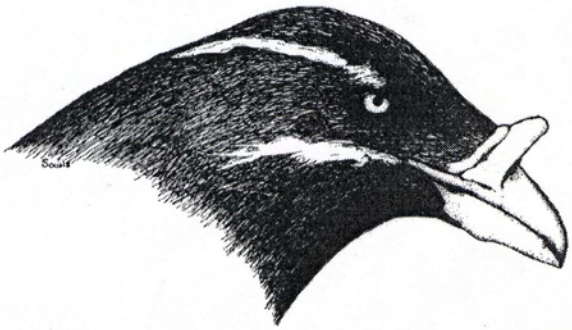
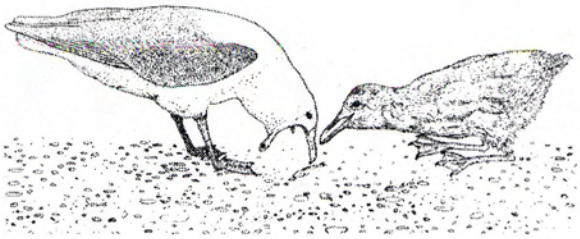
U.S. Geological Survey

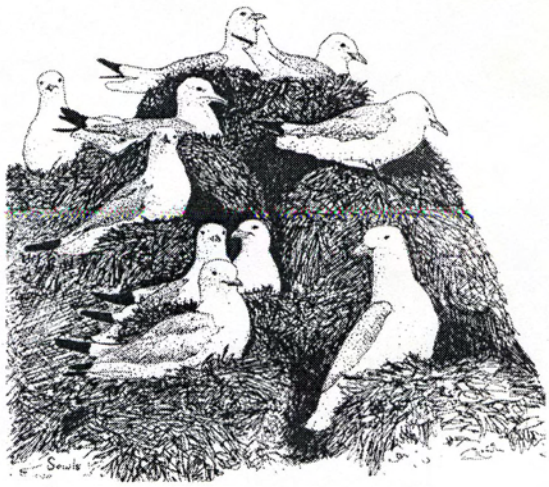
Alaska Biological Science Center

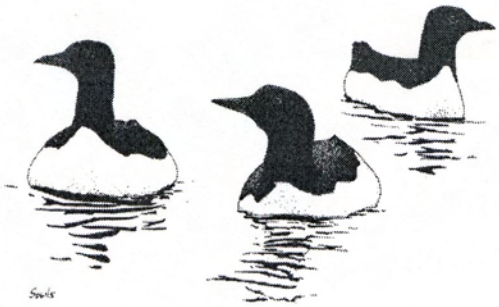
Middleton Island Marine Biological Station

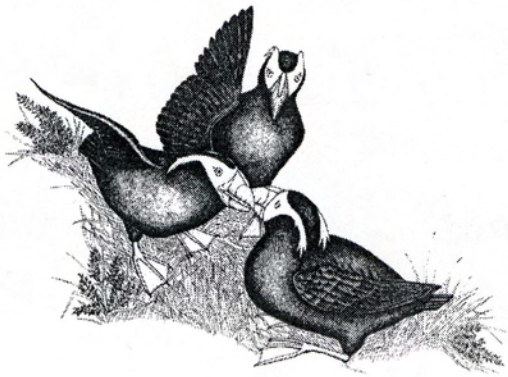
Prospectus for 1999 and Beyond











MIDDLETON ISLAND MARINE BIOLOGICAL STATION: PROSPECTUS FOR 1999 AND BEYOND

Introduction

Middleton Island, lying about 80 km south of the entrance to Prince William Sound (Fig. 1), has been an active site for seabird research and monitoring by the U.S. Fish and Wildlife Service, National Biological Service, and U.S. Geological Survey since the mid 1970's. Research infrastructure was recently developed on this island that affords unprecedented opportunities for observation and experimental studies of seabird breeding and population ecology. Further development or enhancement of artificial nesting habitats for a variety of species is planned. These developments, coupled with easy access to Middleton Island by air and the strategic importance of its wildlife populations to research and monitoring programs in the northeastern Pacific, encourage a long-term, cooperative investment in this site as a marine biological station for the north-central Gulf of Alaska. Public values and potential benefits on Middleton encompass not only wildlife research *per se*, but also hands-on management of populations and habitats, and public use and enjoyment through privately sponsored ecotourism, interpretation, and education. This document is intended to inform and facilitate discussion among potential partners in this endeavor and offers a blueprint for future action.

Vision

Middleton Island will be an internationally recognized venue for innovative research on marine birds and other wildlife. The biological station will be capable of housing 10-15 scientific personnel simultaneously in comfortable surroundings conducive to productive research. A major trademark will be the existence of unique infrastructure for the observation, individual sampling, and experimental manipulation of five seabird species in specially created and controlled nesting habitats. Key natural habitats on the island will be owned and managed by a conservation-oriented organization such as the Nature Conservancy or National Audubon Society. The National Audubon Society or other suitable organization will offer guided excursions to the site so that interested citizens may have a high-quality wildlife viewing experience while gaining valuable educational exposure to ongoing research and management activities.

In short, the Middleton Island Marine Biological Station will be a one-of-a-kind field laboratory jointly managed by a consortium of public and private organizations. Its programs will integrate habitat protection and management, cutting-edge ecological research, and top-quality interpretive programs for public education and enjoyment. The suggested time frame for full implementation of this vision is 10 years.

Special Features of Middleton Island

Birds

Middleton Island supports nesting by seven species of pelagic birds (black-legged kittiwake, thick-billed murre, common murre, pelagic cormorant, tufted puffin, rhinoceros auklet, and glaucous-winged gull), and also has a wide diversity and abundance of nesting, migrating, or wintering waterfowl, shorebirds, raptors, and passerines. Because of its isolated location in a chronically windy environment, Middleton is host to a wide variety of vagrant birds during spring and fall migrations—more than 220 species have been recorded on the island, of which 20-25 are breeders.

For reasons only partially understood, populations of seabirds on Middleton are more dynamic than possibly anywhere else in Alaska. Currently, kittiwakes and murres are in decline, whereas gulls, rhinoceros auklets, and oystercatchers have increased dramatically (Fig. 2). Though precise data are unavailable, it is believed that tufted puffins also are increasing. Cormorant numbers have fluctuated widely, the quantity of nests built each year reflecting environmental suitability for

breeding. Not depicted in Figure 2 are equally dramatic changes that occurred before the 1970's. Between 1956 and 1974, populations of kittiwakes and common murres both increased at least ten-fold. Pelagic cormorants almost certainly increased over the same period, though the magnitude of change is less clear for that species. Probably few or no rhinoceros auklets bred on Middleton Island in the 1950's or 1960's, as old photographs reveal an apparent lack of suitable nesting habitat at that time. Similarly, glaucous-winged gulls were absent as a breeding species in 1956. The steep decline since 1980 in overall kittiwake numbers depicted in Figure 2(a) masks an opposite trend that is now occurring in certain artificial habitats on the island (see below).

Canada geese first nested on Middleton Island in 1981 (one family group observed), and this species has now increased to more than 2,000 residents in summer. There is some uncertainty regarding the racial affinity of these birds. The Alaska Department of Fish and Game has for some years considered this group an outpost of dusky geese (*Branta canadensis occidentalis*), which would mean the Middleton population comprises about one-quarter of the total numbers of this declining race of Canada geese. Genetic evidence suggests the birds may be more closely allied to other island-nesting geese in Prince William Sound or birds in upper Cook Inlet. In any case, Middleton Island currently is one of only a handful of oceanic islands inhabited by nesting Canada geese.

Mammals

Apart from introduced rabbits and humans, the only mammals to inhabit Middleton Island on a regular basis are pinnipeds, including several hundred breeding harbor seals and a few nonbreeding Steller sea lions. Formerly numbering some 1,800 animals, the latter species all but vanished from Middleton in the late 1980's, as it has at numerous other sites in the Gulf of Alaska. Prior to 1987, hundreds of sea lions hauled out regularly on a gravel islet off the northern tip of the island, and in 1987 the animals bred and raised young on the north spit itself. The latter development was apparently in response to reduced human disturbance following relocation of Federal Aviation Administration (FAA) facilities. The subsequent decline was abrupt. It is reasonable to assume that known use areas on Middleton will again be important to sea lions if and when this threatened species is able to rebuild its numbers.

Physical Environment and Geology

Middleton Island lies near the edge of the continental shelf, where the North American plate is being underthrust and deformed by the Pacific plate along the Aleutian trench. It measures about 8 km long by 1.6 km wide, and has a maximum elevation of 47.6 m. The island is only about 4,300 years old, its parent material consisting of marine glacial sediments that have risen out of the ocean during several episodes of rapid deformation and uplift. Six marine terraces associated with those intervals give subtle definition to the island's upland area, which initially strikes the casual visitor as essentially flat (Fig. 3). The youngest terrace emerged abruptly during the Alaska earthquake of 1964, when an elevational change variously estimated at 2.7 to 3.5 m created large areas of previously submerged land below pre-existing sea cliffs (Fig. 4). Middleton's topography and stratigraphy provide an invaluable record of tectonic forces and seismicity in the region, and consequently the island has been extensively studied by earth scientists of the U.S. Geological Survey since the late 1940's. Without question, the 1964 earthquake triggered successional changes in physiography, vegetation, animal habitats, and populations that are still proceeding more than 30 years after the event.

Research Infrastructure

Important groundwork for avian research on Middleton has been laid by capitalizing on the fact that kittiwakes and cormorants nest on an artificial structure—an abandoned radar tower (Fig. 5)—which, with various enhancements, is now a thriving colony of cliff-nesting birds uniquely accessible for observation and experimentation. As the exterior corrugated siding of this building (which dates to U.S. Air Force operations in the early 1960's) was removed by high winds over the years, a limited number of horizontal ledges (2 x 4 cross members in the wall frame) became available to kittiwakes as nest sites. The first instance (one pair) of kittiwakes nesting on the tower was noted in 1986, and

numbers have steadily increased to the present level of more than 1,200 pairs. About 90 pairs of pelagic cormorants also nested on the tower in 1998. Also in 1998, a small number of common murres were attracted to the tower using plastic decoys and recorded murre vocalizations. One pair of murres produced an egg, indicating the feasibility of establishing a larger group of breeding murres in the future.

Since 1994, this colony has been augmented by adding more than 200 wooden ledges to the walls of the tower and replacing deteriorating inner wallboard with new plywood paneling (Fig. 6). A sliding pane of one-way mirror glass is installed behind each of the artificial ledges, all of which are occupied by nesting pairs of kittiwakes or cormorants (Fig. 7). Individual feeding tubes (2-inch diameter PVC pipe cut lengthwise to form small trays that slide back and forth through the wall) permit supplemental food provisioning (typically thawed bait fish) on whatever basis an investigator decides. The one-way glass is virtually 100% effective, so feeding and observations of the birds can be conducted unobtrusively at a distance no greater than the thickness of the wall (Fig. 8). As needed, individuals can be captured on their ledges and pulled into the building for banding, weights and measures, food sampling, or other handling (Fig. 9). In 1996, a permanent AC power source was supplied to the tower in conjunction with an FAA construction project. Thus, electric lighting and heat, freezer space, and ample electrical power for other applications are available at the site.

On the southwest shore of Middleton is an old shipwreck (circa 1944) which, with its large complement of nesting kittiwakes, cormorants, and puffins, is both a compelling aesthetic feature and another facilitator of past and ongoing research on these species (Fig. 10). Currently, a limited number of tufted puffins occupy nest boxes provided for their use inside the ship. Other puffins nest in stateroom closets, under bunks, or in other readily accessible sites on the ship.

Other Improvements and Logistics

The tower colony on Middleton Island is part of a former U.S. Air Force facility (Defense Early Warning Radar) decommissioned in the early 1960's and subsequently transfered to private ownership. Though unmaintained and dilapidated, the various buildings associated with this installation have for several years minimally served the needs of wildlife researchers for living and storage space on the island.

Elsewhere on the island, the FAA maintains a modern facility comprising several thousand square feet of heated space for electronic equipment, vehicles and other machinery, and residential purposes (i.e., bedroom, kitchen, bath, and laundry facilities), plus phone and data communication lines via satellite uplink to the mainland. In the spring of 1998, the FAA changed from a full-time residential operation to an intermittent maintenance schedule (up to several days per month on-island by FAA personnel operating out of Kenai, Alaska). This residential facility now stands idle much of the time.

The FAA continues to maintain vital air navigation and traffic control equipment on Middleton Island. Continuous radar data are monitored remotely in Anchorage. The agency also maintains a mile-long gravel airstrip on the island that is capable of handling even large cargo and passenger aircraft (e.g., C-130's or small jets). For equipment or materials that cannot be transported by air, a barge landing site at the north end of the island provides full access by sea.

An Automated Weather Observation System (AWOS) now operates continuously on Middleton, and in 1997 the National Weather Service completed and brought on line a state-of-the-art NexRad weather radar system. This system has the potential to contribute radar observations of bird migration and offshore movements within a 200-mile radius of Middleton Island. The generating plant associated with this new facility now supplies power to all operations on the island.

Middleton Island has a limited road system that provides near access to most portions of the island. Researchers are able to get to the habitats in which they work with a mimimum of effort or time

expended. The road system can also provide efficient access to choice wildlife viewing areas by the public.

Land Ownership and Management

Middleton Island comprises about 2,200 acres, excluding recent supra-tidal lands resulting from the 1964 earthquake. The latter totals an additional 1,000 acres by rough estimate, but has never been adequately surveyed or mapped, and continues to evolve through longshore deposition and sedimentation. With the passage of the Alaska National Interest Lands Conservation Act in 1980, much of the upland area of Middleton Island was incorporated in the newly established Alaska Maritime National Wildlife Refuge. In 1984, this property (about 1,500 acres) was conveyed to Chugach Alaska Corporation (CAC) under provisions for Native land selections in the Alaska Native Claims Settlement Act of 1972. As a condition of this transfer, the Federal government retained easements for wildlife habitat protection and management on much of the acreage now owned by CAC (Fig. 11). Easements also stipulate unhampered access by Federal biologists for purposes of research and monitoring. Similarly, while CAC has title to acreage supporting the Middleton Island airport, barge landing site, and portions of the road system, the FAA retains easements to ensure continued maintenance and access to these factilities by government operations in the future.

The FAA retains title to three parcels on Middleton totaling approximately 533 acres (Fig. 11). Those tracts encompass the VOR (348 acres), air navigation radar (177 acres), and NexRad weather radar (8 acres), respectively. Lands created "...by means of avulsion after January 3, 1959" (i.e., by the earthquake) were likewise excluded from the conveyance to CAC, and their status is unclear. Presumably this property remains in the public domain. It is prime nesting habitat for geese, gulls, and a variety of other land and water birds.

A key parcel on Middleton in terms of future operations of a Marine Biological Station is the old Air Force site, encompassing 182 acres in the central portion of the island (Fig. 11). In 1966, this property including all its above-ground improvements, was conveyed (for the nominal sum of ten dollars) to a private consortium of 11 businessmen in Anchorage ("MIDICO"). Although reputedly acquired as a potential profit-making investment in case of oil industry or other offshore developments in this region of the Gulf of Alaska, such activity has not occurred and the property has lain idle and unmaintained in the 35 years since the Air Force decommisioned the site. MIDICO has tacitly supported the use of this property for purposes of wildlife research and monitoring in recent years. The property includes the tower colony that is vital to this work as well as other natural and artificial habitats envisioned for future enhancement and research on kittiwakes, cormorants, murres, and puffins.

Plans and Goals for Further Development of Research Facilities

Plans for further development of infrastructure to support seabird investigations on Middleton are best summarized by species:

(1) Black-legged kittiwake – Finish work on the tower colony. More than 200 pairs already nest in window sites, which is adequate for most purposes. However, the upper story of the building still needs to be enclosed as a barrier against the weather, and rusted flooring between the current work space and upper story will need to be removed and replaced with a wooden walkway.

(2) Pelagic cormorant – Establish a large colony in window sites on the upper story of the tower. Goal is at least 100 pairs nesting in accessible sites, with the potential to conduct supplemental feeding and other manipulative research.

(3) Tufted puffin – Add more nest boxes to the ship to bring the total of puffins nesting in boxes to at least 100 pairs.

(4) Rhinoceros auklet – Install nest boxes in the Air Force colony (seaward facing bluffs adjacent to the tower). This is a proven technique, as auklets have been shown to occupy readily nest boxes placed in expanding colonies in Washington state. Goal is 100-200 pairs of auklets in boxes.

(5) Common murre – Birds are vacating natural habitats on Middleton because of vegetation changes that hamper access to the sea by flightless young. Attract nesting birds to a building near the bluff on the Air Force site (using techniques employed successfully in 1998 at the tower colony). Then construct on the concrete foundation of the same building an artificial cliff of concrete blocks and mortar. Employ windows and rear access to provide the same research accessibility for murres as has already been achieved for kittiwakes and cormorants. Goal is 200 pairs of common murres nesting in artificial habitat.

Long-term research on Middleton will also include glaucous-winged gulls. No enhancements to natural habitats are contemplated or necessary, however, as this greatly expanded population nests extensively in easily accessible habitats over much of the island.

In summary, the specially managed setup for seabird research eventually will encompass 6 species, including 5 species in primarily artificial and highly controlled habitats that facilitate close observation, capture and handling of individuals with minimal disturbance, and experimental manipulations.

To complete the requirements of a permanent research station, living quarters and dry lab space are needed to support a complement of 10-15 field researchers and technicians. Currently, makeshift rennovations are underway on one of the old Air Force buildings as a short term solution to the space needs of field personnel. Alternatively, or in addition, these needs could be satisfied by installing one or more trailers in a suitable location on the island. Ultimately, the USGS may want to negotiate with FAA for residential use of its facilities, which likely will see declining use as air navigation shifts from ground-based to satellite-based systems.

Summary of Past, Ongoing, and Future Research

In the summer of 1956, a group of plant and animal researchers conducted a biological reconnaissance of Middleton Island in anticipation of the construction and operation of Air Force radar facilities there. The purpose of their visit was to establish a baseline for assessing possible impacts of the military base on the natural environment, and in that respect the project was notably ahead of its time. Subsequently, Rausch (1958) published his observations on the avifauna of Middleton, and Thomas (1957) catalogued the island's flora. Although species' abundances were not quantified in most instances, Rausch's (1958) account (and personal correspondence) has provided some of the earliest records of seabird numbers for any colony in Alaska, against which later censuses can be compared. A few years later, O'Farrell and Sheets (1962) contributed observations on wintering birds, and O'Farrell (1965) documented the introduction and early history of rabbits on Middleton.

In 1976 and 1978, the U.S. Fish and Wildlife Service sponsored seabird studies on Middleton in conjunction with the Alaskan Outer Continental Shelf Environmental Assessment Program (OCSEAP). Frazer and Howe (1977) and Hatch et al. (1979) reported on the populations, breeding ecology, and food habits of several species and established census protocols that are still in use today. Information on the seasonal departure of murres (Hatch 1983) and the nestling diets of auklets and puffins (Hatch 1984) is also available from that period.

In 1981, the Biological Resources Division of USGS (formerly USFWS Research) initiated annual monitoring of seabird populations and productivity on Middleton. This work, involving two abbreviated visits to the island annually in June and August, proceeded through 1986 with assistance from the Alaska Maritime National Wildlife Refuge (cf. Nysewander et al. 1986 and references cited therein). That year (1986) BRD also initiated banding studies of black-legged kittiwakes to determine adult survival rates and other population parameters of that species. BRD

scientists have visited Middleton each year since 1987, typically for 3.5 months from early May through mid August. Roberts and Hatch (1993, 1994) reported on the behavioural ecology of kittiwakes and Hatch et al. (1993) published the first survival estimates of kittiwakes from any Pacific colony. Work still to be reported includes a study of body weight dynamics in nesting kittiwakes using computer-automated electronic balances in the ship colony, and retrospective accounts spanning 20 years of nearly continuous seabird monitoring on Middleton.

Between 1980 and 1992, as part of a long-term study of trans-Gulf of Alaska bird migration, D.D. Gibson and associates from the University of Alaska Museum made several extended visits to Middleton during spring and fall migration periods to survey numbers and movements of birds on the island. This work has established a comprehensive bird list for Middleton, including the first Alaska records of several species (Gibson 1982 and pers. comm.).

Research for two master's theses was completed on Middleton in the 1980's, and a third thesis project is currently in the write-up phase. Bonfield (1986) examined the predatory behavior of glaucous-winged gulls, while Roberts (1988) studied incubation and chick-rearing behavior of black-legged kittiwakes. V. A.. Gill (University of Alaska Anchorage) has recently completed data collection for a supplemental feeding study of kittiwakes on the tower.

As previously noted, Middleton has long held the attention of geologists interested in plate tectonics and seismic activity in the Gulf of Alaska. For highlights of this work, see Capps (1933), Miller (1953), Plafker (1970), Prescott and Lisowski (1977, 1980), and Mankinen and Plafker (1987). Because geologists and biologists alike have taken many photographs on Middleton in the course of their studies, an extensive photographic record exists, including landscape views obtained in each decade from the late 1940's through the 1990's. Such photodocumentaion is of particular interest because of sweeping changes wrought by the earthquake in 1964. Going back even further, a few photographs are available from a feature-length article about fox farming on Middleton in the 1920's that appeared in National Geographic Magazine (Parker 1923).

Recent seabird research on Middleton (1996-1998) has centered on the tower colony. More than 500 kittiwakes have been individually color banded at the site, and a few known-age birds are starting to return from those banded as young in previous years. The first large-scale experiment involving supplemental feeding of adult and nestling kittiwakes has been conducted (1996-1997), and continuation of this approach (1998 and beyond) will allow various hypotheses concerning food limitation on seabird productivity and behavior to be tested over the longer term. In 1998, special investigations were mounted on the social behavior of kittiwakes during prenesting, on sibling rivalry as mediated by hormonal factors, and on daily energy expenditure of adult kittiwakes using the doubly-labelled water technique. These studies involved collaboration among researchers from the University of Alaska Anchorage, Oregon State University, University of Antwerp (Belgium), Konrad Lorenz Institute for Comparative Ethology (Vienna), and the Biological Resources Division of USGS. Also in 1998, the National Oceanic and Atmospheric Administration funded studies of the breeding performance of rhinoceros auklets on Middleton as part of a broader assessment of El Niño effects on seabird populations in the northeastern Pacific.

Future work will continue to focus on the unique capabilities afforded by the tower and on other species in artificial habitats as those developments come on line. The ongoing population study of kittiwakes will yield definitive data for comparison with long-term studies on this species in the northeastern Atlantic. Middleton Island offers the best opportunity in Alaska to mount similar long-term demographic studies of pelagic cormorants, common murres, tufted puffins, and rhinoceros auklets. Already we have learned that the population dynamics of kittiwakes in the northeastern Pacific and northeastern Atlantic differ dramatically. Research on the reproductive physiology, energetics, behavior, and feeding ecology of species widely monitored elsewhere in Alaska, but uniquely accessible for detailed investigations on Middleton, will help to explain such differences and provide a basis for the informed treatment of seabirds in the context of marine ecosystem management in the North Pacific.

Future Organization: Roles and Responsibilities

The preceding discussion has emphasized that Middleton Island offers special opportunities to public and private organizations concerned with environmental research and conservation. These opportunities include, but are not limited to, the pursuit of research on marine bird species that is field-oriented yet relatively controlled and amenable to experimental manipulation. Another objective is the conservation of prime wildlife habitats that support both a rich variety and abundance of species and also present a unique and fascinating showcase of geological processes in action. Thirdly, this site has outstanding potential to deliver the preceding two benefits tangibly to the public through a coordinated program of public information and education.

The realization of all three values—conservation, research, and public use—could best be achieved through a special partnership of public and private organizations with the appropriate interests, mandates, and expertise. In the first instance, an organization such as the Nature Conservancy would be an appropriate landowner and manager for property on Middleton that, while not extensive in total acreage, has relatively concentrated wildlife and conservation values. Similarly, an organization such as the National Audubon Society is well-suited to develop a program of natural history interpretation on Middleton consistent with its existing programs for ecotourism. The island is accessible in one hour by air from population centers in south-central Alaska. The earthquake created wide, flat areas below the cliffs from which seabird colonies can be viewed safely and unobtrusively, and the island's road system provides efficient access to all primary wildife viewing areas. Seabirds nesting on artificial structures such as the shipwreck, buildings, and abandoned radar towers are a unique aesthetic attraction. In this scenario, the visiting public would be introduced on Middleton Island to a variety of ongoing research and management techniques as they are implemented by the partnership.

For its part, the U.S. Geological Survey will continue to administer the Middleton Island research program as a field station of its Alaska Biological Science Center. It is anticipated that guest researchers from other agencies, universities, or privately funded organizations will participate regularly. The Center will review and prioritize proposed work to ensure that coordinated, compatible, and productive use is made of the facilities. While responsibility for managing each component of the station's mission will thus be assigned to one or another leading partner, other organizations with potential stakeholding interests (e.g., U.S. Fish and Wildlife Service, Alaska Department of Fish and Game, Exxon Valdez Oil Spill Trustee Council, Chugach Alaska Corporation, various universities, etc.) should also be encouraged to establish formal affiliations with the Middleton Island Marine Biological Station.

In principle, some of the proposed activity can proceed in the absence of any formal partnership. However, the evident potential on Middleton Island for a uniquely synergistic relationship of research, conservation, and public use suggests that a joint venture involving both public and private cooperators is worth a try. Furthermore, the possibility that current owners of key land parcels on Middleton, especially the MIDICO tract, could someday decide to pursue other, incompatible uses for the site, creates a measure of uncertainty in the future of the marine station. Thus, every avenue should be explored for transfering ownership or obtaining commitments of future support from current property owners. One possiblity to consider is the Exxon Valdez Oil Spill Comprehensive Habitat Protection Process, which has substantial funding still available for land acquisition, EVOS-relevent research and monitoring, and general restoration of resources affected by the 1989 oil spill.

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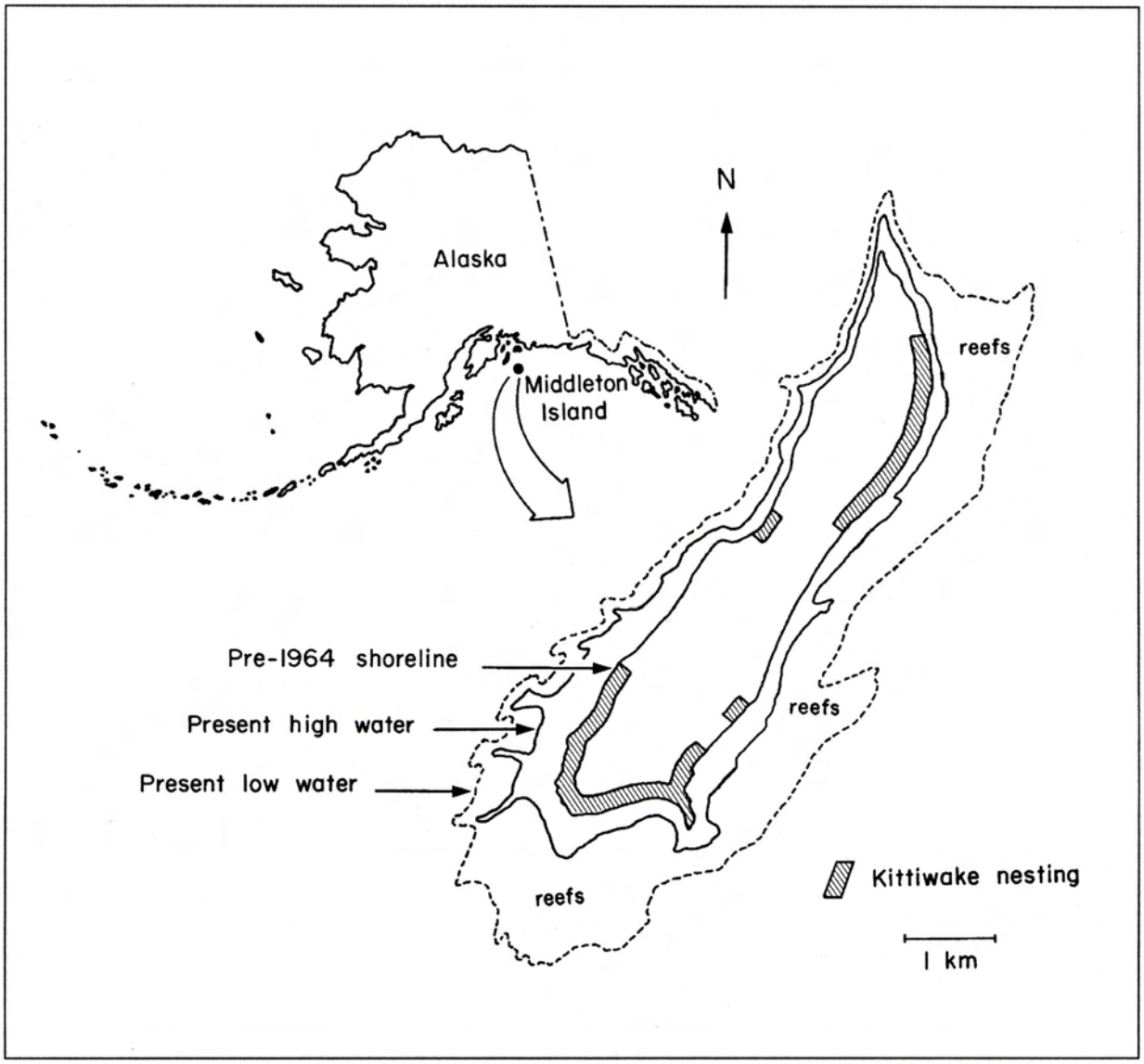

Figure 1. Location of Middleton Island in the north-central Gulf of Alaska.

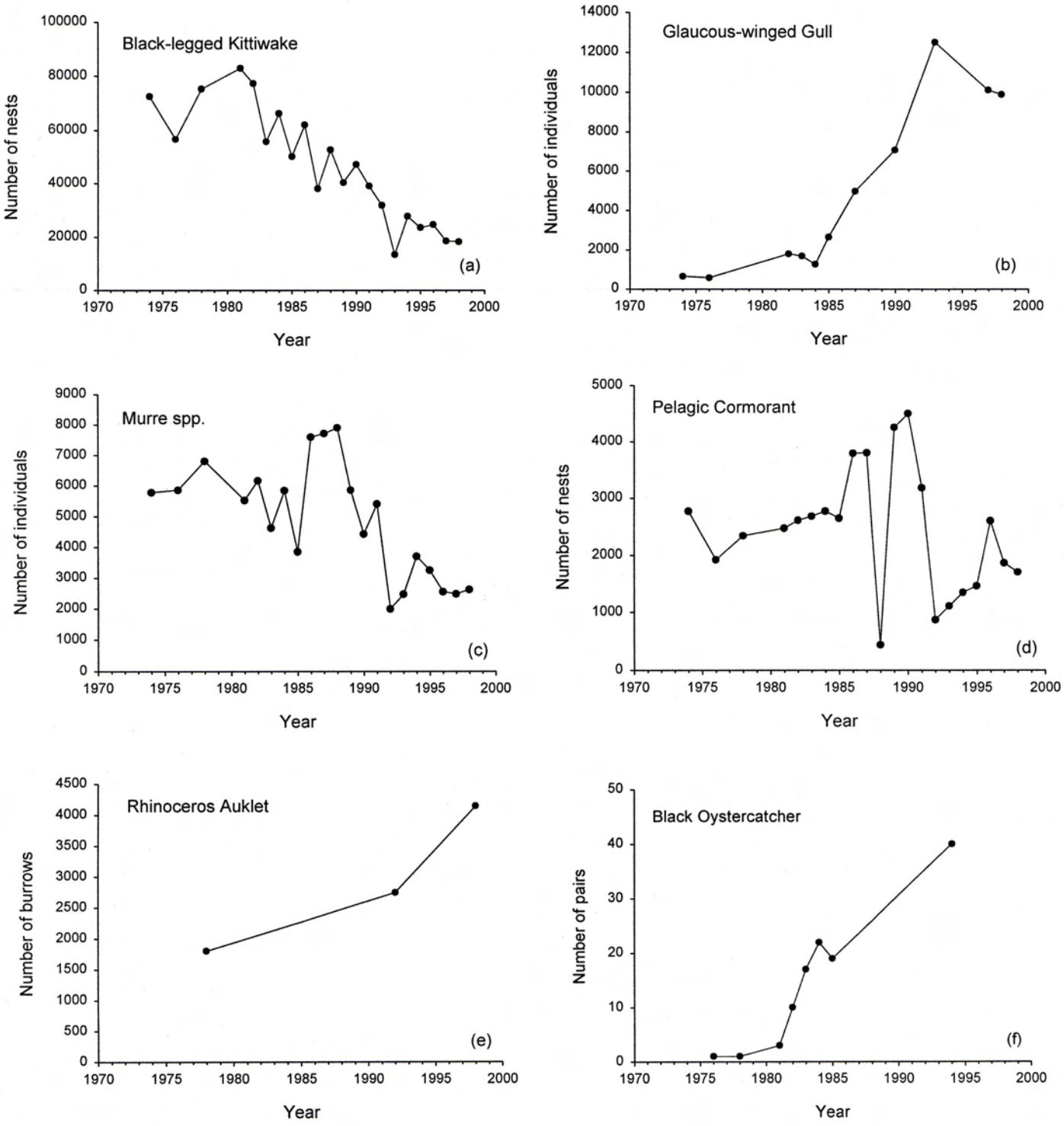

Figure 2. Seabird population changes on Middleton Island.

Figure 3. Aerial view of Middleton Island looking south. Marine terraces create elevational steps rising from east to west.

Figure 4. The unique physiography of Middleton Island presents a rich variety of habitats for wildlife. Aerial view (looking north) showing land created seaward of the cliffs during the 1964 earthquake. Ledge-nesting seabirds still breed abundantly on southwestern cliffs.

Figure 5. An abandoned radar tower on the MIDICO tract offers high-quality nest sites for kittiwakes and cormorants.

Figure 6. Competition among birds is intense for artificial ledges added to the upper portion of the tower.

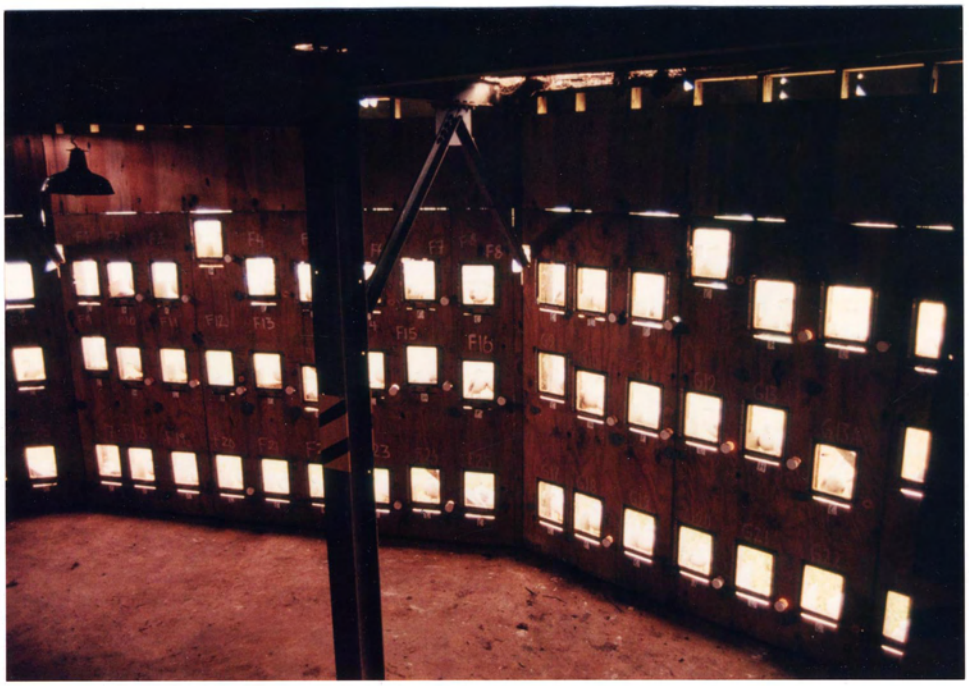

Figure 7. More than 200 nest sites are backed by one-way mirror glass to facilitate work from inside the building.

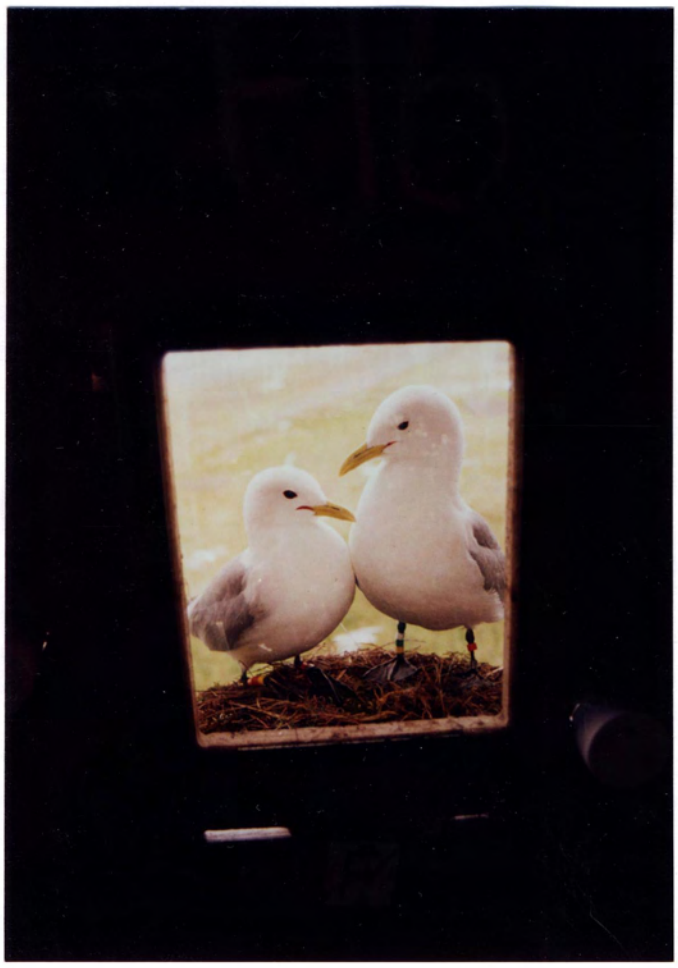

Figure 8. Window sites provide unparalleled opportunities for close observation, manipulation, and food provisioning. Note the feeding tube at lower right corner of the site.

Figure 9. The tower provides a unique, laboratory-like setting in which to study wild, cliff-nesting seabirds.

Figure 10. The S.S. Coldbrook was grounded on Middleton in 1944 and today is used by nesting kittiwakes, cormorants, and puffins.

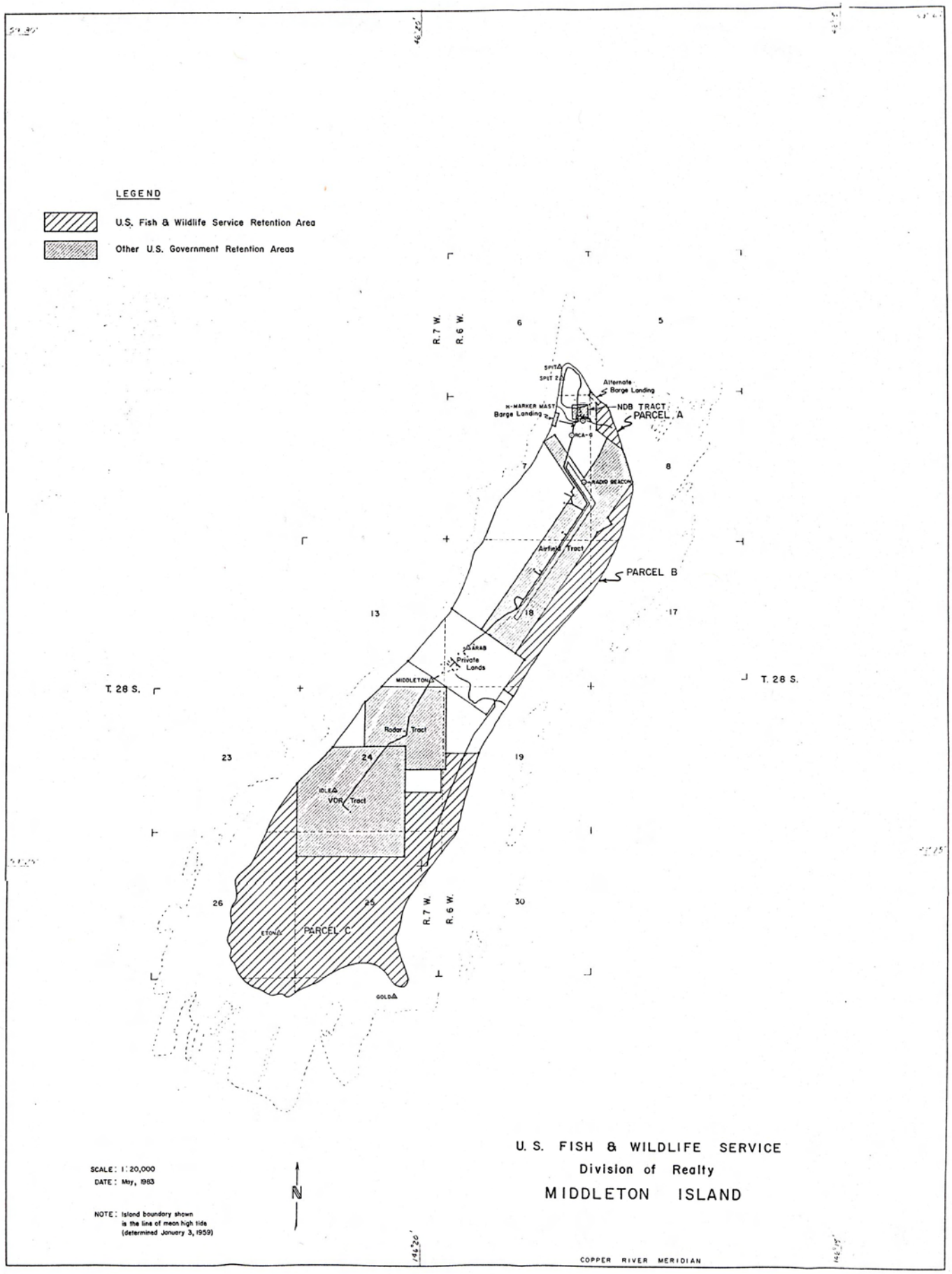

Figure 11. Status of land ownership and use on Middleton Island.