early May to late June; the peak period occurs in mid-June and varies somewhat from year to year (Bishop 1967, Johnson 1976a, Sease 1992a). In 1967 and 1968, after the peak of pupping had occurred, 53 and 50.8 pups were counted per 100 adult seals, respectively (Klinkhart 1969). The first several hours following birth are critical to formation of a mother-pup bond. Disturbance during this period that forces a female seal to abandon her pup often results in the pup's death. Pups are usually weaned three to six weeks after birth (Sease 1992a). Thus, the period when the largest numbers of pups are most sensitive to disturbance is June to mid-July.

The period of highest use by harbor seals on Tugidak island is during the annual molt. Harbor seals on Tugidak Island molt from June to mid-October, but the period of highest use occurs in August and September (Mathisen and Lopp 1963, Bishop 1967, Pitcher and Calkins 1979). Hauling out is important during the molt to warm the skin and promote growth of epidermal cells. Molting seals are in the poorest physical condition of the year (measured by blubber reserves) and under considerable stress (Pitcher and Calkins 1979). Molting seals tend to remain on the beach for long periods, regardless of the tide and time. Disturbance during the molt is physiologically stressful.

Human-related disturbances on Tugidak have included aircraft overflights, all-terrain vehicles, hikers, beach-combers, gold miners, domestic animals, hunters, and research activities. Seals on Tugidak appear to be particularly sensitive to aircraft. They have left the beach when a small, fixed-wing airplane passed over at 2,000 feet while in other areas they remained undisturbed when the aircraft was 1,000 feet or less in altitude (Pitcher and Calkins 1979). Helicopters create even more of a disturbance. On occasion, a large jet at high altitude has caused seals to enter the

water. All-terrain vehicles, hikers, and domestic animals were not serious problems in the 1970s, largely because they were infrequent (Pitcher and Calkins 1979). Some research activities, particularly capturing hauled-out seals, can be major disturbances. These are timed to avoid sensitive periods whenever possible and tend to occur infrequently, rather than being chronic sources of disturbance.

Hunting, although it is no longer believed to have a significant impact on the harbor seal population, certainly affected the population in the 1960s and early 1970s. Before 1960, seals were probably harvested infrequently on Tugidak Island. Two factors, one regulatory and one economic, spurred an intensive harvest of harbor seals for a relatively short period in the mid-1900s.

The Territorial Legislature established a bounty on "hair" seals[*] in 1927 (Lensink 1959). The bounty peaked in 1949-50 at $6 per animal, but was reduced to $3 the following year (Lensink 1959).[**] The bounty on Tugidak's harbor seals ended in 1967.

Before 1964, seals were not hunted heavily on Tugidak Island, despite the bounty, because fur prices were low. Only one hunter from Kodiak visited the island regularly (Bishop 1967:110). This bounty hunter shot over 230 harbor seals on Tugidak in five days on foot (Hensel 1964), presumably in 1963. By the mid-1960s, declines in Atlantic seal stocks led European furriers to look for other sources (Courtright 1968). A dramatic rise in value of seal hides in 1964 resulted in an equally dramatic increase in the number of seals shot for bounty and hides (Bishop 1967). The average value of seal hides in 1965 was about $10 (Burns 1966). After 1964 the pup crop was heavily harvested. An estimated 75% of the pups were harvested in 1964 and 1965 (Kelly 1981). Bishop (1967) believed the 1964 rate of harvest was excessive. Additional pups died from starvation or predation after having been abandoned. Walking the beach on July 1, 1964, Bishop (1967:112) saw no more than 100 pups among 2,500-3,000 seals, and most of these pups had been abandoned. In 1964, two of the bounty hunters collected 1,060 "scalps," mostly from deserted pups, during an 18-hour walk along the west beach (Bishop 1967:113). Perhaps a more typical harvest was reported by Nault (1980) who, with "continuous effort," was able to collect about 400 skins with a partner in six weeks during the mid or late 1960s. Prices for harbor seal skins peaked in 1965 (Courtright 1968). In 1967 the hunting season was opened late (July 1), only four

[*] Includes harbor, spotted, ringed, ribbon, and bearded seals.

[**] Lensink questioned the efficacy of paying bounties to remove hair seals to protect salmon when, except in turbid rivers such as the Copper River delta, salmon appeared to be a small proportion of their diet.

individuals participated, and seals were more wary than usual (Klinkhart 1968). With low fur prices and removal of the $3 bounty in April 1967 for seals south of Bristol Bay, interest in the Tugidak Island population declined (Klinkhart 1968).

From the early 1960s to 1972 an estimated 18,000 seals were harvested on Tugidak; about 90% of these were pups (Pitcher 1990). Over half of the total harvest occurred in 1964 and 1965. Since passage of the Marine Mammal Protection Act in 1972, killing harbor seals has been prohibited except for subsistence uses by Alaskan Natives or under terms of permits for research or commercial fishing activities.

Seal hunters on Tugidak Island often used two-wheeled motor scooters equipped with large tires to rapidly approach seal herds (Klinkhart 1967, 1969). At least one hunting party used a jeep, which was subsequently abandoned on the island (Nault 1980). In 1968, a party of seal hunters used a 21-foot outboard skiff when weather and sea conditions permitted and a Volkswagen bus equipped with large tires (Klinkhart 1969).

One of Tugidak's seal hunters, Andy Nault, described the experience in some detail (Nault 1980). He was probably on the island during the mid-to-late 1960s, and used a three-wheeled Honda all-terrain vehicle with a trailer to travel the beaches. He estimated only about a half dozen hunters were on the island at once. Pups were approached easily and killed with clubs until July, when they were about two months old. By then, the survivors were wary and able to outrun a hunter with a club. So the hunters would switch to rifles. Within days, the pups would abandon the beaches at the sound of rifle fire. Hunters with skiffs and good weather would follow the seals to offshore sandbars, but within a week it was difficult to surprise them on their haulouts. Hunters would then shoot at swimming seals, pulling the carcasses aboard with a long-handled hook. Some seals would sink before they could be retrieved.

A seal herd undisturbed by humans is reluctant to leave its hauling area (Bishop 1967). Hunters caused seals to desert pups, enter the water prematurely, and move to other parts of the island, including offshore sand bars, that were less preferred haul outs (Bishop 1967:109; Klinkhart 1967, 1968, 1969). For example, from 1964-1969 hauled-out seals were dispersed all along the western shore, and seals were also reported to haul out on the exposed sand bars in Tugidak Passage at low tide (Johnson 1976a).

Sea Otter

No surveys have been conducted since 1976, but sea otter numbers are probably low to moderate near Tugidak Island. There are no extensive kelp beds in the area, although this does not preclude sea otters. Sea urchins, a common food, are generally not common on sand and mud bottoms; therefore, molluscs (Lensink 1960a) and other invertebrates and fishes probably form the bulk of their food in this area.

Sea otters were exterminated throughout most of their original range during 170 years of commercial exploitation, but small groups survived in widely scattered locations (Lensink 1960a). Sea otters were hunted up to 15 or more miles from shore in the Trinity Islands (J. Norton, pers. commun. in Lensink 1962). In 1911, after hunting was no longer profitable, sea otters were protected under the Fur Seal Treaty. It is possible that sea otters now found in the Trinity Islands are descendants of a known remnant population found in 1922 near Shuyak Island (Lensink 1960a, Schneider 1979). More likely, a few sea otters survived commercial exploitation in the Trinity Islands due to the expansive offshore habitat (Lensink 1960a) and dangerous seas that made systematic extermination difficult. A single otter was seen in the Trinity Islands by N. Christianson in about 1928 (pers. commun. in Lensink 1962). Sea otters were "practically extinct" in the Kodiak Archipelago in the 1930s, although "it is said that an occasional pelt is illegally taken" (Capps 1937).

Alaska's sea otter population has grown tremendously since 1911. There were unconfirmed reports in the Trinity Islands in the early 1950s (Beals 1950 and others cited in Lensink 1962). Aerial surveys in 1951 found none in the Trinity Islands (Lensink 1960a), although small numbers are easily missed and were probably present. Lensink (1962) observed no sea otters in the Trinity Islands in 1957 during both a boat and aerial survey; however, a fisheries biologist spotted 15 sea otters in the vicinity in September. No sea otters were observed in the Trinity Islands during single aerial surveys in 1959 (Lensink 1962) or 1965 (Vania 1965); however, all of these early surveys apparently ignored the extensive, shallow continental shelf between Tugidak and Chirikof islands (Lensink 1962). Lensink (1960a) estimated 100-300 individuals were in the vicinity in 1960, based on increases in the Kodiak Archipelago, difficulties in sighting the otters from the air, the likelihood that shoreline surveys missed otters offshore, and the hypothesis that it is unlikely that any distinct population of less than 100 individuals could survive 50 years without molestation (Lensink 1962). Schneider (1979) estimated 400-700 animals inhabited the waters south of the Trinity Islands in 1976. This population probably exceeds the total number of sea otters that remained in Alaska in 1911, although the estimated density in the Trinity Islands (0.14-0.24 sea otters/mi^2) was low compared

to that of southwestern Bristol Bay (over 1.2 sea otters/mi^2) and even denser concentrations (8 sea otters/mi^2) elsewhere in Alaska.

Schneider (1979) predicted that the Trinity Island population would continue to increase. Most of the sea otters were observed in waters less than 90 feet deep, although individuals may occasionally range offshore to the 240-foot contour. Small numbers of sea otters north of Tugidak Island in the mid-1970s indicated that the population would extend its range in that direction in the near future. Ultimately, sea otters are expected to colonize most of the shallow continental shelf less than 240 feet deep, which is extensive in this area (3,860 square miles), if they have not already done so.

Other Species

Northern sea lions and an unidentified porpoise have been seen from the island (Bishop 1967). McAllister (pers. commun.) has seen harbor porpoises near the island. The nearest northern sea lion haul-outs are on Cape Sitkinak and Sundstrom Island. Other marine mammals that have been found dead on Tugidak's beaches include northern fur seal, orca or killer whale, gray whale, and an unidentified toothed whale (Lensink 1960b). Gray whales and northern fur seals pass by the Trinity Islands during their annual migrations; however, only gray whales have been observed regularly on the beach.

Kelly and Sease (1990a) examined 14 gray whale carcasses on Tugidak Island in July 1990. Residents of the Trinity Islands believed that this was considerably more carcasses than normal (Hall 1990). Kelly had surveyed the shoreline on two previous occasions--in July 1977 and June 1978--and found only one gray whale carcass freshly killed by orcas. In 1990 there were no signs of external injury, and local speculation that they died as a result of the EXXON Valdez oil spill were believed to be unfounded. Sease and Rea (1990a) returned to Tugidak Island in late August-early September and found three additional gray whale carcasses. In previous years, relatively large numbers of gray whale carcasses have been observed on other Alaskan beaches, and Kelly and Sease (1990; also in Hall 1990) suggested that the number of carcasses was directly related to natural mortality of an increasing gray whale population.

TERRESTRIAL MAMMALS

Only six species of land mammal are believed to be indigenous to the Kodiak Archipelago: red fox (Vulpes vulpes), brown bear, ermine, river otter, tundra vole, and little brown bat (Clark 1958, Rausch 1969). Of these, the fox, bear, otter, and bat could have colonized the Kodiak Archipelago as the Wisconsian glaciation uncovered the islands and Shelikof Strait (Rausch 1969). The ermine may be a better swimmer than its size and high metabolic rate indicate; Clark (1958) observed them on all the large islands of the archipelago and had seen individuals swim up to 100 yards in freshwater. The vole may have been introduced to the archipelago inadvertently by aboriginal people traveling to and from the mainland (Rausch 1953, 1969). No shrews have been found anywhere in the Kodiak Archipelago (Clark 1958).

At least 13 additional mammalian species are known or suspected to have been introduced to the Kodiak Archipelago by humans. Among these was the ground squirrel, which may have been introduced from North Semidi Island, near the coast of the Alaska Peninsula (Osgood 1903). Ground squirrels were a valuable commodity to the Russian American Company. The company reserved the right to catch ground squirrels and forbade the Koniags to do so (Davydov 1977:214). On Tugidak, they are abundant on upland areas, ridges, and other dry areas (Lensink 1960b, Clausen and Dolezal 1988).

Tugidak apparently supports only one other species of rodent, the tundra vole. Vole populations often have a three-year cycle of high and low numbers. Tundra voles were abundant on Tugidak in 1960, particularly in moist areas (Lensink 1960b).

River otters are the only mammalian predator on the island. The size of the otter population is not known. Lensink (1960b) saw few otters, but droppings and other sign suggested the population may have been large; McAllister (pers. commun.) saw otters often in 1978 and 1979. River otters are often observed in marine waters in other parts of the state. Therefore, Tugidak Passage and other straits between Tugidak and nearby islands are not a barrier to movement of river otters.

Red and arctic foxes (Alopex lagopus) do not occur on Tugidak Island and there is no record that they were ever introduced (Bailey 1993). If they were introduced for fur harvesting, they did not survive. Red foxes are indigenous on nearby Sitkinak Island (Bailey 1993). The Russian-American Company transplanted breeding foxes to many unnamed small islands in the Kodiak Archipelago where food was available (Tikhmenev 1978), though without large colonies of nesting seabirds, Tugidak may have been less than desirable. Arctic foxes were introduced on Sitkinak Island and both species to the nearby Geese Islands and Chirikof Island (Bailey 1993). If foxes were not brought to Tugidak Island, it is one of very few islands in southcentral Alaska with wildlife populations unaffected by fox

depredation. There is no record that the other mammalian predators indigenous to the Kodiak Archipelago--brown bear and ermine--have ever occurred on Tugidak.

There has been at least one unconfirmed sighting of deer tracks on Tugidak Island (D. McAllister, pers. commun.). Sitka black-tailed deer (Odocoileus hemionus) from Southeast Alaska were transplanted in the Kodiak Archipelago on several occasions between 1924 and 1934. By the late 1960s they were distributed throughout Kodiak and many adjacent islands (Smith 1991). In the last decade, deer have been observed on Sitkinak Island (D. McAllister, pers. commun.), and the first tracks were seen on Tugidak Island in the mid-1980s, about the time the deer population peaked throughout the archipelago. A deer population may become established on Tugidak, if it has not already done so.

LAND STATUS

Tugidak Island was managed by the Bureau of Land Management until it was selected by the state in 1975. In 1978 a rancher on Sitkinak Island proposed expanding his cattle grazing operation to Tugidak Island, where he held a preference right for a grazing lease. The Department of Fish and Game opposed the release of cattle on Tugidak Island, because of concern for the large harbor seal haulouts and other fish and wildlife resources of Tugidak Island, particularly the abundant ground-nesting birds.

The department first proposed establishing the island as a critical habitat area in 1974. Bills that were introduced in the 1970s and in 1980 to designate Tugidak Island a state critical habitat area were not successful. The Legislature finally created the critical habitat area in 1988. In 1990, The Nature Conservancy's Alaska Natural Heritage Program listed Tugidak Island as a bioreserve megasite candidate. The Kodiak Island Borough has classified Tugidak Island as a Conservation District.

HUMAN USES

ACCESS

Most access today is by airplane, helicopter, and boat. Floatplanes can land in the lagoon at high tide and on several large lakes. Wheeled planes as large as a Beaver and Twin Beechcraft have landed at low tide on the beach in the southwest portion of the lagoon and other beaches (Sease 1992b; D. McAllister, pers. commun.). Boaters skiff into the beach from larger vessels anchored in nearshore waters. Seal hunters, miners, and scientists have used off-road vehicles on Tugidak. Most off-road vehicle use has been confined to the beach. Some damage to wetlands from the off-road use of motorized vehicles is visible at the southwest end of the island and south of the lake complex near the lagoon's mouth. At

least some stretches of shoreline can only be used on a "good minus tide" because of precipitous cliffs.

In 1988, the ADF&G published a boat and aircraft advisory to avoid disturbance of pupping and molting seals on the northern and western beaches of Tugidak Island. The advisory recommended avoiding all of these beaches from May 1 to October 1. Aircraft pilots were requested to stay above a minimum altitude of 1,500 feet above ground level. Pilots flying over the lagoon were asked to maintain a minimum altitude of 1,500 feet above ground level from October 1 to April 30 to avoid disturbing wintering waterfowl. During these periods, boats and aircraft were encouraged to stay about one mile offshore of the northern end of the island and the mouth of the lagoon and to intersect the island's beaches only on the southeastern side.

WILDLIFE RESEARCH

The critical habitat area was established to protect the world's largest haulout of harbor seals, as well as other fish and wildlife. Because Tugidak Island is one of the few sites in Alaska with fairly long-term trend data for harbor seals, it has great importance for monitoring population trends.

Apparently, Tugidak was first visited by state and federal wildlife biologists Cal Lensink and Dick Hensel in 1960. A graduate student from the University of Alaska, Richard Bishop, spent over three months on the island in 1964. A cabin was built in 1965 and Department of Fish and Game personnel spent time on the island each year until 1973 (Johnson 1976a). In addition to monitoring seal hunters, researchers counted seals and tagged over 4,300 pups from 1965-69 (Table 4, Johnson 1976a). Borrowing a technique from seal hunters, biologists used two-wheeled motor scooters equipped with large tires to rapidly approach seal herds and capture the pups before they could reach the water. Many tagged pups were taken by seal hunters later in the summer. The monitoring program was reinstated in 1976, and researchers counted seals every year from 1976-1979 and every other year from 1982-1994. Kelly (1981) studied variation among light and dark-phase harbor seals using Tugidak Island in 1977-1978. Thirty-five seals were captured on the large haulout area on southwest Tugidak Island and radio transmitters were attached in 1978 (Pitcher and Calkins 1979). The department began monitoring pup and juvenile survival on Tugidak beginning in 1994.

Other marine mammal biologists and ornithologists have made brief visits to the island, but none have conducted research or systematically counted animals on Tugidak.

RECREATION

Tugidak Island is visited by a few people each year. Waterfowl hunters, bird-watchers, wildlife photographers, beachcombers, miners, and wildlife researchers are occasionally on the island (Troll 1979, Pitcher 1990). Remote setting and a variety of abundant, easily approached wildlife contribute to high wilderness value (Troll 1979).

SUBSISTENCE USE

No records are available, but less than 1,000 harbor seals in total are estimated to have been harvested on Tugidak Island between 1972 and 1990 (Pitcher 1990).

Even this estimate may be high. The nearest settlement is Akhiok, on Kodiak Island. Akhiok had an estimated population of 80 people in 1993, almost 90% Alaska Natives (Mishler 1993). Subsistence use of marine mammals appears to have declined since the early 1980s in Akhiok. Marine mammals comprised about 30% of the total pounds of fish, game, and plant resources harvested by Akhiok residents in 1982-83. Residents harvested 6 harbor seals in 1986 and 17 harbor seals in 1992-93, less than 1% and 4% of the annual harvest of fish, game, and plant resources (Fall and Walker 1993, Mishler 1993).

No one from Akhiok has hunted harbor seals on Tugidak Island in at least a decade (C. Mishler, pers. commun., 1994), although many of the seals they have hunted are likely to have used Tugidak as a haulout for pupping or molting.

MINING

Placer gold has been the only mineral mined on Tugidak Island to date, although at least one miner has claimed there are other, presumably commercially valuable, minerals in far greater abundance (Waage 1987). Mining claims were staked over about two-thirds of Tugidak Island during the winter of 1986-87. There are currently over 30 active mining claims and 5 mineral leasehold locations on Tugidak Island. Current mining activity is limited to recreational mining of the beach below the high tide line.

In November 1990 the Alaska Department of Natural Resources administratively closed most of the critical habitat area to new mineral location and staking (see Land Status Map). Existing claims on the south and east sides of the island were not affected by the mineral closing order. Nor did the order diminish normal and reasonable means of getting to and from existing claims, except that trail construction and movement of heavy equipment was not allowed. The order was issued to provide interim protection to fish and wildlife resources pending completion of this management plan.

The National Marine Fisheries Service indicated that any mining on Tugidak Island's beaches that has the potential to disturb harbor seals will necessitate an environmental impact statement before it can be approved (Brooks 1988).

GRAZING

Portions of the Kodiak Archipelago have attracted the attention of ranchers and herders since the islands were discovered by the Russians. According to Buck et al. (1975), the potential productivity for cattle grazing for both Tugidak and Sitkinak islands has been touted by many. Tugidak is one of the few offshore islands in the archipelago where cattle have not been introduced (Smith 1987). Buck et al. (1975) erroneously reported that Tugidak had supported "significant numbers" of cattle.

Tugidak's tundra has been described as unsuitable for cattle grazing (Troll 1979). Bluejoint (*Calamagrostis* spp.) and beach rye grass (*Elymus mollis*) are the primary forage in the Kodiak Archipelago. If overgrazed, these species may be replaced by less palatable forbs and annual grasses (Buck et al. 1975). In winter, the energy value of bluejoint and beach rye grass is almost zero (Vrooman and Associates 1956). The carrying capacity of nearby Chirikof Island has been demonstrated to be 20 head per square mile (Buck et al. 1975).

In addition to its limited productivity, most of Tugidak supports a growth of water hemlock (*Cicuta* spp.) that is "too thick for clearing" (Buck et al. 1975). Water hemlock is a poisonous plant that grows in moist areas. It should not be heavily grazed in spring (Buck et al. 1975).

Despite these concerns, grazing lease preferences have been filed in the past with the Alaska Department of Natural Resources, Division of Land, before the island was established as a critical habitat area. However, grazing never occurred on Tugidak Island.

CABINS

In 1988, when the critical habitat area was established, five cabins were on Tugidak Island. The first cabin, built on Tugidak Island in 1965 by the Alaska Department of Fish and Game for use in seal surveys and research, is in extreme disrepair. A second cabin was built by the department in 1978. Two cabins are occupied seasonally or year-round by private owners engaged in recreational mining activities on the island. In 1978, Mrs. Murphy estimated her family had spent summers on Tugidak Island for 15-20 years (McAllister 1978), and they still occupy a cabin on the southern end of the island. The Garber family has lived in a cabin on the east side of the island since 1986-87 (Voley 1989a). A fifth, uninhabitable cabin located on the southwest corner of the lagoon was left over from seal hunting days. Since 1988, one trespass cabin has been built on Tugidak Island next to the seal hunter's cabin.

EXXON VALDEZ OIL SPILL

Crude oil from the March 24, 1989, *Exxon Valdez* oil spill in Prince William Sound began washing ashore on Tugidak Island in early May 1989. Early surveys indicated only a small amount washed ashore on Tugidak Island. Because its removal might have resulted in a more significant disturbance to harbor seals than leaving it, the National Marine Fisheries Service requested that the beaches not be cleaned. Residents of the island disagreed, picking up "thousands of dead birds." A later survey, in mid-August, found a portion of northern beach that had been purposefully avoided by previous surveys due to seasonal use by harbor seals had been "moderately" impacted. A small portion, approximately 50 square yards, of the moderately oiled beach was cleaned in August.

RESEARCH NEEDS

1. Additional information on population trends of harbor seals needs to be gathered on Tugidak Island.

2. Aerial surveys of waterfowl that winter in the lagoon and nearby waters are needed.

3. Additional research on Dungeness crab use of the lagoon is needed to determine the lagoon's importance to crab.

4. A comprehensive inventory of raptor nests on the island is needed.

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Table 1. Birds observed on Tugidak Island, Alaska, and in adjacent marine waters.[1]

Red-throated loon *	Wandering tattler
Common loon *	Whimbrel
Shearwater sp.	Ruddy turnstone
Pelagic cormorant	Black turnstone
Tundra swan *	Sanderling
Snow goose	Western sandpiper
Emperor goose	Least sandpiper *
Brant	Rock sandpiper *
Canada goose	Dunlin
Green-winged teal *	Short-billed dowitcher *
Mallard *	Common snipe [+]
Northern pintail *	Red-necked phalarope *
Northern shoveler	Parasitic jaeger *
Gadwall *	Long-tailed jaeger *
American wigeon *	Mew gull *
Greater scaup *	Glaucous-winged gull *
Lesser scaup	Black-legged kittiwake
King eider	Arctic tern *
Steller's eider	Aleutian tern *
Harlequin duck	Common murre
Oldsquaw	Pigeon guillemot
Black scoter	Tufted puffin
Surf scoter	Horned puffin
White-winged scoter	Short-eared owl *
Barrow's goldeneye	Violet-green swallow
Common merganser	Bank swallow *
Red-breasted merganser *	Common raven [+]
Bald eagle *	Northwestern crow
Northern harrier	American pipit [+]
Rough-legged hawk *	Yellow warbler *
Golden eagle	Wilson's warbler [+]
Merlin	Savannah sparrow *
Peregrine falcon [+]	Fox sparrow *
Gyrfalcon *	Song sparrow *
Willow ptarmigan *	Golden-crowned sparrow [+]
Pacific golden-plover	Dark-eyed junco
Semipalmated plover *	Lapland longspur *
Greater yellowlegs	Rusty Blackbird
Lesser yellowlegs	Rosy finch [+]

[1] Compiled by R. A. MacIntosh from mostly unpublished reference materials (MacIntosh 1994a, b).
[2] * means the species nests on the island (i.e., nest building, nest, or young documented).
[3] + means the species probably nests on the island.

Table 2. Mammals observed on Tugidak Island, Alaska, and in adjacent marine waters.

Common Name	Scientific Name
OBSERVED ON TUGIDAK ISLAND	
Arctic ground squirrel	Spermophilus parryii
Harbor seal	Phoca vitulina
River otter	Lutra canadensis
Sitka black-tailed deer (tracks)	Odocoileus hemionus
Tundra vole	Microtus oeconomus
OBSERVED ONLY IN ADJACENT MARINE WATERS	
Dall's porpoise	Phocoenoides dalli
Gray whale	Eschrichtius robustus
Harbor porpoise	Phocoena phocoena
Humpback whale	Megaptera novaeangliae
Minke whale	Balaenoptera acutorostrata
Northern fur seal	Callorhinus ursinus
Orca (or killer whale)	Orcinus orca
Sea otter	Enhydra lutra
Steller's sea lion	Eumetopias jubatus

Table 3. Summary of repetitive counts[1] of harbor seals on the southwestern beach of Tugidak Island, Alaska: 1976-1992 (Pitcher 1990, 1991; Sease 1992a).

Year	Mean	Minimum	Maximum	Coeff. Variance for Observ.	Coeff. Variance for Mean	No. of Observ.
1976	6,919	2,800	9,300	0.283	0.082	12
1977	6,617	6,596	6,640	0.005	0.004	2
1978	4,839	2,532	6,817	0.270	0.078	12
1979	3,836	2,572	4,886	0.200	0.044	21
1982	1,575	660	2,323	0.390	0.123	10
1984	1,390	789	2,187	0.380	0.127	9
1986	1,270	639	1,673	0.230	0.073	10
1988	1,014	605	1,437	0.240	0.076	9
1990	960	433	1,283	0.245	0.082	9
1992	571	70	1,075	0.647	0.264	6

[1] Repetitive counts are conducted from the same location, under similar conditions, using similar methods each year. These figures do not represent total numbers of harbor seals on Tugidak Island; however, they do afford an accurate estimate of population trends.

Table 4. Documented commercial harvests of harbor seals, numbers of hunters, and numbers of harbor seals tagged on Tugidak Island, Alaska (Bishop 1967; Klinkhart 1966, 1967, 1968, 1969; Sease 1992a).

	Estimated no. seals harvested				
Year	Adults	Pups	Total	No. hunters	No. pups tagged
1963	--[1]	--	230[2]	--	0
1964	1,500	4,000	5,500	--	0
1965	200	4,100	4,300	18	18
1966	75	2,200	2,275	13	300
1967	50	700	750	4	1,106
1968	0	800	800	5	1,461
1969	--	--	900	--	--
1970	--	--	1,160	--	--
1971	--	--	1,100	--	--
1972	--	--	1,100	--	--

[1] Unknown.

[2] Number harvested by one bounty hunter, but there may have been other hunters.