SHORT-TERM MANAGEMENT OPTIONS FOR TERN ISLAND, FRENCH FRIGATE SHOALS

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INTRODUCTION

Meetings between then Interior Secretary, Cecil Andrus, and Hawaii Governor, George Ariyoshi, on 20 November 1978 and 29 February 1979 led Secretary Andrus to commit the Interior Department to take no action that would foreclose options for future use of Tern Island, including its potential use as a fisheries support station, before completion of ongoing Tripartite research studies. With the knowledge that the Coast Guard intended to disestablish the Tern Island LORAN Station in June 1979, the FWS contracted MANTA CORP in March 1979 to prepare a preliminary assessment of long-term management options for Tern Island. This study involved extensive data gathering including interviews with representatives of involved agencies, industry and interested public organizations. In July 1979, the FWS established an interim field station on Tern Island when the Coast Guard crew departed. This station is still in operation at this time.

The purpose of this report is to update portions of the MANTA "Tern Island Study" based on approximately two years of operational experience at Tern Island by Refuges and Wildlife Resources (RWR) staff in the Honolulu Area Office. This report will also take into account relevant events which have occurred or other pertinent data which have been gathered subsequent to establishment of the FWS field station. Unlike the "Tern Island Study", this report will consider only options which the FWS can implement although some could involve other agencies.

The planning time frame for this evaluation of options is short-term (5 years). This period corresponds with anticipated completion of Tripartite field research and analysis of data by cooperating agencies (National Marine Fisheries Service, Hawaii Department of Land and Natural Resources, Fish and Wildlife Service, Sea Grant).

HISTORY

French Frigate Shoals was first visited by French expedition ships, BROUSSOLE and ASTROLABE, under the command of Jean Francois de la Perouse in November, 1786. Over the next century, numerous other sailing ships visited the Shoals. Commercial exploitation began with a search for guano by the bark, GAMBIA, in March 1859. In the same month the first recorded ship wreck (SOUTH SEAMAN) took place. The lure of turtles, seals, beche-de-mer, bird feathers, fish and shark products led other sailing ships to their demise in the years to come. The first biological survey of the Shoals was made in 1891. In 1894, several of the Northwestern Hawaiian Islands (NWHI), including FFS, were leased to the North Pacific Phosphate and Fertilizer Company for guano harvest, but they never worked FFS.

The effects of unregulated exploitation led President Theodore Roosevelt to sign Executive Order 1019 in February 1909, establishing the Hawaiian Islands Reservation. This EO, which did not include Midway Atoll, was issued to prevent the continued slaughter of birds which had been exploited for their eggs, feathers and guano. Despite this protection,

an earlier introduction of rabbits at Laysan Island during this exploitive period would lead to extinction of three land bird species by 1923. In 1940 Presidential Proclamation 2416 changed the designation of the Hawaiian Islands Reservation to the Hawaiian Islands National Wildlife Refuge (HINWR), and administrative jurisdiction was transferred from the Department of Agriculture to the Department of Interior. Limited exploitation of fish and wildlife resources continued within refuge boundaries until the mid-1950's. It was, in part, concern stimulated by this exploitation and its effect on refuge resources that led the Bureau of Sport Fisheries and Wildlife (later U.S. Fish and Wildlife Service) to enter into agreement with the Territory of Hawaii in 1951 authorizing declaration of all emergent lands of the HINWR as a Territorial Wildlife Refuge. This refuge which also includes Kure Atoll became a State Wildlife Refuge upon statehood.

French Frigate Shoals began an important role in military history in 1928 when hydrographic surveys were conducted in consideration of its potential as a strategically located anchorage. Naval air maneuvers took place throughout the 1930's at FFS. The Battle of Midway prompted the decision to build an airstrip at FFS in order to support ferrying aircraft to act as an emergency landing facility and to provide an outpost for defense of Pearl Harbor. Dredging began near Tern Island (then 1800' by 450') in August 1942. A 12,000' ship chanel was dredged to 20' deep, and an 8,000' seaplane landing area was cleared of coral heads. A total of 660,000 cubic yards of coral fill was placed behind a partial rim of steel sheet piling to "create" a new island 3,100' by 350'. By March

1943 ground facilities included eight buildings, 21 fuel tanks and a 90' radar tower. The total project had cost nearly 2 million dollars.

The new Naval Air Facility was commissioned on 17 March 1943. In November 1944 there were four officers and 123 enlisted men on the island with parking for 22 planes. The station was never attacked, and the incidence of enemy ships in the area was low. The station was placed into caretaker status a month after the war ended in September 1945. Final disestablishment occurred on 9 June 1946.

Two years prior to this date, a Coast Guard LORAN station had been established on nearby East Island. The LORAN station was supplied through the Tern Island Naval Station. When the Naval facility closed in June 1946, the LORAN facility was supplied by bouy tender. Storms and corrosion caused rapid deterioration of buildings. Morale of the crew deteriorated as well due to undependable supply and isolated duty. When funds were released in October 1951 to renovate the East Island station, a decision was made to improve the abandoned Tern Island facility instead. Construction began in early 1952, and by October the Tern Island LORAN station was in operation. At that time the facility consisted of a power and signal building, a barracks (with living areas, galley and mess deck), a recreation building, antenna system, 2 water tanks and 9 fuel tanks. Ship and aircraft activities at the shoals increased after opening of the new facility. Repairs were made to the seawall in 1959. A Pacific Missile Range team tracked satellites and missiles between December 1962 and August 1963.

In early 1964 plans were drawn up for rehabilitation of station facilities. This rehab included construction of a new cement block LORAN building, repairs to the recreational building and barracks, and new pilings on the east and west ends. The station routine was interupted during the mid-sixties by periodic visits by Bureau of Sport Fisheries and Wildlife (BSFW) biologists and personnel involved in the Smithsonian's Pacific Ocean Biological Survey Program (POBSP).

Storm waves washed over the island on 1 December 1969, extensively damaging equipment and buildings, and forcing helicopter evacuation of the crew from the LORAN building rooftop the following day. The crew returned by vessel ten days later, but the runway was not operational until 15 January 1970. As a result of the damage caused by this storm and to prevent further weather problems, the living quarters were rebuilt in 1972 at a cost of nearly $200,000. This building is now constructed in such a way that wave wash can pass under the floor. Only short-term maintenance and repair of other facilities occurred during the remainder of the Coast Guard's occupation of the island.

On 30 June 1979 the Coast Guard decommissioned the LORAN C station at Tern Island. The crew of 22 men left the island and were replaced by two refuge staff. Since that time, the station has been occupied by 1 to 3 FWS refuge staff. Additional family members, researchers and other visitors have raised the total station occupancy to as high as 10 for short periods.

FUNCTIONS OF THE TERN ISLAND STATION

Since construction of the Tern Island facility by the U.S. Navy, the site has played a varied role in the support of military and non-military activities in the NWHI. The purpose of this section of the report is to evaluate historic, current and potential functions of the Tern Island facility and to consider the significance or value of these functions to Service objectives and to other agencies.

(1) Maintenance of Existing Facility: During the period of Coast Guard occupation, a crew of 18-22 men were stationed on Tern Island to operate the LORAN equipment and to maintain the facility. This maintenance function has been continued during the period of Service occupation by 1-3 on-site RWR staff. Assistance has been provided in the maintenance function by individual private contractors, particularly in the maintenance of the electrical system, water system, refrigerators/freezers and communications equipment. Of greatest value to the Service in the maintenance area has been our continuing relationship with Atlas Electric Co. This contractor has made several visits to the island, enabling design and installation of our generator system (including hot water system) and modification of the water pumping system to meet our specific requirements and minimize energy demands.

We have followed the Secretarial commitment to maintain options for Tern Island by devoting operational funds and manpower to a preventive maintenance and equipment repair program that includes some equipment and

facilities of no immediate use to our existing operation (e.g., periodic servicing and operation of 250 kw generators). We have focused this attention on equipment or facilities that would soon require total replacement or major rehabilitation if allowed to deteriorate. However, we have not devoted a level of effort or funds comparable to the Coast Guard, so gradual deterioration of some other facilities or equipment will continue (e.g., bulkheads, roofs, fuel tanks, water tanks, building paint, runway surface) and will eventually require more substantial funding if the station continues its operation. The bulk of our current maintenance schedule is devoted to equipment and facilities that are critical to station operation at the reduced staffing level (e.g., runway grading, Onan generators, water pumps, tractor/pickup truck, boats/motors, boat hoist, refrigerators/freezers, radios, safety equipment).

The significance of facilities maintenance to Service operations is a complex issue. Although the Service has in the past and could in the future "manage" the HINWR without a service facility at Tern Island, several of the station functions discussed in this section of the report would not be possible or, at the very least, would be more difficult or costly. The fact would also be of significance to other entities including other State or Federal agencies who presently or might possibly derive benefits through a Service facility at Tern Island.

(2) Service "Presence" within the HINWR: Tern Island is presently the only "permanent" on-site Service facility within the remote island refuges of the Hawaiian/Pacific Islands NWR Complex. In fact, the only other

on-site facility in the entire complex is at Kilauea Pt., Kauai. Primary administrative offices are in the Federal Building in Honolulu. No other locations within the existing boundaries of the HINWR are practical for a permanent Service station although Service personnel could be stationed at Midway Atoll. If all or a portion of Midway Atoll were incorporated into the NWR system, on-site Service personnel would be appropriate to perform educational, enforcement, management, and research duties.

Service "presence" within the HINWR supports the Service mission statement and program goals, particularly those of the Endangered Species and Migratory Bird Programs. Program goals for Endangered Species include listing of qualified species, protection of listed species and recovery of listed species through the development and implementation of recovery plans. There are no recovery plans as yet in effect for any listed species in the NWHI, including the green sea turtle, monk seal and four island bird species or subspecies. However, recovery planning is in progress for the monk seal and anticipated to occur for the land birds during FY82. In addition, at least 10 NWHI plant species have previously been recommended for formal listing pursuant to the Endangered Species Act. In addition, IRP #20 relating to recovery of endangered species in Hawaii and the Trust Territories is clearly supported by Service "presence". The Migratory Bird Program goals relating to maintenance of population levels with optimum diversity and to the preservaton/management of habitats can best be addressed through physical Service "presence" in the NWHI. The Coast Guard facilities at Tern Island, and more recently the FWS station, have made this "presence" possible in a meaningful way.

We believe that public knowledge of Coast Guard occupation of Tern Island in previous years and FWS occupation in the recent past has acted as a meaningful deterrent to illegal entry onto refuge lands and waters at FFS. Most fishermen and other boaters in the State are aware that Service personnel at Tern Island have the authority to enforce refuge regulations as well as other pertinent legal mandates (i.e., Endangered Species Act, Marine Mammal Protection Act, Migratory Bird Treaty Act).

There have been no incidents requiring direct enforcement action during the two years of Service occupation although, with LE assistance, several preliminary investigations of NWR violations have been conducted. Fishing boats have frequently transited by or fished outside refuge boundaries during this period. Some of these boats have been in radio contact with Tern Island personnel. At least one fisherman publicly threatened to occupy Tern Island at the disestablishment of the LORAN station in 1979 if the Service did not permit use of the island as a fishery support station. The expanding albacore fishery operating out of Midway has resulted in an influx of mainland fishing vessels, virtually all of which pass by FFS after resupplying in Honolulu. Well documented interest in glass balls among boaters in the NWHI further underlines the preventative enforcement value of on-site staff in these remote areas.

Service "presence" could be maintained at Tern Island or, for that matter, at other NWHI locations on a more temporary basis through the continuation of field camps. However, these temporary camps do not provide an effective base of operations for meaningful enforcement in

nearshore waters. These camps may also act as an attractant to uninformed boaters in nearby waters who may conclude that people on these islands are in distress or trespassing themselves. Also the temporary and intermittent nature of these camps diminish their value as a deterrent to illegal activities.

One function of permanent Service presence at Tern Island has been to facilitate monitoring of approved refuge activities including research to insure that all refuge regulations are adhered to. Refuge staff on Tern Island have been able to fulfill this role without significantly affecting their own maintenance/research schedule. To this extent, limited approved activities that would otherwise require continuous supervision of refuge staff have occurred with little additional FWS staff time or funds.

Were authorized activities in the Shoals to increase significantly, the enforcement role of RWR staff would demand considerably more time (additional staffing) and improved boat support capability. The extent of this impact on existing operations would depend on the nature and magnitude of the authorized activities. Some forms of research or commercial fishery activities would require virtually continuous on-scene monitoring and regulation by RWR personnel, even as shipboard observers. It may be possible to effect such control through the use of temporary employees, as these activities are generally seasonal.

(3) Service Research/Wildlife Management at FFS: Prior to Service occupation of Tern Island, Service research/management studies at FFS involved intermittent census and tagging of seals, turtles and seabirds. Coast Guard presence at Tern Island facilitated this work by insuring housing, airplane transport of goods and people, and in some cases, boat support and labor during studies on other islets in FFS. Opportunities for year-round monitoring of fish and wildlife species at FFS became a reality when the Service permanently occupied the station in July 1979. Long-term Service studies initiated or accelerated at this time included seabirds (phenology, breeding success, monitoring of known age birds, nest site tenacity, food habits), seals (patterns of habitat use, population estimates through molt studies, pup production), turtles (habitat use), and reef ecosystems.

Of particular relevance to the Tripartite cooperative research program has been the ability of Service biologists to test censusing/ monitoring techniques for seabirds through extended study that would not have been feasible in temporary field camps. Refuge staff and volunteers have also been able to monitor the post-Coast Guard re-population of Tern Island by monk seals, using frequent surveys to document habitat use patterns and to identify individual animals by scars and other marks. The value in continuation of long-term studies after the end of the Tripartite program lies in the relevance of monitoring capability, particularly in the assessment of future human activities in the NWHI (e.g., fishery development and public use). Tripartite research has provided important base-line data against which to document future change

and has enabled development and testing of viable indices of population status. Tern Island provides a convenient site for the necessary follow-up to these preliminary studies.

Maintenance of a station at Tern Island is not absolutely critical to ongoing Service research/management programs involving migratory birds. In fact, there is some justification in focusing these studies at other sites in the NWHI. Midway Atoll will likely be available for long-term seabird studies, whether or not it becomes part of the NWR system. Most species of seabirds found in FFS are considerably more abundant at Midway, and the logistics of air travel and housing at Midway make that site a practical alternative to Tern Island. On the other hand, FFS is centrally located in the archipelago and is more reflective of conditions on other refuge islands than is Midway. For this reason, continuing studies at FFS are critical to an effective program of refuge management.

Valid arguments can be made for and against expanded studies on the major NWHI breeding population of turtles and on the only substantive monk seal population that has not shown a significant downward trend in the last decade. On the one hand, the condition of the FFS seal population justifies close monitoring, at least of pup production, to facilitate a management response in the event of a documented increase in mortality or decrease in production. On the other hand, such monitoring carries with it the risk that wildlife biologists may disturb this "healthy" population unnecessarily and further jeopardize the species. Midway does not provide

a workable alternative for monk seal studies due to the extremely low population. Other sites of recent studies, such as Laysan and Lisianski, provide opportunities for future monitoring but don't provide the logistical support at Tern, Midway or Kure. Diminishing availability of inexpensive transportation options and rising fuel costs for chartered vessels insure that operation of field camps on remote islands will continue to rise in cost commensurate with oil prices and inflation.

Continued turtle studies are warranted at FFS because it supports the primary North Pacific breeding population, and because extensive baseline studies over the last decade provide unique opportunities for monitoring population trends. Most of the turtle research to date has been conducted by non-Service personnel. However, jurisdictional responsibility by the Service for this species on its breeding islands justifies greater Service involvement in future monitoring studies. Maintenance of the station at Tern Island would greatly facilitate that research.

(4) Non-Service Wildlife Research: Research by non-Service personnel in the NWHI predates establishment of the Hawaiian Islands Reservation in 1909 and has continued throughout the 20th century. The most intensive non-Service wildlife research program in the NWHI was the Smithsonian's Pacific Ocean Biological Survey Program in the mid 1960's, focusing primarily on seabird resources. Although this project relied heavily on vessel support, permanent stations at Kure, Midway and Tern Island greatly facilitated field studies in those areas. The Coast Guard LORAN station

at Tern also facilitated repeated surveys of seals by NMFS biologists in past years. Other non-Service wildlife studies which took place at the station or were enabled by the Station's presence include thermoregulation of monk seals, and breeding biology of green sea turtles (primarily on East Island).

Non-Service wildlife research has accelerated at FFS since the Service occupied the station in July 1979. Most of the projects have related directly to Tripartite research commitment of various agencies involved. An ecosystem approach to studies at FFS has developed as various cooperating researchers have begun to focus on this site as a model atoll ecosystem where various predictive theories can be tested. This interagency research program at FFS will peak in summer 1981 during which between 2-6 non-Service researchers at a time will work at or from the Tern Island station over a four month period. Projects will include (a) hydrography, primary productivity and inshore planktivorous fish production, (b) benthic primary productivity, (c) trophic analysis of shallow water fish communities, (d) seabird bioenergetics, (e) ciguatoxigenic dinoflagellate studies, (f) population biology of spiny lobsters, (g) green sea turtle population biology, (h) sooty tern breeding biology. All of the researchers involved in these studies are dependent to some degree on the Tern Island facility for access (aircraft support), boat support, housing, dependable power supply, laboratory space, shop/repair facilities, fuel supply, and staff assistance. It is clear that Tripartite research projects will diminish significantly by the end of FY 82, but it is anticipated that several researchers who have been gathering base-line data at FFS will desire to continue their studies well into the future.

Although the islands and waters of the HINWR are within a designated Research Natural Area, and the Service has encouraged and supported productive research, all research proposals have been carefully scrutinized, and major steps have been taken to minimize the potential adverse effects of these activities on wildlife resources, including threatened or endangered species. There is considerable dissension among researchers and administrators familiar with FFS regarding the desirability of encouraging or permitting research at the Shoals, particularly those studies which do not directly yield important management data on endangered monk seals or threatened green sea turtles. The documented re-population of Tern Island by increasing numbers of monk seals has intensified the concern that intensity of human activity at FFS including Tern Island should be stringently regulated. To this end, the Service has placed a limit of ten persons (including Refuge staff) at Tern Island during the summer 1981 research peak. Furthermore, haul-out areas and seabird colonies are off limits to Tern Island visitors. Boating and research activities (netting, traps, etc.) are restricted in the Shoals to prevent conflicts with seals, turtles or seabirds.

It is important to note that shared legal jurisdiction with NMFS for seals and turtles has provided a vehicle for interagency review (Section 7) of all proposed activities at FFS including non-Service research that occurs under Special Use Permit. With sufficient lead time, this process has worked reasonably smoothly in FY 81. Assuming there is no irresolvable conflict of management philosophy between NMFS and FWS at FFS, it is anticipated that this process will continue to work smoothly in the future.

(5) Non-Wildlife Research: The operation of a manned facility at Tern Island has attracted a variety of individuals and agencies seeking a platform for one-time or long-term monitoring studies at FFS. During Navy occupation, the Pacific Missile Range scientists were stationed at the island for several months in order to monitor satellites and missiles. More recently, the Nuclear Defense Agency has approached the Service for access to Tern Island to permit atmospheric testing.

The National Weather Service (NWS) has installed a monitoring facility that transmits weather data by satellite. Although remotely operated, Service staffs on the island assist the NWS in monitoring this equipment and provide logistical support for periodic maintenance. NWS officials note that the Tern Island station plays an important role in monitoring weather "upstream" of the Main Islands. The only other station to the northwest is Midway. The station permits ground-truthing of satellite photos and verification of infrequent ship observations. The data are particularly valuable in the analysis of the strength and movement of storms that may affect the Main Islands. Abandonment of the island would probably force the NWS to shut down the weather reporting equipment because of the likelihood of periodic failure and high cost in maintenance by boat charter.

The Hawaii Institute of Geophysics maintains a recording tide guage at Tern Island that is periodically monitored and repaired by refuge staff. This equipment could also not be operated without on-site personnel. In recent years FFS has also attracted geologists with varied interests who have collected rock samples from La Perouse Pinnacle and reef substrate from other locations in the Shoals.

(6) Logistic Support for Other Research Elsewhere in the NWHI: Even prior to disestablishment of the LORAN station, the Tern Island facility provided some support for archipelago-wide research studies. Tern has been a frequent stopover site for vessels enroute up and down the archipelago. Investigators have embarked onto or disembarked from passing research vessels on several occasions, particularly during the most recent years of Tripartite research. Together with aircraft transport to and from Tern Island, the ability to transfer researchers has improved their productivity due to lengthy vessel time and increased the number and variety of studies that have been possible. Spare parts and other equipment have also been transferred to vessels in need of emergency repairs through the Tern Island station on several occasions.

The FWS station at Tern Island has served to coordinate some FWS field camps on other islands by providing communication support and exchange of research information and procedures. To some extent, this function has been duplicated by additional radio support on Kauai and more recently in Honolulu. However, conditions for radio transmission have been such that communication has generally been most reliable between the Tern Island station and field camps at Laysan and Nihoa islands. Until higher frequencies are authorized for FWS use, it is likely that the distinct advantages of camp communication with Tern will continue to exist. The Tern Island radio is also monitored at least 18 hours per day, providing a safety valve for field camps that is not currently provided by either main island radio.

The Tern Island station now provides a convenient landing field and refueling site for aircraft used in FWS research projects. In May 1981 the Beechcraft regularly chartered by FWS for Tern Island supply flights was used in an archipelago-wide aerial photography mission co-sponsored by NMFS and Sea Grant. The objectives of the mission were to census monk seals, map seabird colonies, map vegetation and to map submerged reefs throughout FFS. This mission would not have been possible without landing and refueling capability at Tern Island and Midway, except at significantly higher cost through the EROS Program.

(7) Emergency Response Capability: There is no well-documented record of the historical use of the Tern Island airstrip for emergency evacuation of on-site crew or crewman from vessels. There were at least two documented cases during Coast Guard occupation when injured crew from fishing vessels were taken to Honolulu by aircraft. Others have been treated by medical corpsmen stationed at the LORAN station.

In spite of the limited historical record of this need, there is some reason for concern that increasing boat activity in the NWHI carries with it the likelihood that emergency response capability will increase in importance as well. Between February 1980 and January 1981, three vessels grounded at FFS. The salvage and/or rescue operation of each vessel was facilitated by the FWS crew and the station at Tern Island. In the first instance, the fishing vessel SANTA INEZ grounded west of Disappearing Island. Assistance was rendered by another fishing vessel (EASY RIDER) after a Service operated Boston Whaler guided the EASY RIDER

through the reef. The Service again assisted in notification of the Coast Guard when the SANTA INEZ broke its anchor line while moored near Tern Island. The vessel was later towed towards Honolulu, but sank enroute.

In April, 1980 the Greek Freighter, ANANGEL LIBERTY, grounded on the south end of FFS. The Service assisted in the salvage of this vessel through aerial reconnaissance, radio communications, boat and air transport of Navy and salvage personnel, housing of salvage crew and other coordination. It is probably safe to say that the quick overall response that ultimately permitted salvage without (major) fuel spill would not have been possible without an operating facility at Tern Island. At least 24-48 hours were saved in the overall salvage procedure, allowing salvage only a short time before deteriorating weather and tides may have prevented success.

In January 1981 the fishing vessel, KEOLA, grounded on the southeast fringing reef before dawn. The crew managed to reach Little Gin Island with limited supplies on a small life raft. Without a radio, they were unable to communicate with FWS personnel on Tern Island. Twelve days later they observed the light of another fishing vessel offshore the shoals and signalled that vessel with a flare. That vessel contacted Tern Island, and the Coast Guard was notified. A CG C-130 dropped supplies and radio to the stranded crew the next morning. Wind and water conditions were such that the Service personnel at Tern Island put off rescue by Boston Whaler until the following day. The rescued KEOLA crew were then evacuated by aircraft from Tern Island.

Service experience in these recent emergency actions at FFS has underlined the need for adequate facilities, equipment and staff capability if the Service intends to operate the Tern Island station. Ability to react effectively requires appropriate communication support, rough-water boats, and sufficient trained staff to operate boats and onshore equipment. In all of the rescues or salvage operations discussed above, some important backup support was provided by non-Service personnel who were on the island at the time of the incidents. Unless planned in advance, such backup support cannot always be assured.

The implications are clear from consideration of the recent groundings that both environmental as well as human safety hazards are involved. The inadvertent introduction of rats or other exotic pests (including plants or insects) to refuge islands could have very serious results. However, the ability to regularly monitor and react at FFS by virtue of the Tern Island station would have little effect on response capability for the other refuge islands, many of which are far more vulnerable to these threats. On the other hand, response capability would be critical in the event of a major oil spill near FFS where direct impacts on the major turtle and seal populations could be very serious. Continued operation of the Tern Island station would facilitate rapid response capability for such an event. The effectiveness of this response could be further enhanced if appropriate oil spill containment gear was stored for rapid deployment at Tern Island.

(8) Logistic Support for Fishery Activities in the NWHI: Historically, Tern Island was used as a base of fishery operations, including air transport, only for a brief time between Navy and Coast Guard occupation. Since that time, including the most recent period of FWS station operation, fishery activities have been facilitated only incidentally through the evacuation of injured crew, the transfer of parts or supplies and as a place of refuge during inclement weather. The TERN ISLAND STUDY considers in detail the support facilities that would facilitate various fishery activities at FFS and elsewhere in the NWHI, so this topic will not be pursued in this report.

(9) Emergency Landing Site: We are aware of two recorded incidents in which the Tern Island runway was used as an emergency landing site. In one case, a Japanese ferry pilot landed at twin-engine Beechcraft experiencing fuel transfer problem and then departed after solving the problem. In the other case, an Air Force helicopter landed with engine problems. Parts and maintenance personnel were flown to Tern Island on chartered aircraft to fix the helicopter which departed soon after. In the latter case, the same "rescue" may have been possible by vessel and/or air support on virtually any of the refuge islands although it is clear that the facilities at Tern greatly facilitated the operation.

The future value of the island as an emergency landing site depends on runway maintenance and bird control. The Coast Guard insists that they will not land C-130's at Tern Island unless a life or death emergency exists, and then only if a smaller alternative aircraft is not available to react. The risk of bird ingestion into engines is more serious in turbine aircraft, such as the C-130, than in piston-engine aircraft.

(10) Educational/Recreational Use of Tern Island: Several of the recent research projects at FFS that have utilized Tern Island have involved graduate students working under the direction of agency or university investigators. One UCLA graduate student working independently has been assisted in her work with sooty terns through housing and use of the facilities at Tern Island. Other graduate students have expressed interest in conducting their advanced degree research programs at Tern Island in future years as well. Service information needs and program objectives are facilitated by our ability to provide such logistical support at minor additional cost to the taxpayers.

The Service has been approached on several recent occasions by operators of various commercial nature tours, expressing interest in conducting such tours in the HINWR. This activity has been discouraged because of the anticipated impact on fragile island resources. However, educational film makers and writers have visited the HINWR, including Tern Island, and have produced films and articles that have been widely distributed. These have been closely supervised visits that have not required the use of Tern Island facilities.

Recreational activities including wildlife oriented activities have been discouraged in the HINWR. The Service has denied requested access for sport fishing, recreational diving, boating, glass ball collecting and other similar activities. A station at Tern Island would greatly facilitate these activities if access were eventually permitted.

Pertinent legal mandates and refuge policy clearly dictate a continuing restrictive policy towards non-wildlife oriented activities in the HINWR, particularly at FFS where critically important monk seal and turtle populations are at stake. Even wildlife oriented activities including some forms of educational use must be restricted in an effort to reduce all potentially impacting human activity to the minimum necessary to manage the wildlife resources.

IMPLICATIONS OF FWS OPERATION OF A TERN ISLAND STATION

As described in an earlier section of this report, facilities at Tern Island have served numerous useful functions before and since FWS occupation in July 1979. Yet experience in operation of the station has revealed a number of implications that should be considered in evaluation of future station management options. Some of these implications are easily mitigated while others are an inherent part of remote station operation. These implications are discussed briefly below and in the detailed consideration of various management options.

(1) Annual O&M/Cyclical Maintenance Costs: Each of the management options under consideration would involve substantial annual O&M and cyclical maintenance costs to the Service except the abandonment option. Principal costs include salaries, boat/plane charters, food (paid for by employee under some options), equipment repairs and expendable supplies (fuel, lubricants, etc.). Steps which have been taken to reduce annual O&M include: (a) staff reductions, (b) appointing the spouses of married staff as volunteers, (c) advance procurement of fuel, (d) conversion to small power generation equipment, (e) modification of power and water systems to provide hot water using generator engine heat, (f) installation of salt water cooling system for generators, (g) removal of most air conditioners, (h) shared use of chartered boats and aircraft with other investigators, (i) occasional shipment of supplies at no cost to FWS on cooperative fishing boats or the NOAA ship, TOWNSEND CROMWELL, (j) reduction in the frequency of chartered flights through improved planning and resupply, (k) deferral/downgrading of major cyclical maintenance requirements.

(2) Anticipated Rehabilitation Cost: No rehabilitation or replacement of major equipment or facilities is likely to be necessary during the five year planning period if the particular management option selected is undertaken throughout the period. In other words, unless the decision is made to upgrade the station during the planning period or to stop and restart operation of the station, funding needs will reflect only O&M and cyclical maintenance. Major storm events, acts of vandalism or disasters (fire, explosion, etc.) lack sufficient predictability to be a consideration unless the unforeseen happens.

The inevitable long-term need for rehabilitation or replacement of some equipment and facilities will be largely ignored through implementation of any of the short-term options under consideration. "Stopgap" measures will be taken to postpone rehab projects where necessary. If the level of station operation never exceeds the options under consideration, then some of the identified major rehab projects can be postponed indefinitely or ignored altogether. This would include rehab of those fuel tanks and water tanks not now in use and rebuilding of the 250 kw diesel generators. Other major rehab projects will be necessary for long-term continuation of any management options other than remote field camps. These projects include repair of deteriorating bulkheads, replacement of the boat hoist, rehab of fuel/water tanks now in use, plumbing repairs, roof repair, replacement of some major components of the water system, and boat basin/channel dredging with buoy-mooring system. Rough estimates of the costs associated with the major rehab projects are indicated below. Costs could be reduced significantly if major repairs requiring boat charter were accomplished simultaneously.

250 kw diesel generator rebuild:	40K
Fuel tanks (not in use):	60K
Water tanks (not in use):	40K
Bulkhead repair/replacement:	1,000K
Boat hoist replacement:	15K
Fuel/water tanks (now in use):	20K
Plumbing repair:	10K
Roof repairs:	15K
Water system replacements:	25K
Boat basin/channel dredging:	1,200K

(3) User Conflicts: Service operation of a facility at Tern Island has been a source of controversy. Conflicting demands for potential use of the site by other agencies or individuals insure that Service management of the island will continue to be closely scrutinized. Decisions to implement a particular management option preclude at least some other potential uses of the facility.

(4) Disturbance to Wildlife: Any human activity on islands or waters of the HINWR involves some disturbance to wildlife including migratory birds and endangered or threatened species. Service policy restricts authorized activity to the level necessary to monitor the status of wildlife resources and prevents activities that may adversely affect those resources. The documented repopulation of Tern Island by monk seals has heightened concern that human presence, even at minimum levels, may jeopardize this species. On the other hand, a low level of disturbance may be justified

if it is necessary to effectively monitor populations and enforce regulations to prevent more serious disturbance by unauthorized visitation into the HINWR.

(5) Safety Hazards: Operation of a remote facility can not occur without significant risks to human safety. These risks can be minimized with proper planning, equipment and staff training, but they can not be eliminated. Among the safety hazards associated with operation of the Tern Island station are the following: (a) fire, (b) aircraft accident, (c) boating/diving injuries (including shark attack), (d) drowning, (e) weather related injuries, (f) electrocution or other equipment related injury, and (g) fish poisoning. The seriousness of injuries is aggravated by the remote nature of the station and the difficulty in medical treatment and evacuation of personnel. The significance of the safety hazards varies with the number of personnel at the station and the types/locations of activities in progress. On the whole, these risks are not significantly greater than operation of other FWS remote field stations/camps in the Pacific Islands, Alaska, Canada, or other parts of the world.

(6) Staffing Problems: The unique nature of the Tern Island operation demands staffing skills and experience that are not easy to come by. Few FWS employees at the suitable grades have had the varied experience that has proven to be useful in maintenance of equipment, enforcement, and wildlife research. The classification of the Tern Island positions as career-seasonal has also reduced their appeal. For those applicants without extensive remote station experience, we lack the experience base

on which to predict their ability to handle extended periods of isolation or to work and live on a full-time basis with other employees and spouses. Morale considerations are very important in scheduling supply flights, in staffing, setting work requirements and in communication with supervisors. Support of the station also puts unusual demands on the time of other refuge staff who must schedule their work around supply flights, boat charters and unpredictable breakdowns of equipment on the remote station.

(7) Energy Consumption: Operation of a remote station involves the expenditure of considerable amounts of fuel for aircraft/boat charters and for the nearly continual operation of generators on-site. Steps taken to reduce energy consumption include conversion to smaller generators, heating of water by circulation through the generator engine, elimination of most air conditioners, shared use of boat/aircraft supply charters, shortening of the daily generator schedule, and reductions in the amount of boat use at FFS.

CONSIDERATIONS INFLUENCING A CHOICE OF TERN ISLAND MANAGEMENT OPTIONS

Evaluation of management options for Tern Island without consideration of the varied issues and events that affect or may be affected by FWS management decisions is not realistic. These factors are discussed briefly below to provide some perspective in the interpretation of management options covered in detail later in this report. The existing or potential relationship between these factors and FWS management of Tern Island is noted.

(1) Secretarial Commitment: The commitment by former Secretary Andrus to keep all options for future use of Tern Island is open to some interpretation. It appears that only complete abandonment of facilities prior to conclusion of Tripartite research would be in direct conflict with this commitment. Yet even abandonment would not necessarily preclude future uses, but it would greatly increase the cost of options that could otherwise make use of existing facilities if they were adequately maintained. Also, the appointment of a new Interior Secretary does not negate the earlier commitment, but it does raise the possiblity of a significant change in Interior policy with respect to Tern Island. We have honored the Secretarial commitment in our operation of the station since July 1979, particularly where it has involved maintenance of equipment and facilities beyond our immediate needs. We have also supported the research efforts of others involved in Tripartite studies to enable timely management planning based upon sufficient data.

(2) Guidance of the Marine Mammal Commission and Monk Seal Recovery Team Regarding FFS: Members of both the MMC and MSRT have expressed concern regarding the variety of activities, including research, which are ongoing or have been proposed for FFS. In FY 81 all proposed research has been subjected to Section 7 review and has also been reviewed by the MMC. The argument has been voiced that the comparative stability of the FFS monk seal population warrants a "hands-off" policy for all actions including research that might possibly disturb seals in their haul out and pupping areas. A contrasting opinion holds that a low level of monitoring research on FFS seals is justified to detect changes in population status and to enable prompt response to population problems.

(3) Pending Resolution of the HINWR Boundary Dispute: The State of Hawaii contends that the legitimate boundary of the HINWR includes only emergent (fast) lands (excluding Midway and Kure), while the FWS position includes an additional 300,000+ acres of lagoon waters and fringing reefs within refuge boundaries. Disputed fishery potential of these waters aggravates the debate over legal boundaries. Interest of the State and the fishing industry in long-term managment of Tern Island is intimately tied to the resolution of this lingering boundary issue.

(4) Pending Designation of Critical Habitat for Monk Seals and Turtles: Critical habitat, pursuant to Section 7 of the Endangered Species Act of 1973, has not been formally designated for any listed species in the NWHI. A draft critical habitat proposal for the threatened green sea

turtle (including habitat within the HINWR) was prepared in 1978 and subsequently withdrawn. Conceivably a modified version of the original proposal will be reproposed at a later date.

Critical habitat was formally proposed by NMFS for the monk seal in 1978 and in a second draft in 1979. Three boundary options were reviewed in this most recent proposal (10 fathom line, 20 fathom line, 3 mile line). Considerable opposition to critical habitat designation was raised by State and industry representatives. The Monk Seal Recovery Team has recommended designation of the 20 fathom isobath as the critical habitat boundary. It is anticipated that NMFS will soon make an updated formal proposal. In view of the documented repopulation of Tern Island by a significant number of monk seals over the last two years, it is virtually certain that the land at Tern, if not all surrounding nearshore waters, would be included within the updated CH proposal. Such an inclusion would affect the choice of long-term management options for Tern Island.

(5) Wilderness Area and Research Area Designation: The HINWR has been twice proposed for wilderness area designation pursuant to the Wilderness Act of 1964 (16 U.S.C. Sections 1131-1135). The initial proposal included all land and water within the refuge, excepting Tern Island and adjacent waters which had been extensively dredged. In response to strong State opposition, the proposal was modified to include only emergent lands (also excluding Tern Island), but this proposal is still pending. The man-made nature of Tern Island, including buildings and other facilities, were not considered appropriate to wilderness areas regardless of documented

wildlife values. However, eventual wilderness area designation of other areas, particularly lagoon waters, could lead to more substantial restrictions on permitted activities and could, therefore, affect the selection of long-term management options for Tern Island.

Lands and waters of the HINWR, including Tern Island, were designated as Research Natural Areas in 1967 (40 CFR Sections 8127-28). The objective of such designation is to protect ecosystems in a natural state with no intervention of man except to preserve the system. Research natural areas on national wildlife refuges derive regulatory protection through 50 CFR. This designation will not in itself exclude any particular option for Tern Island, but it does support options which seek to protect marine and terrestrial ecosystems within the refuge.

(6) State Proposal for Test Bait Fishery and Use of Tern Island: By letter in December 1979, the State of Hawaii formally expressed desire to use Tern Island as a test fishery support station and to initiate a test bait fishery within FFS. Both requests were forwarded to NMFS for Section 7 consultation in April 1980. Meetings were held between agencies involved to evaluate methods to assess baitfish resources that would not jeopardize seals or turtles. On March 11, 1981 NMFS issued a biological opinion concluding that both projects were likely to jeopardize the monk seal and turtle. Alternatives proposed to avoid jeopardy included a visual baitfish assessment and a mothership support station.

FWS intra-Service consultation pertaining to responsibility for green sea turtles on land concluded that the proposals, as modified by NMFS, would not jeopardize the turtle. It is clear that these biological opinions directly affect the Service's consideration of fishery station opinions at Tern Island. The possibility exists that the original NMFS jeopardy opinion may be challenged or appealed under provisions of the Endangered Species Act by the State of Hawaii or the fishing industry.

(7) Other Ongoing Planning Programs: The FWS is not the only agency or entity involved in resource management planning in the NWHI. The Western Pacific Fishery Management Council is currently developing fishery management plans for fishery resources within the Fishery Conservation Zone, an area which overlaps boundaries of the HINWR at certain locations within the archipelago. Among the various fishery resources included in these plans will be billfish, lobster, tuna, precious coral and others. Exploitation of these resources is in part related to the availability of shoreside logistic support, so long-term management decisions for Tern Island are of interest to the fishing industry. The State of Hawaii's Fishery Development Plan (December, 1979) strongly advocates development of fishery support stations on Tern Island and at Midway as means to permit cost-effective resource exploitation in the remote NWHI.

Other ongoing planning efforts relating to NWHI resources include a project by Sea Grant to employ the Delphi technique in the evaluation of management options. This method would be used to gather information on which to base management decisions. The format and time schedule

for this study are now under investigation by Sea Grant. In addition, Sea Grant has funded a study of institutional policy-making on resource management in the NWHI. Presumably, the results of this study will also affect future involvement of various agencies in the resolution of resource management conflicts.

(8) Schedule for Tripartite Research and Data Analysis: Although some investigators involved in Tripartite research intend to carry their studies beyond the end of FY 81, it is clear that for most the ongoing field season will be the last year of intense data gathering in the NWHI. Data analysis will follow in FY 82 and beyond. The Tripartite Coordinating Council has tentatively planned a Spring 1983 "wrap-up" Tripartite Symposium. May 1983 would be the end of the five year research period specified in the original agreement. The research vessel, TOWNSEND CROMWELL, will be used for resource assessment work in the Northern Marianas Islands after FY 81. The Service intends to incorporate Tripartite research data into a master planning process for remote islands that will begin in FY81 and extend until the end of FY83. Additional Sect. 7, NEPA processes and citizen participation will likely extend the planning process through FY84.

(9) Reduced Availability of Vessel Support: U.S. Coast Guard bouy tenders provided vessel support for FWS trips into the HINWR for 15 years, beginning soon after the first resident refuge manager position was established in 1964. The last bouy tender cruise in the NWHI was in August 1980. During this trip, 20,000 gallons of diesel fuel were

transported to the FWS station at Tern Island. No future Coast Guard vessel support is anticipated in the NWHI. The NOAA ship, TOWNSEND CROMWELL, has provided the primary field research platform during Tripartite studies in the NWHI although other charter vessels have supplemented this support. The final Tripartite cruise is scheduled to end in August 1981 after which the vessel will return to the mainland for maintenance and repairs. The CROMWELL is then scheduled to support resource assessment studies in the Northern Marianas Islands and is not anticipated to support any additional work in the NWHI in the foreseeable future.

The relationship of this anticipated reduction in vessel support to Tern Island management is mixed. On the one hand, reduced access to other islands in the HINWR increases the value of alternative means to monitor wildlife resources and to maintain FWS enforcement presence, such as through operation of an aircraft supported facility at Tern Island. On the other hand, these government vessels have provided considerable logistical assistance in support of the current FWS station at Tern Island and other field camps at considerable savings to the FWS. Fuel and heavy or bulky supplies will still require alternative vessel support. Rapidly escalating fuel prices tend to make private boat charters in future years less available.

(10) Increasing Frequency of Fishing Boat Traffic in the NWHI: Accelerating interest in NWHI fishery resources by local and non-Hawaiian boats is expected to continue, particularly as a result of recently successful

albacore fishing programs northwest of Midway. Increasing restrictions on access to various mainland fisheries will further stimulate interest in Hawaiian resources by Mainland-based boats. Continuing Federal, State and industry support will help to provide the shore-based infrastructure that will permit more boats to venture farther into the NWHI and stay longer. Many of the boats exploiting resources in the western end of the archipelago will market their fish and resupply in Honolulu, insuring that boat traffic adjacent to refuge islands and waters will increase significantly. This accelerating boat activity is already evidenced in two goundings by fishing vessels at FFS between February 1980 and January 1981. Many of the fishing boats now entering the NWHI are doing so without the benefit of prior experience in often treacherous waters.

Again, this increasing use of NWHI waters by fishing vessels is a mixed blessing for FWS management of the HINWR. The risks of shipwreck (and possible introduction of exotic species), oil spill, loss of life and harassment of wildlife are clearly greater as boat traffic increases. For these reasons, the emergency response capability and enforcement value of a FWS station at Tern Island becomes more significant. On the other hand, as the frequency of boat traffic increases, so does the opportunity for station support. With declining activity of NOAA and Coast Guard ships, this assistance may prove critical to cost-effective operation of a FWS station at Tern Island.

EVALUATION OF MANAGEMENT OPTIONS

This report evaluates only six short-term management options. Each is implementable by the Service. None inherently precludes possible involvement of other agencies or organizations through sharing of logistical support, equipment, staffing or simply through the shared funding of Service operations. However, it is our position that shared management of the station at this point in time should be avoided to insure that proprietary rights, or feelings do not develop. One possible exception might include shared operation of the station with NMFS in view of our joint jurisdictional responsibility for endangered monk seals and threatened green sea turtles.

The six options under consideration are based on real-life experience over the previous two years, during which three versions of these options have actually been in effect at one time or another. The six options are evaluated in relationship to identified benefits and implications inherent in station operation. This evaluation is summarized in Table 1. Detailed cost estimates for each options are provided in Tables 2-7 and summarized in Table 8.

OPTION ONE: ABANDONMENT

Description

A decision to abandon existing facilities at Tern Island could be implemented at any time. To be cost-effective, it would include removal of valuable equipment and supplies (small generators, tools, research equipment, boats/ motors, food, radios, personal effects, etc.). This would require at least one large vessel charter. The tractor, the truck and large generators would not be removed. Preventative measures would be taken to "mothball" equipment which remained, but deterioration could only be retarded, not prevented. One version of the abandonment option that was not considered would involve demolition and removal of all facilities and buildings in an attempt to convert the island to a "natural" state. The abandonment option would include removal of remaining diesel fuel and gasoline. Implementation of this option would not preclude future use of the island for field camps as now regularly occurs on other islands in the HINWR.

Relationship of Option to Identified Benefits and Implications

Enforcement of regulations preventing unauthorized activities on refuge islands and lagoon waters at FFS would not be possible under this option, so uncontrolled disturbance to wildlife and habitat would occur. Failure to maintain Service occupancy would almost inevitably lead to vandalism and theft of remaining facilities and equipment. Even authorized

activities, such as refuge research, would need to be severely restricted because of the logistical difficulty in monitoring. Equipment or facilities not disturbed by unauthorized visitors would deteriorate rapidly due to corrosion.

Ongoing Service research programs would be severely curtailed or eliminated. In particular, projects requiring long-term monitoring that are not possible at other locations would be terminated. Monk seal productivity could not be accurately determined, even with extended field camps in place of the station because of the inherent difficulty in maintaining and operating necessary boats and motors for inter-island trips. Non-Service research would be restricted for lack of monitoring capability. Long-term non-wildlife research on Tern would be terminated for lack of regular equipment maintenance capability. Tern Island would no longer provide logistic support for other NWHI research, nor would there be any greater emergency response capability at Tern than at other islands in the archipelago.

The runway would soon lose its value as an emergency landing site after winter storms, high winds, nesting birds, and encroaching vegetation rendered it unusable. Educational opportunities would be limited to temporary field camps with no inherent advantage over other NWHI. Some unauthorized recreational activities, such as pleasure boating, diving, and sport fishing would probably occur at FFS in the absence of effective enforcement of refuge regulations.

Annual O&M cost savings resulting from abandonment would be offset to some degree by the major cost of equipment removal, the costs due to deteriorating or vandalized facilities and the added cost of rehabilitation should a later decision be made to reactivate the station. Increased costs of operating temporary field camps at FFS in lieu of a permanent station would also partially offset savings caused by abandonment. Major rehab costs would not be incurred if abandonment was final. These costs would be significantly greater if the station was reactivated after a number of years because of accelerated deterioration of systems and facilities.

User conflicts would be aggravated by a decision to abandon the station because it would preclude some options or make them cost-prohibitive. Greater limitations on non-Service research or other activities would not be acceptable to those whose work is now facilitated by the station. Initially, disturbance to wildlife would diminish when Service personnel left FFS. However, in their absence unauthorized visits or even extended occupation of Tern and other islands would increase and the disturbance factor would be much more severe. Safety hazards and staffing implications associated with station operation would be eliminated by abandonment of the facility although future temporary field camps at Tern could not be operated without risk or staffing problems inherent in more remote field research. Energy consumption would decrease markedly after completion of boat charters necessary to remove equipment. Any diesel fuel or gasoline left on the island upon abandonment would likely be stolen or become unusable within a short time. Energy consumption by increased charters for field camps could offset decreases in generator and air craft use.

OPTION TWO: PART-TIME STATION

Description

This option would involve continued use of existing facilities and equipment, as modified by FWS since Coast Guard disestablishment of the LORAN station. However, occupation would occur during only six months of the year between April and September. This period corresponds with the time of year when weather is most amenable for research on other islands and the period when boating and fishing activity is most intense and hence the need for enforcement is greatest. It also corresponds with the peak breeding seasons for seabirds, turtles and seals.

Implementation of this option would require mothballing of some equipment (i.e., truck, tractor, generators, etc.) and removal/replacement each year of valuable portable equipment (radios, personal gear, etc.). All equipment left on the island would be vulnerable to vandalism, corrosion and theft. This option would require boat charters at the beginning and end of each season in order to move equipment too heavy or bulky for the airplane and to prepare the runway surface. Successful (cost-effective) implementation of this option would depend upon the somewhat unpredictable yet high deterioration rate of equipment/facilities and the potential effects of vandalism, occupancy or theft.

During the period of station operation, two full-time staff would be resident on the island, and a half-time staff member would handle

supply out of the Honolulu office. A major portion of the island staff's time would be devoted to the start-up and mothballing operations at the beginning and end of each field season.

Relationship to Identified Benefits and Implications

On the surface, it would appear that this option would permit continuing maintenance of the existing facility. However, some major equipment probably could not be effectively mothballed for six month periods (i.e., 250 kw diesel generators), and other equipment or facilities would be vulnerable to accelerated deterioration, vandalism and theft. Service presence would not be maintained during half the year, but enforcement of refuge regulations would be adequate during the most critical breeding seasons. Service research/management could continue, but some long-term studies dependent upon year-round data would suffer for lack of continuity. In particular, ability to monitor seal, turtle and bird populations would be impacted. The same would apply to non-service wildlife studies, although these have generally been concentrated during the months that the station would be in operation. Non-wildlife research would likely be curtailed, for the most part, because the primary ongoing studies require year-round maintenance of recording facilities (i.e., weather and tidal equipment). Logistic support for other NWHI research could still be provided during periods of station operation. All other benefits attributable to a Tern Island station would be available only during occupancy by Service personnel.

Barring major losses to vandalism or theft, annual O&M/cyclical maintenance costs would decline as a result of fewer aircraft charters, fewer supplies, reduced salaries and less frequent equipment maintenance. However, this would be offset somewhat by boat and plane charters required at the beginning and end of each season and the unpredictable higher maintenance costs for certain pieces of equipment that require continuous or frequent operation. Major rehab costs would increase for those facilities or equipment that now benefit by periodic operation and maintenance throughout the year.

User conflicts would increase to the extent that intermittent operation of the station would preclude support of other station users during the "off" season. Disturbance to wildlife by researchers and FWS personnel would decrease during the period when the station was not occupied, although unauthorized visitation to FFS would likely occur and the effects of this activity would be more severe than station occupation by Service personnel. Also, re-occupation of the station after an extended period of absence might have a greater adverse effect on those populations of wildlife that appear to accomodate over time to continued, very limited human presence. It may also require intentional disturbance to nesting birds in areas that would affect aircraft operations.

Safety hazards would diminish overall by virtue of the shortened field season but would be unchanged during station operation. Staffing problems would increase because of the much greater difficulty in finding and retaining qualified remote station personnel that would be willing

to work significantly less than full time. Previous experience in station operation would be particularly critical at the start of each new field season when mothballed equipment would have to be put into operating condition. Energy consumption would drop due to reduced air charters and reduced operation of generators and boats. However, stockpiled diesel fuel and gasoline would be subject to deterioration and possibly theft during the "off" season, so the savings may not prove cost-effective.

OPTION THREE: ONE EMPLOYEE ON ISLAND

Description

This option would involve a one person permanent staff at the Tern Island station, but it would require the presence of a spouse or volunteer staff during the entire period for safety reasons. An additional ½ time equivalent staff would provide support for the station out of the Honolulu office. The staff person on Tern would rotate off the island for a month after five months on. He would be replaced by another RWR staff person during the two months off the island.

The principal role of the staff person on Tern would be facilities maintenance. There would be no time for research or wildlife management except through scheduled overtime or on the employee's own time. Some activities that occasionally require two people could be scheduled to occur during turn-around flights or during periods when other researchers or maintenance staff may visit the island. There would not be a significant reduction in on-island equipment operation, and off-island boat use would not be permitted because of safety considerations, except when a visitor was available to provide boat rescue presence or radio operation.

Relationship to Identified Station Benefits and Implications

Maintenance would be limited to activities absolutely necessary to keep the station in operation. There would be insufficient time for any

rehabilitation work or major preventative maintenance programs except as contracted. Major breakdowns may require unscheduled flights to bring additional personnel or equipment. Service "presence" would be maintained at the station, but ability of staff to enforce refuge regulations off Tern Island would be eliminated by safety restrictions on boat use without backup personnel.

Service research/management at FFS would be reduced from present levels unless visiting biologists work at the station. Even this work would require additional support because the Tern Island staff person would be unable to divert his attention from maintenance duties. Non-Service wildlife research would be subject to the same limitations in support. Non-wildlife research could be continued at a limited level, assuming the employee's spouse would be willing to monitor weather or tide-recording equipment as has occurred in past years. Logistic support for other NWHI research could also continue to the extent it did not seriously infringe on maintenance responsibilities.

Emergency response capability would be limited to radio communications and on-island assistance to vessels in distress. Ability to assist by boat would be eliminated by the lack of back-up people on Tern Island. Continuing runway maintenance would permit emergency flights to land with additional people in the event of a boat grounding or other emergency. Logistic support for other activities, including fisheries, would be severely limited by staff constraints. The runway would continue to be available as an emergency landing site. Educational opportunities at Tern Island and FFS would be curtailed because of minimal monitoring and support capability.

Annual O&M costs would diminish proportionately to the reduced staffing level and as a result of reductions in other activities that can not be adequately supported by a single on-site staff member. Rehab needs would increase and life expectancy decrease because the resident staff member would be unable to devote time to major preventative maintenance projects, and the rate of deterioration would be accelerated by more use and harsh climatic conditions. User conflicts would increase and uses eliminated by virtue of the Service's inability to support activities of others, including research, with limited staff. However, concern that future options at Tern Island would be precluded by Service activities would be satisfied through continued station operation, even at reduced levels.

Disturbance to wildlife would diminish on Tern Island but would increase elsewhere due to our inability to effectively enforce refuge regulations. Two people on the island is an absolute minimum for continued safe operation. Even with two people, safety hazards of equipment operation are significantly increased when compared to a larger staff. Precautions to minimize these problems relate primarily to the use of boats, but other operations (i.e., aircraft landings, tractor use, electrical repair, movement of heavy objects) are also more risky with reduced staff. Dependency of continued station operation on a single individual also aggravates the problem of locating and keeping a multi-talented person who can adjust appropriately to the isolation and difficulty in working alone. Successful operation of the station requires a resourceful self-starting person with a working knowledge of

electricity, plumbing, engineering, diesel/gas engine repair, boats, pumps, tractors, radio communication, refrigeration and a wide variety of other kinds of equipment and systems. Continued station operation is also jeopardized when the primary staff member leaves the island before a follow-up person can be adequately trained to continue after he/she leaves.

OPTION FOUR: TWO PLUS ONE, ROTATIONAL

Description

This option is similar to the status quo as of May 1981. It involves two island staff (GS-9, GS-7) who rotate on (5 months) and off (1 month) the island. Preferably each would be accompanied by his spouse or partner who is not employed by the Service. At the present time, both partners are working under volunteer agreements with the Service. They conduct research/management studies and provide station support, in return for which, they receive food and room. This option, when fully staffed, would also include a staff person (GS-7) in the Honolulu office who would provide station support by procuring supplies and would rotate onto the island for the four months each year that a staff person would rotate off Tern. The supply task is presently taken care of by other RWR staff at the expense of other program and operational responsibilities.

Currently, even with two staff persons on the island, virtually all refuge time is directed towards maintenance activities. Involvement in Tripartite research, including the development of census/monitoring techniques, has necessitated frequent overtime and contributions by island staff on their own time. Additional maintenance support is provided incidentally by periodic visitors to the island and by contractors. Long-term rehab projects are virtually ignored although periodic preventative maintenance of some equipment (i.e., 250 kw diesel generators) helps to delay rehabilitation.

Relationship to Identified Station Benefits and Implications

This option would be adequate to maintain equipment and facilities needed for continuing operation at reduced occupancy. Extended support of additional researchers or other activities would be difficult but manageable with periodic scheduled overtime and close cooperation by all involved. Service "presence" would be maintained on Tern Island, but the ability to effectively enforce regulations in FFS waters is contingent upon back-up boat and radio support in case of emergency. Long-term wildlife monitoring studies would be possible, particularly with periodic assistance in research and maintenance. Station volunteers and staff have gathered particularly valuable data on monk seal haul out patterns, pup production and seabird breeding success that would not be obtainable without continued presence in the shoals. Non-wildlife research has been possible on Tern Island by Service staff or volunteers, and other work has been supported off the island. Emergency response capability has been tested over the last year with three grounded vessels. In one case, when the freighter ANANGEL LIBERTY grounded, it proved to be particularly valuable that three refuge staff were on Tern Island at the time of the event. More assisted from the Honolulu office.

Logistic support for other work at FFS would be difficult without additional staff. In particular, activities that potentially disturb wildlife require staff to help avoid and/or monitor effects. Educational activities, such as graduate research, have been accomodated at a low level on Tern Island but only through close cooperation with Service

personnel and operations. Continued maintenance of the runway insures availability of the site as an emergency landing site and minimizes bird encroachment and disturbance.

Annual O&M costs are best identified for this option because of our recent experience in station operation. However, the unpredictable nature of equipment deterioration and failure adds a level of uncertainty that can not be eliminated. There do not appear to be remaining areas of operation under this option where significant additional savings can be generated. Major rehab projects have not been addressed under this option, except through the periodic running of 250 kw generators to retard deterioration and intermittent backfilling behind rusting bulkheads to retard erosion. Given additional staffing or possibly through contract labor, other preventive treatment could be directed to the boat hoist, fuel/water tanks, buildings and possibly even the most seriously affected bulkheads.

User conflicts have been defused somewhat through operation of the station at a level that does not preclude any of a full range of future management options. Demand for research support has also been satisfied, at least to the point where conflict with endangered wildlife has become the determining factor.

Disturbance to wildlife has been minimized but not eliminated through enforcement of restrictions on human access to important seabird colonies or haul-out sites for turtles and seals. However, increasing

demand for research support, particularly at Tern Island, cannot be accommodated without some risk of disturbance to resident animals. Continuing increase in the number of seals using Tern Island is evidence that the reduction of people on the island (and the change in behavior of residents) has made the site more attractive to seals. However, this repopulation might have occurred at an even faster rate, and pupping may also have occurred if the resident staff and frequency of other visitor use had been reduced even more or eliminated.

Safety hazards have been reduced through the continued presence of at least two refuge staff on Tern Island and through the implementation of measures to insure safe operation of equipment. Boating safety, particularly over long distances, could be further enhanced by greater numbers of on-site support staff and larger, rough-water boats. However, the capacity of the boat hoist currently limits our options in choice of equipment.

Staffing problems continue to be difficult, yet certain aspects are not substantially different for this option than for the others. Weaknesses in the experience of one staff person on the island can be offset to some degree by the skills of the other, although the need to operate the station independently during periods of the year requires that critical skills be shared. Long-term sharing of housing facilities and working together create some personnel conflicts that cannot always be predicted in the selection of staff. At the same time, the company of others, including visiting researchers or volunteers, relieves some of the monotony

of isolation and improves morale. Training has proven difficult to arrange given short off-island periods although appropriate correspondence courses have proven useful.

Energy consumption has been closely watched during the period of Service occupation at Tern Island. Additional staffing increases generator load and hence fuel demand to some degree, but it is not a linear relationship. Major changes in operation, such as the operation of additional freezers to support researchers, do clearly increase fuel use and cut into generating capacity. The extent of boating activities also directly affects gasoline usage and the frequency of boat charters necessary to transport gasoline drums to the island.

OPTION FIVE: THREE PERSON, ROTATIONAL

Description

Under this option, three staff (1 GS-9, 2 GS-7) would operate the Tern Island station on a rotational basis. Each would be on the island four months, and off two. The schedules would be staggered so that two people would operate the station at all times. The staff person off the island would resupply the station while working out of the Honolulu office. He would also take annual leave and LWOP (if career seasonal status is maintained) during periods off the island. While on active duty in Honolulu, this staff person would be paid per diem at the government rate. A less costly alternative might involve use of government furnished housing with reduced per diem. This option has the advantage of insuring that the person charged with resupply (including purchase of equipment parts and other specialized items) would be intimately familiar with station needs. This would also relieve other RWR staff of the resupply function.

A version of this option was in effect between April 1980 and April 1981. This began as a 2-month-on/1-month-off arrangement and shifted to the proposed 4-on/2-off routine. During this period, the staff person off Tern Island was based in government housing at Kilauea Pt Administrative Site on Kauai. This resulted in inefficient communication between the employee and Honolulu staff and did not prove cost-effective because

of the high cost of inter-island travel and purchase of necessary supplies on Kauai. It also continued to demand considerable time by Honolulu staff in the resupply effort.

Relationship to Identified Station Benefits and Implications

Virtually all identified station benefits would be addressed as in Option Four because on-island staffing would remain at two throughout the year under both options. Both maintenance programs and research/ management studies may suffer somewhat as a result of reduced continuity of personnel, although this would be offset by greater opportunities or coordination with RWR staff, analysis of data and review of available literature. Also, all Tern Island staff would share equally in the resupply, maintenance and research/management roles insuring greater familiarity with all aspects of the job. This may prove particularly important when Tern Island staff transfer to other positions.

Salary costs for this option would not differ from Option Four, however annual O&M costs would increase overall due to greater per diem incurred for support of rotational staff working in the Honolulu office. An estimated 5K could be saved in per diem costs if RWR rented an apartment or house for rotational staff to occupy during periods off Tern Island. Rehab costs, user conflicts, wildlife disturbance and safety hazards would not differ between options four and five.

The effect on staff is problematic. Current staff appear to prefer a rotational schedule that minimizes the time they spend in Honolulu. At the same time, prolonged sharing of the Tern Island facility can aggravate personality conflicts, including those involving staff spouses or partners on the island. The 4-month-on/2-month-off schedule would also improve opportunities for staff training.

OPTION SIX: FOUR PERSON, ROTATIONAL

Description:

This option would involve three refuge staff (1 GS-9, 2 GS-7) who would rotate duties at Tern Island on a 5-month-on/1-month-off schedule, and an additional half-time GS-5 employee in the Honolulu office who would perform the supply function throughout the entire year. Periods off the island could be staggered evenly or intentionally scheduled to maximize on-island staff during periods of peak research/management activities (including work of other agencies).

One version of this option would involve position classification and selection of personnel so that maintenance and research roles were split between the two GS-7 positions. Although each staff member would be expected to cover for the other when necessary, this division of responsibility would have some distinct advantages in productivity.

While off the island, each Tern Island employee would work out of the Honolulu office, providing opportunity for training classes and coordination with RWR staff. Actually, unless these positions are converted from career seasonal to PFT, at least four of the eight weeks off the island each year would be occupied by annual leave and LWOP.

Relationship to Identified Station Benefits and Implications

This option would permit enhanced station maintenance, including some activities designed to further delay major rehab projects through preventative maintenance. Most importantly, Service "presence" would be at an effective level whereby off-island enforcement of refuge regulations and monitoring of research/management activities of other investigators could be implemented safely. Service research/management capability would also be increased by virtue of additional manpower and diversity of training and experience. This would permit us to effectively address important research/management studies that must be ignored under present staffing levels. Non-Service wildlife and other research could be more effectively supported without impacting day-to-day Service studies or maintenance needs. All other support activities, including emergency response, would be enhanced with additional on-site staff. The ANANGEL LIBERTY incident clearly illustrated the need for more than current staff levels during an event of this significance. All of the identified benefits could be addresed to an even greater degree if spouses were present to assist in some station operations.

Salary costs would be greater for this option than for the others due to increased staff. However, this would be offset somewhat through a more effective preventative maintenance and equipment repair program that would lead to cost reductions elsewhere and by reduced per diem costs when compared to Option Five. User conflicts would be reduced by capability to support and monitor additional non-Service activities and

to improve maintenance of facilities during "predecision" years. The overall level of wildlife disturbance would increase with a greater level of human activity although this larger staff would enable tighter controls and regulation of all non-Service projects. Safety hazards would be significantly reduced by the presence of a third trained staff member on site. Staffing problems would also be reduced by the ability to insure continuity in experience as employees transferred in and out of the station. Morale would also be improved by the diversity of people on site.

EXPLANATION OF TABLES 2-7

VERTICAL COLUMNS:

Staffing

Staffing refers to the number and classification of USFWS employees that man the field station at Tern Island and/or obtain materials, supplies and provide support on a full- or part-time basis in the Main Islands.

Staff Schedule

The staff schedule describes the pattern of station occupancy by resident Tern Island staff.

Aircraft Charter

The ongoing need for supplies (including repair parts), the exchange of personnel and the frequency of visits by researchers determine the need for chartered aircraft flights to Tern Island. Although the current rate is about $2,100 per flight, it is still more cost efficient than to charter boats at the cost of about $1,500 per day with a typical minimum of about six days or $9,000 needed for a round trip to French Frigate Shoals.

During FWS occupation, chartered flights have been scheduled monthly. Transportation to the field station for non-refuge staff is on a space-available basis on scheduled supply flights or is paid for by the agency with which the individuals are affiliated. The present aircraft being utilized is a twin-engined Beechcraft equipped with LORAN navigational equipment. It is also capable of following the non-directional beacon signal that is transmitted from Tern Island. The capacity of the aircraft is 1,200 lb of material or personnel.

Boat Charter

Boat charters are needed to supply fuel and/or heavy materials that cannot be carried by the chartered aircraft. During the two years that the station has been operated by FWS, charter costs have been limited to the costs that were required to divert a U.S. Coast Guard fuel supply ship to the Shoals to deliver diesel fuel. We have also been able to utilize the NOAA ship TOWNSEND CROMWELL to deliver boat gasoline, boats and other supplies at no cost because this ship was in the vicinity of the Shoals on research missions. Neither Coast Guard nor NOAA vessels will be available for resupply of Tern Island after August 1981. Transportation of fuel and other heavy supplies will thereafter require the expense of chartering appropriate sized vessels at the June 1981 costs of $1,500 or more per day. The availability of charter craft to carry out this service is dependent on season, weather conditions, fishing conditions and a variety of other factors. The present harbor conditions at Tern Island determine

upper size limitations on the type of vessel that can be used, and the distance and sea conditions determine lower size limitations. The frequency of need for boat charters is dependent on fuel use, frequency of replacement of heavy equipment and the level of usage of the station. Even brief abandonment of the station would necessitate the use of a boat to get to Tern Island because the air strip is subject to deterioration during adverse weather conditions and obstruction by nesting birds. Its condition can only be ascertained from the ground.

Food

The amount of food is directly dependent upon the level of usage of the station. Food costs are borne by the staff and visitors, but costs related to supplying the staff's food to the station and costs of food for visiting RWR staff are paid for by the refuge. Reduction in the demand for fresh foods can result in cost savings through less frequent supply flights, but it also has an adverse effect on morale of resident staff. Non-Service personnel are responsible for their own purchase and transport of food.

Onan Generators

The electrical power supply is provided by two generators of 15 kw and 17.5 kw capacity respectively. A spare engine is available, and it is rotated with the two engines that run the generators during times that they are removed and periodically overhauled in Honolulu. Costs indicated

represent the cost of periodic overhaul, estimated repair or replacement of parts that break down between routine overhauls, replacement of lubricants on a routine basis and the cost of fuel to operate the engines. Generally the generators are operated between 0600 and 2300 hours. However, the presence of researchers or other visitors or the operation of special projects may necessitate their continual operation. Fluctuation in costs of operation is directly related to the number of people and the type of work that is being conducted on the island. For example, a research party that uses the stoves, washing machines and freezers along with increased usage of lights and other equipment may almost double the daily cost of supplying power.

250 kw Diesel Generators

Three 250 kw generators were used by the Coast Guard to supply electrical power to operate the former LORAN transmitters and to operate the living facilities for a crew of about 22 people prior to the time that they abandoned the station in 1979. These generators are too large for the cost-effective operation of the station at current levels. The large generators are each run for one hour per month to retard deterioration of equipment. Costs associated with this operation are reflected in the status quo level of costs. Because of an unexpected breakdown in the battery system needed to start the diesel engines that operate the generators, a one time (cyclical maintenance) cost of replacement was borne by the refuge in 1981. We are currently investigating the possibility of long-term mothballing of these generators.

Tractor with Loader and Backhoe

The Coast Guard left a 1976 Case diesel tractor with a front end loader and a backhoe when they abandoned the station. The tractor also has a plow attachment. The tractor is used to drag (level) the coral runway, to assist in the unloading of boats, to carry heavy equipment and to excavate. It is critical to the current operation of the station, particularly because of the frequent need for runway maintenance. Costs involved are those related to fuel, routine maintenance, and repair of corroded, worn or broken parts. Tractor usage increases considerably when the station supports research of others and, for this reason, is highly seasonal in peak use.

Pumps/Motors

A wide variety of pumps and motors are used to move fresh and salt water for domestic uses or to cool engines, to operate machinery and to pump fuel. Costs involved relate to the continual checking, routine maintenance and the repair and replacement of worn or broken parts, and to the occasional replacement of an entire pump or motor. Costs are roughly correlated with the level of usage of the station.

Whalers (Boston Whaler Boats)

Three 16.5 ft outboard motor boats are used to travel to the other islets in the Shoals, to carry materials and personnel between Tern Island and visiting supply vessels and to conduct marine research. The boats have also been used to rescue shipwreck victims. The condition of the boats ranges between one that has just been purchased to one that has much of its flotation material waterlogged, and is only usable in the immediate vicinity of the island. Costs involve fuel (gasoline and oil), repair and/or replacement of the hulls, moldings, controls and other components. Because of the treacherous nature of the reefs and current and wave patterns within the shoals, it is difficult to predict when replacement or major repairs of the boats will be necessary. Increased monitoring of the populations and other research on the other islets or increased transfer of supplies between Tern Island and supply vessels will increase the cost of operation of the boats and also increase the risk of damage to them.

Boat Motors

The refuge currently has two new 55 hp Mercury, a 55 hp Johnson and 65 hp Evinrude that are all about four years old and a 15 hp Johnson and a 20 hp Mercury that are about three years old. Each boat uses a large motor for propulsion and a small motor for use in case of emergency. In most situations only two boats are fully ready for use, one being used and one prepared for emergency. Costs related to the motors include on-the-spot maintenance and repair or replacement of parts and occasional shipment of

the motors to Honolulu for major repairs. Fuel costs are included under boats. The frequency of repairs is related to the high degree of corrosion that results from their continual use in salt water (although a major part of the maintenance time is for frequent rinsing of the motors in fresh water). The degree of costs for motors is directly correlated with the level of station usage and also to the type of research and/or the amount of work done on the other islets.

Trailers

There are three boat trailers on the island. Normal maintenance involves routine rinsing with fresh water, lubrication and occasional changing of bearings, tire replacement and occasional painting.

Boat Hoist

A single, fixed hoist is available on the island to lift boats into and out of the water or to unload heavy objects from boats. Maintenance involves lubrication of the motor and cables, checking all parts for corrosion, repair and replacement of corroded or broken parts and occasional painting. Costs relate to the materials used for these activities. The capacity of this hoist in its present condition is uncertain, but it has proven adequate to handle 17' Boston Whalers. Larger boats may prove useful in some FWS operations and provide a greater margin of safety in rough water, but the capacity of the hoist appears limiting.

Refrigeration

There are four walk-in refrigerator/freezers and a 14 CF refrigerator and a 20 CF domestic freezer at Tern Island. With only refuge staff present, two of the walk-in coolers are not used. The presence of visitors at the station for more than a few days usually requires that an additional unit be used. Identified cost of operation does not include the electricity involved but rather the periodic maintenance and the occasional recharging with refrigerant and repair or replacement of worn or broken parts.

General Cleaning

The present living quarters previously housed a crew of about 22 officers and enlisted men. There is a large recreation room, a large galley area and store rooms. With a nearly constant 10-30 mile/hr trade wind blowing across an exposed dirt runway, the job of keeping the place clean can be formidable at times. Costs reflect the materials needed for this cleaning job. With only the maintenance staff present, most of the unused rooms can be sealed off; however, the presence of visitors results in an increased amount of required cleaning.

Safety Equipment

Safety equipment includes heat and smoke detectors in the rooms and halls, emergency lighting and exit lighting in the halls and work areas, and fire extinguishers for all classes of fires. A wide variety of shop safety equipment includes eye guards, safety shoes, emergency showers, etc. Boating equipment includes life vests, emergency radio locator, beacons, flares, handie-talkies (covered under radios), etc. Costs relate to replacement of used, broken or out-dated equipment and have little relationship to station usage within the range of options presented.

Water System

Domestic water is supplied by rain water runoff collected from roofs and a cement court and passed through a water purifier. Sea water is used for toilets. Costs in this category relate to the replacement of pumps or their repair, maintenance of the water lines, valves, storage tanks and the surface of the collection areas. In addition, water purification chemicals must be replenished. The use of seawater results in corrosion of some of the equipment and resultant repairs. Differences in costs are a reflection of the changes in the use of both salt and fresh water.

Sewage System

Domestic sewage is treated by a septic tank. Costs are minimal and are related to the occasional maintenance of sewer lines and the septic system. Extended support of personnel comparable to CG station numbers would require use and maintenance of the existing sewage treatment system.

Runway Maintenance

The dirt runway is subject to damage resulting from high waves during storms and from wind and rain erosion. When that happens, leveling and removal of debris is required and is done by tractor dragging an I-beam. Costs involve the fuel that is used during this operation. The routine dragging operation also prohibits the encroachment of nesting sea birds on the runway.

Runway Lighting

The runway is presently not lighted. However, for emergency situations we intend to acquire smudge pots or battery-operated, emergency strobe lights to mark the runway at night.

Dock Maintenance

The present dock consists of a telephone pole and lumber device that has improvised bumpers attached to protect boats from being damaged. Deterioration from fouling organisms and salt water corrosion of the connecting hardware result in occasional expenditure of time and money for repairs.

Communications Equipment

All communications between Tern Island and Honolulu or other places, boats or planes is by radio. Long distance communication is by single side-band radio, and local communication is by walkie-talkie. A Motorola Micom radio is the principal radio used. One of these is installed at Tern Island, and another is at the Kilauea Pt. Administrative Site on Kauai. A backup system includes two RF2200 radios, one at Tern and the other at Honolulu. The walkie-talkie system includes 5 rechargeable Motorola FM Walkie Talkies that are based at Tern Island.

A non-directional radio beacon is used at the station to provide electronic navigational guidance to incoming planes. This system is only put into operation when a plane is arriving or departing Tern Island.

The corrosive nature of the salt-spray that is constantly in the air at Tern Island results in constant deterioration of the electronic equipment even though most of it is kept in an air-conditioned or dehumidified room.

Frequent maintenance and expenditures for repair or replacement of parts is required for all components of the radio systems. Increase in station use above status quo levels should have little effect on the overall costs involved except that increased use of the walkie-talkies in the boats increases maintenance and replacement costs. The risk of their loss either through accidental emersion or through accelerated corrosion is increased as well. Increased station usage also increases the amount of time spent by the staff on the long range radios and the amount of time that is used for operating the non-directional beacon.

Truck

A 1977 Dodge pick-up truck is used to move the boats around and to carry heavy supplies and equipment around the island. The body of this truck is very corroded because of the salt air and coral operating surface but, mechanically, is in fair condition. Maintenance involves periodic service and replacement of worn parts. Costs reflect use of fuel and of the materials needed to keep the truck operating properly. The frequency of needed maintenance and the related costs is directly correlated with the degree of station usage.

Distillation Unit

The Coast Guard supplemented their freshwater needs by operating a distillation device. The present level of usage of the station should not require this unit. Service personnel have not maintained the unit.

Bulkheads

The entire island is surrounded by sheet piling much of which is badly corroded and collapsed in some areas. The purpose of the bulkheads is to prevent wave and current-caused shifts in the configuration of the island and to maintain the surface of the island at a fairly constant six to eight feet above sea level. The coral fill has eroded behind the sections of the bulkhead that are collapsed. To prevent or retard additional erosion, the Coast Guard has previously dumped large pieces of scrap metal and other junk into the eroded areas. We continue to do this and to fill in the eroded areas with sand and gravel that have been deposited in other areas of the island. However, we are unable to prevent additional deterioration of the bulkheads themselves. It is difficult to predict when major repairs to the bulkheads will be absolutely necessary, but continual corrosion from salt water and occasional heavy storms are expected to cause major damage over the next ten years.

Fuel Tanks

Five 28,000 gallon fuel tanks connected in series are located near the southwest corner of the island. We use one of these to store diesel fuel. Corroded areas on these tanks require occasional sand blasting and painting. The base of the tanks are surrounded by a cinder-block retaining wall to contain spills should they occur. High waves from the southwest occasionally cause damage to this wall which then requires time and materials to repair.

Water Storage Tanks

Reserve fresh and salt water is stored in six 20,000 gallon capacity redwood tanks. These require periodic maintenance to insure their water-tight integrity. Four of them had been left dry for a long time before the Fish and Wildlife Service started to maintain the station. They have dried out and would require extensive rehabilitation to place back in service. They are not needed for the options now under consideration.

Channel Dredging

The channel that leads to the island from the southwest has not been dredged for years. Because of frequent storms and resultant movement of sediment, the entrance depth varies considerably and thereby presents a navigational hazard to supply ships. This channel may require dredging, particularly if the station were to be jointly operated as a fishing support station. The draft (6-8') of the present supply boats is such that dredging will probably not be needed for continued FWS operation in the next 10 years. Replacement of channel markers removed by the Coast Guard would enhance safe movement of supply boats.

Boat Basin Dredging

The northern and western sides of the island were dredged at the time when Tern Island was enlarged to form the airstrip. The same comments that were made concerning the entrance channel pertain to the boat basin as well.

Shop Tools

The repair and maintenance shop at Tern Island has as set of tools that includes 10-inch radial arm saw, 10-inch table saw, drill press, 7¼-inch worm drive saw, electric drills, sabre saw, air compressor, electric impact wrench, hand tools and welding equipment. The amount of use and maintenance rises and falls with the number of people that are on the island.

Lab Equipment

Lab equipment is presently limited to a binocular microscope, dissecting equipment and a wet and dry lab bench. Future research and management activities at the island will require expenditures for scales, drying ovens, chemicals, ventilation hoods, photography lab and a variety of other equipment. The costs for these and the amount of maintenance time and expenditures will increase with the level of usage of the station for research.

Field Research Equipment

Equipment for field research includes binoculars, camera equipment, nets, banding materials, scales, calipers, tapes and other measuring devices. Also included are the boats and radios mentioned above. All of this equipment is subject to corrosion and loss due to the nature of research in an isolated marine environment. Increased level of use of the station for research would increase the amount of time and money to maintain field equipment in a usable condition.

Diving Equipment

The only diving equipment presently available at the station is a set of three wet suit jackets. Future surveys of the reef environment or other research underwater will require additional equipment and the time and money to maintain that equipment in a safe condition.

Medical Equipment and Supplies

Present medical equipment includes emergency first aid equipment and medicine. Costs involve replacement of used or outdated supplies. Increased use of the station would cause a slight increase in the cost of medical equipment and supplies. The remote nature of the station requires purchase and frequent resupply of a substantial variety and amount of medical supplies under the direction of the U.S. Public Health Service in Honolulu.

Buildings

Buildings on Tern Island are shown on the attached map of the island. Included are living quarters, two garages, a machine and radio transmitting building and small buildings that house the water purifying equipment, fuel and flammable materials.

Painting

Periodic painting of all the buildings is required. Changes in use patterns of the island will probably have little effect on the amount of painting that is required during the 5-year planning period. Long-term use would require sandblasting and repainting.

Roof Maintenance

Storms and sun oxidation cause the need for occasional repairs to be done to the roofs on all the buildings. Little change in time or costs related to this category would occur with changing levels of use except in the case of abandonment in which case minor damage could change to major damage because of neglect.

Door Maintenance

Corrosion of metal doors and hinges causes time and money to be expended in order to make sure that doors remain usable. Other than minor damage turning into major damage as a result of abandonment of the station there is probably little relationship between station use and the time and money expended for door maintenance.

Window Maintenance

Corrosion of metal window frames and rare breakage of windows results in expenditures in this category. Abandonment or occasional visit options would probably greatly increase costs due to expected vandalism. Otherwise costs should not change according to station activities.

Air Conditioners/Dehumidifiers

Although the entire living quarters were previously air-conditioned, the FWS staff seldom use air conditioners or dehumidifiers except in the radio room and the room where cameras and other delicate equipment are stored. The remaining air conditioners have been stored. Increased use of the station for research or other activities that would require the maintenance of fairly constant temperature conditions would result in an increase in repair and maintenance costs.

Rescue Operations

This category is very difficult to predict in terms of cost and time needed, but during the first year and a half of operation we have been involved in three rescue operations due to ship wreckage and one due to the overturning of one of the small boats stationed at the island. These operations have resulted in loss of some equipment. The predicted costs include the contingency for air charter to evacuate sick or injured people from the island. Costs in this category are expected to correlate with the level of use of the island.

Field Research/Management Studies

Costs and time involved in this category are correlated with the level of staffing or researchers visiting the island. The status quo costs reflect current expenditures in this category for FWS research/ management studies at Tern Island and within the rest of the Shoals.

Researcher Support

This category reflects time and costs associated with providing support to outside researchers (e.g., University of Hawaii, National Marine Fisheries Service, etc.). This time and costs are very closely related to the number and type of research that may be conducted. Research that involves boat use and/or diving requires a large amount of time and effort on the part of the staff.

Honolulu Support

Honolulu support includes man-hours spent in the obtainment of food, equipment and supplies for Tern Island, coordination of flights with FWS and non-FWS visitors to Tern Island, and the library, computer and other Honolulu-based needs for research/management at French Frigate Shoals. Costs in this category are covered within the salary of the support personnel. Differences in man-hours reflect the differences between full- and part-time requirements depending upon the considered option and, in some options, assistance from Tern Island based personnel visiting Honolulu.

HORIZONTAL COLUMNS:

Operational Status

This column indicates the probable condition or level of operation that can be maintained for identified equipment or facilities at the particular level of staffing. Level one is fully operational and maintained as per manufacturer recommendations or better (due to excessive corrosion). Level five indicates non-operational status and no maintenance. Maintenance levels for most equipment or facilities correlates closely with anticipated replacement or rehabilitation dates.

Annual O&M/Cyclic Maintenance Man-hours

This column identifies the amount of time that would be alloted to maintenance of identified equipment and facilities. These estimates are based on experience over the previous two years and on manufacturer's maintenance recommendations. They reflect best estimates of breakdown frequency as well, although failure to replace equipment or effect major repairs on schedule (i.e., engine overhaul) is expected to result in progressive increases in maintenance hours.

Annual O&M/Cyclic Costs

These costs include staff salaries (plus overtime), training, travel and out-of-pocket expenses for materials, supplies, parts, and contractors. These estimates also consider anticipated equipment breakdowns and could vary widely if maintenance schedules are not adhered to. For example, unscheduled air charters for equipment repair by contracted labor can easily add as much as $5,000 to station expenditures without even including repair parts.

Replacement Cost/Date

These figures represent gross estimates of anticipated costs and dates for replacement or restoration of equipment and facilities at the described level of operation and maintenance. Under those options that involve extended absence of Service staff from the station (1 & 2), costs reflect anticipated vandalism and deterioration in the absence of continued maintenance. As in the estimation of annual costs, all figures represent 1981 dollars and, therefore, do not incorporate anticipated inflation.

CONCLUSIONS

The last two years of station operation by the FWS has provided us with a base of experience that now enables a realistic, objective appraisal of the six short-term management options now under consideration. The following conclusions can be drawn from the previous evaluation of these options:

(1) Options One (Abandonment) and Two (Part-time Station) would not provide the continuity of Service "presence" that is critical to the Secretarial commitment, the enforcement of refuge regulations, the protection of government property and the effective management of fish and wildlife resources, including threatened and endangered species.

(2) While Option Three (One Employee) would provide continuity, staffing would be inadequate to meaningfully address maintenance and research/management requirements. Safety considerations would preclude off-island enforcement of regulations or collection of management data. This option would also not eliminate significant safety risks on Tern Island without backup staff.

(3) Option Four (Two Plus One) and Five (Three Persons) do not differ in number of on-site personnel, and hence, maintenance, research and management needs would be addressed essentially equally. There would, however, be some differences in overall cost and staffing implications.

(4) Option Six (Four Persons) would enhance the level of maintenance, research/management and enforcement while providing additional benefits in safety and support of other station users. It would increase annual operational costs but be offset to some degree by enhanced operating life for equipment and facilities receiving more frequent maintenance.

(5) It is important to remember that approximately half (10-12) people in the original Coast Guard crew at Tern Island worked full time, performing this maintenance function. The remainder operated the LORAN equipment and provided support for the station. For this reason, it is not surprising that none of the proposed options fully addresses the maintenance needs nor the inevitable long-term rehabilitation requirement of the station. Continued operation of the facility beyond this short-term planning period will require a major financial commitment to address the maintenance projects that are being neglected due to reduced staffing and the rehab projects that will be required as facilities and equipment deteriorate to an unusable state.

(6) Operation of this remote field station has involved some unique problems in logistical support and staffing. It has required a major commitment of time in planning and implementation of maintenance and management programs. Morale of on-site staff has, at times, been quite low due to inadequacies in logistical support, failure of the Service to live up to employment "promises" (housing, COLA, etc.), personality conflicts between staff, delays in resolution of lingering personnel problems and demanding work schedules.

(7) In spite of the problems described, this station has operated without a major equipment breakdown, without serious injury, and without any unscheduled flights or charters due to inadequate maintenance. In the period of Service operation, the station has played an important support role in the rescue of crew from two grounded fishing vessels and in the successful salvage of a grounded freighter. The station has provided logistical support for dozens of non-Service researchers working on important projects that would have been impossible or prohibitively expensive without this support. Continuity of Service "presence" has been maintained throughout, and important Service research/management studies have been conducted that would not have been possible otherwise.

RECOMMENDATIONS

We offer the following recommendations regarding operation of the Tern Island station:

(1) Option Four (Two Plus One, Rotational) should be implemented on an experimental basis during FY82. In reality, this would be a continuation of the existing operation, with the addition of a second GS-7 position to handle the support function in Honolulu and to rotate onto the island when "permanent" staff are off the island.

(2) Requests for personnel assistance in advertising and filling of Tern Island positions should be addressed promptly. We anticipate that the two staff currently on board will accept other positions within the next six months. The unique requirements of the Tern Island positions will complicate the selection process to fill behind these personnel.

(3) Consideration should be given to conversion of the existing career-seasonal positions (at least for the GS-9 Assistant Refuge Manager) to permanent, full-time. This would enhance the attractiveness of the positions for appropriately trained personnel. This would also avoid the added complication of scheduling LWOP for personnel that would otherwise be performing critical support tasks and training during their short periods off Tern Island.

(4) The decision to implement Option Four should be reviewed annually during the short-term planning period to determine if it remains cost-effective in meeting the objectives of the station. Some consideration should be given in upcoming years to a seasonal implementation of Option Six, particularly during periods when management studies or maintenance/ support needs are greatest.

(5) Planning effort should be directed at reducing the costs of annual O&M and major rehab projects. In particular, alternatives for boat charter support and fuel resupply need to be critically evaluated in view of the anticipated reduction in NMFS and Coast Guard vessel support. Measures to mothball facilities and equipment not now in use or to delay long-term rehab at the station should also be reviewed and implemented where cost-effective.

(6) The Service's obligation for maintenance and implementation of search and rescue capability at Tern Island should be critically evaluated. To be fully operational in this regard would require significantly increased funding for equipment, training and probably for staffing.

(7) The Service should insure that population status of monk seals and turtles, including the repopulation of Tern Island by seals, is closely monitored. These management studies should be conducted in close cooperation with NMFS.

(8) All activities at Tern Island, including non-Service projects, should be subjected to Section 7 review, both internally and externally (with NMFS).

(9) Research and management studies of migratory birds at Tern Island and elsewhere in FFS should be designed to take advantage of the unique opportunity for continuity in monitoring. However, the impact of these studies on seal and turtle populations must be critically evaluated and closely monitored.

(10) Non-Service research/management studies at Tern Island or elsewhere in FFS should be accommodated within the practical limits of existing facilities and equipment (including power generation and water supply) only after these proposed studies have been subjected to internal and external review to determine that they can be conducted without jeopardy to seals, turtles, migratory birds or other sensitive species. All non-Service studies should be closely supervised by refuge personnel.

(11) Safety should always be a primary consideration in work conducted, permitted or supported by Service personnel at Tern Island or elsewhere in FFS.

Table 1 : Relationship Between Benefits/Implications and Short-Term Management Options

		Option 1	Option 2	Option 3	Option 4	Option 5	Option 6
Benefits:							
(1)	Maintenance of facility	5	4	3	2	2	1
(2)	Service "presence"	5	4	3	2	2	1
(3)	Service research	4	4	3	2	2	1
(4)	Non-Service wildlife research	5	4	4	3	3	2
(5)	Non-wildlife research	5	4	2	2	4	1
(6)	Logistic support for NWHI res.	5	4	3	1	1	1
(7)	Emergency response capability	5	4	4	3	3	2
(8)	Fishery logistic support	5	4	3	3	3	2
(9)	Emergency landing site	4	4	1	1	1	1
(10)	Educational/Recreational use	4	3	3	2	2	1
Implications:							
(1)	Annual O&M Costs	5	4	3	2	2	2
(2)	Rehab costs	1	2	2	2	2	4
(3)	User conflicts	1	2	2	3	3	4
(4)	Disturbance to wildlife	1	1	3	3	3	4
(5)	Safety hazards	5	2	2	3	3	4
(6)	Staffing problems	5	2	4	3	2	2
(7)	Energy Consumption	5	3	4	3	3	3

Code: Under Benefits, figures indicate extent to which option permits realization of identified benefit or function (1= benefit highly feasible, 5= benefit not feasible). Under implications, figures indicate magnitude (1= implication/problem most serious, 5= implication/problem least significant).

Table 2. OPTION ONE: ABANDONMENT

	Operational Status	Annual O&M/Cyclic MH	Annual O&M/Cyclic $K	Replacement Cost/Date
Staffing: No. 0		400 (one-time)	4.0	
Staff schedule: n/a				
Aircraft charter: (For removal of equipment)			4.5	
Boat Charter: (For removal of equipment)			30.0	
Food: n/a				
Fuel:				Remove or suffer 18K loss
Onan Generators:				Remove
250kw Generators:				Total loss (300K)
Tractor:				Total loss (40K)
Pumps/Motors:				Partial removal (10K loss)
Whalers:				Removal
Boat Motors:				Removal

OPTION One: ABANDONMENT (pg. 2)

	Operational Status	Annual O&M/Cyclic MH	Annual O&M/Cyclic $K	Replacement Cost/Date
Trailers:				Partial Removal (5K loss)
Boat Hoist:				Total Loss (10K)
Refrigeration:				Total Loss (40K)
General Cleaning:				N/A
Safety Equipment:				Partial Removal (5K loss)
Water System:				Partial Removal (25K loss)
Sewage System:				Total Loss (10K)
Runway Mtnce:	(Restoration after abandonment would require replacement of tractor)			
Runway Lighting:				N/A
Dock Mtnce:				N/A
Communications:				Removal
Truck:				Total Loss (3K)
Distillation Unit:				Total Loss (15K)
Bulkheads:				Continuing deterioration
Fuel Tanks:				Total Loss (150K)
Water Tanks:				Total Loss (80K)
Channel Dredge:				N/A
Basin Dredge:				N/A

OPTION ONE: ABANDONMENT (Pg. 3)

	Operational Status	Annual O&M/Cyclic MH	Annual O&M/Cyclic $K	Replacement Cost/Date
Shop Tools:				Partial Removal (10K Loss)
Lab Equipment:				Removal
Field Research Equip:				Removal
Diving Equip:				Removal
Medical Equip:				Partial Removal (5K Loss)
Buildings:				Replacement cost estimated at 500K
Painting:				
Roof Mtnce:				
Door/window Mtnce:				
Air Conditioners:				
Rescue Operations:				Partial Removal (15K loss)
Research/Mgmt.(Tern):				N/A
Research/Mgmt.(FFS):				N/A
Researcher Support(Tern):				N/A
Researcher Support(FFS):				N/A
Honolulu Support:				N/A
TOTALS:			38.5	1241.0 (Est. of replacement cost after theft/vandalism or deterioration)

Table 3. OPTION TWO: PART TIME STATION

		Operational Status	Annual O&M/Cyclic MH	Annual O&M/Cyclic $K	Replacement Cost/Date
Staffing: No. 2.5 (1 GS-9, 1/2 GS-7, 1 GS-7) (Step 2, 15% COLA)				28.7 (Salary) 10.9 (Overtime) 1.0 (Training)	
Staff schedule: (7 months, 2 persons on Tern; 1/2-time support in Honolulu)					
Aircraft charter: (4)				8.4	
Boat Charter: (2 @ 1.5K per day)				18.0	
Food:				1.0	
Fuel:				11.0 (not necessary until FY-83)	
Onan Generators:		1	376	4.6	10.0 ('84, '88)
250kw Generators:		4		10.0 (first year only)*	
Tractor:		1	92	1.4	50.0 ('86)
Pumps/Motors:		1	109	2.9	7.0 ('83, '87)
Whalers:	#1	1			6.0 ('83)
	#2	1	81	2.0	6.0 ('87)
Boat Motors:	#1	1			1.5 ('84, '90)
	#2	1			1.5 ('84, '90)
	#5	1	110	5.2	5.0 ('88)
	#6	1			5.0 ('88)

OPTION TWO: PART TIME STATION (pg. 2)

	Operational Status	Annual O&M/Cyclic MH	Annual O&M/Cyclic $K	Replacement Cost/Date
Trailers:	1/2	12	0.1	1.3 ('83, '87)
Boat Hoist:	2	20	0.4	5.0 ('85,'90)
Refrigeration:	1/5	14	0.3	1.5 ('83,'87)
General Cleaning:	1	117	0.1	
Safety Equipment:	1	23	0.6	
Water System:	1	35	1.2	
Sewage System:	1	6	0.1	
Runway Mtnce:	1	28		
Runway Lighting:	n/a			
Dock Mtnce:	2	9	0.1	
Communications:	1	46	1.2	6.0 ('85,'90)
Truck:	2	23	0.4	12.0 ('83,'88)
Distillation Unit:	5			
Bulkheads:	2			
Fuel Tanks:	2	17	0.3	
Water Tanks:	1	17	0.3	
Channel Dredge:	2			
Basin Dredge:	2			

OPTION TWO: PART TIME STATION (pg. 3)

	Operational Status	Annual O&M/Cyclic MH	Annual O&M/Cyclic $ K	Replacement Cost/Date
Shop Tools:	2	35	1.7	
Lab Equipment:	1	9	0.3	
Field Research Equip:	1	12	0.1	
Diving Equip:	1	9	0.2	2.0 (new in '82)
Medical Equip:	1		0.1	
Buildings:				
Painting:	2	69	0.3	
Roof Mtnce:	3	46	0.6	
Door/window Mtnce:	3	46	0.3	
Air Conditioners:	1	23	0.3	5.0 ('83)
Rescue Operations:	2	46	0.5	
Research/Mgmt.(Tern):	1	780	0.3	
Research/Mgmt.(FFS):	1	260	0.7	
Researcher Support(Tern):	2	80		
Researcher Support(FFS):	2	180	0.5	
Honolulu Support:		520		
TOTALS:		3250	106.1	'82 12.0, '83 32.8, '84 13.0, '85 11.0, '86 50.0, '87-9 61.8

*assumes no vandalism
-cost reflects mothballing

Table 4. OPTION THREE: ONE PERSON ON ISLAND

		Operational Status	Annual O&M/Cyclic MH	Annual O&M/Cyclic $ K	Replacement Cost/Date
Staffing:	No. 1.5 (1 GS-9, 1/2 GS-7) (Step 2, 15& COLA)			32.0 (Salary) 3.9 (Overtime) 1.0 (Training) 2.3 (Travel)	
Staff schedule: (GS-9 and spouse on Island 10 months & in Honolulu 2 months; Part-time staff on Tern 2 mos, in Honolulu 8 months)					
Aircraft charter: (monthly)				26.0	
Boat Charter: (one @ 1.5K per day)				9.0	
Food:				1.0	
Fuel:				22.0	
Onan Generators:		1	400	8.0	10.0 ('84,'88)
250kw Generators:		3	40	1.0	
Tractor:		2	103	1.0	50.0 ('86)
Pumps/Motors:		2	110	3.0	5.0 ('83,'87)
Whalers:	#1	1	40	0.5	6.0 ('83)
	#2	1			6.0 ('86)
	#3	2			6.0 ('90)
Boat Motors:					
	#1 15 hp	1	40	1.0	1.5 ('85,'90)
	#2 20 hp	1			1.5 ('85,'90)
	#3 55 hp	1			5.0 ('85,'90)
	#4 55 hp	1			5.0 ('87)
	#5 55 hp	1			5.0 ('87)
	#6 65 hp	1			6.0 ('85)

OPTION THREE: ONE PERSON ON ISLAND (pg. 2)

	Operational Status	Annual O&M/Cyclic MH	Annual O&M/Cyclic $K	Replacement Cost/Date
Trailers:	1-2	10	0.1	1.3('83,'85,'88
Boat Hoist:	1	10	0.2	5.0 ('85)
Refrigeration:	1-4	10	0.5	1.5('83,'85,'87
General Cleaning:	1	80	0.1	
Safety Equipment:	1	20	1.0	
Water System:	1	30	2.0	
Sewage System:	1	10	0.1	
Runway Mtnce:	1	48		
Runway Lighting:	n/a			
Dock Mtnce:	2	10	0.1	
Communications:	1	80	2.0	6.0 ('85,'90)
Truck:	2	30	0.8	12.0 ('83,'88)
Distillation Unit:	5			
Bulkheads:	2			
Fuel Tanks:	2	15	0.2	
Water Tanks:	1	15	0.5	2.0 (major repair '84)
Channel Dredge:	2			
Basin Dredge:	2			

OPTION THREE: ONE PERSON ON ISLAND (pg. 3)

	Operational Status	Annual O&M/Cyclic MH	Annual O&M/Cyclic $K	Replacement Cost/Date
Shop Tools:	1-2	30	1.5	3.0('85 & '87)
Lab Equipment:	n/a			
Field Research Equip:	1	10	0.1	
Diving Equip:	n/a			
Medical Equip:	1		0.1	
Buildings:				
Painting:	3	40	0.3	
Roof Mtnce:	3	40	0.5	
Door/window Mtnce:	3	20	0.3	
Air Conditioners:	3	20	0.3	5.0 ('83 &'87)
Rescue Operations:	5	40	0.5	
Research/Mgmt.(Tern):	1	626	0.2	
Research/Mgmt.(FFS):	1	40	0.1	
Researcher Support(Tern):	2	40		
Researcher Support(FFS):	2	50		
Honolulu Support:		900		

TOTALS:			'83	'84	'85	'86	'87-'90
	2747	123.2	30.8	12.0	24.8	62.0	67.8

Table 5. OPTION FOUR: TWO, PLUS ONE ROTATIONAL

	Operational Status	Annual O&M/Cyclic MH	Annual O&M/Cyclic $K	Replacement Cost/Date
Staffing: No. 2.5 (1 GS-9, 2 GS-7) (Step 2, 15% COLA)			58.2 (Salary) 6.3 (Overtime) 2.0 (Training) 4.8 (Travel)	
Staff schedule: (2 persons on Tern for 5 months, one off rotation 1 person in Honolulu 5 months, 4 months on Tern)				
Aircraft charter: (Monthly)			26.0	
Boat Charter: (one @ 1.5K per day)			9.0	
Food:			2.0	
Fuel:			22.0 (not necessary until '83)	
Onan Generators:	1	655	8.0	10.0 ('85 & '90)
250kw Generators:	3	40	1.0	
Tractor:	1	160	2.0	50.0 ('90)
Pumps/Motors:	1	190	5.0	7.0 ('84, '89)
Whalers: #1	1			6.0 ('83)
#2	1	140	1.5	6.0 ('85)
#3	2			6.0 ('90)
Boat Motors: #1 15 HP	1			1.5 ('84,'89)
#2 20 HP	1			1.5 ('84,'89)
#3 55 HP	1	190	1.0	5.0 ('84,'89)
#4 55 HP	1			5.0 ('86,'90)
#5 55 HP	1			5.0 ('86,'90)
#6 65 HP	1			6.0 ('84,'89)

OPTION FOUR: TWO, PLUS ONE ROTATIONAL (pg. 2)

	Operational Status	Annual O&M/Cyclic MH	Annual O&M/Cyclic $K	Replacement Cost/Date
Trailers:	1-2	20	0.1	1.3('83,'85, '88)
Boat Hoist:	1	35	0.6	5.0 ('87)
Refrigeration:	1-4	25	0.5	1.5 (replace motor '83,'87)
General Cleaning:	1	204	0.1	
Safety Equipment:	1	40	1.0	
Water System:	1	60	2.0	
Sewage System:	1	10	0.1	
Runway Mtnce:	1	48		
Runway Lighting:	2	4	0.1	
Dock Mtnce:	2	15	0.1	
Communications:	1	80	2.0	6.0 ('85,'90)
Truck:	2	40	0.8	12.0 ('84)
Distillation Unit:	5			
Bulkheads:	2			
Fuel Tanks:	2	30	0.5	2.0 (major repair '84)
Water Tanks:	1	30	0.5	
Channel Dredge:	2			
Basin Dredge:	2			

OPTION FOUR: TWO PLUS ONE ROTATIONAL (pr 3)

	Operational Status	Annual O&M/Cyclic MH	Annual O&M/Cyclic $K	Replacement Cost/Date
Shop Tools:	2	60	3.0	
Lab Equipment:	1	15	0.6	
Field Research Equip:	1	20	0.2	
Diving Equip:	1	15	0.3	2.0 ('82)
Medical Equip:	1		0.1	
Buildings:				
Painting:	1	120	0.5	
Roof Mtnce:	1	80	1.0	
Door/window Mtnce:	2	80	0.5	
Air Conditioners:	2	40	0.5	5.0 ('83, '87)
Rescue Operations:	2	80	0.5	
Research/Mgmt.(Tern):	1	1144	0.5	
Research/Mgmt.(FFS):	1	520	0.2	
Researcher Support(Tern):	2	120		
Researcher Support(FFS):	2	210	0.5	
Honolulu Support:	1	1152		

TOTALS:		5672	165.6	'82	'83	'84	'85	'86	'87-9
				2.0	13.6	35.0	23.3	10.0	115.

Table 6. OPTION FIVE: THREE PERSONS, ROTATIONAL

	Operational Status	Annual O&M/Cyclic MH	Annual O&M/Cyclic $K	Replacement Cost/Date
Staffing: No. 3 (1 GS-9, 2 GS-7) (Step 2, 15% COLA)			58.2 (Salary) 6.3 (Overtime) 2.0 (Training) 18.9 (Travel)	
Staff schedule: (Rotational with four months on Tern Island and Two months in Honolulu)				
Aircraft charter: (Monthly)			26.0	
Boat Charter: (one @ 1.5K per day)			9.0	
Food:			2.0	
Fuel:			22.0 (not necessary until '83)	
Onan Generators:	1	655	8.0	10.0 ('85 & '90)
250kw Generators:	3	40	1.0	
Tractor:	1	160	2.0	50.0 ('90)
Pumps/Motors:	1	190	5.0	7.0 ('84,'89)
Whalers: #1	1	140	1.5	6.0 ('83)
#2	1			6.0 ('85)
#3	2			6.0 ('90)
Boat Motors: #1 15 HP	1	190	1.0	1.5 ('84,'89)
#2 20 HP	1			1.5 ('84,'89)
#3 55 HP	1			5.0 ('84,'89)
#4 55 HP	1			5.0 ('86,'90)
#5 55 HP	1			5.0 ('86,'90)
#6 65 HP	1			6.0 ('84,'89)

OPTION FIVE: THREE PERSONS, ROTATIONAL (pg. 2)

	Operational Status	Annual O&M/Cyclic MH	Annual O&M/Cyclic $K	Replacement Cost/Date
Trailers:	1-2	20	0.1	1.3('83,'85 '88)
Boat Hoist:	1	35	0.6	5.0 ('87)
Refrigeration:	1-4	25	0.5	1.5 (replace motor '83,'8
General Cleaning:	1	204	0.1	
Safety Equipment:	1	40	1.0	
Water System:	1	60	2.0	
Sewage System:	1	10	0.1	
Runway Mtnce:	1	48		
Runway Lighting:	2	4	0.1	
Dock Mtnce:	2	15	0.1	
Communications:	1	80	2.0	6.0 ('85,'9(
Truck:	2	40	0.8	12.0 ('84)
Distillation Unit:	5			
Bulkheads:	2			
Fuel Tanks:	2	30	0.5	2.0 (major repair '84)
Water Tanks:	1	30	0.5	
Channel Dredge:	2			
Basin Dredge:	2			

OPTION FIVE: THREE PERSONS, ROTATIONAL (pg. 3)

	Operational Status	Annual O&M/Cyclic MH	Annual O&M/Cyclic $	Replacement Cost/Date
Shop Tools:	2	60	3.0	
Lab Equipment:	1	15	0.6	
Field Research Equip:	1	20	0.2	
Diving Equip:	1	15	0.3	2.0 ('82)
Medical Equip:	1		0.1	
Buildings:				
Painting:	1	120	0.5	
Roof Mtnce:	1	80	1.0	
Door/window Mtnce:	2	80	0.5	
Air Conditioners:	2	40	0.5	5.0 ('83,'87)
Rescue Operations:	2	80	0.5	
Research/Mgmt.(Tern):	1	1144	0.5	
Research/Mgmt.(FFS):	1	520	0.2	
Researcher Support(Tern):	2	120		
Researcher Support(FFS):	2	210	0.5	
Honolulu Support:	1	1152		
TOTALS:		5672	179.7	'82 2.0 '83 13.6 '84 35.0 '85 23.3 '86 10.0 '87+ 115

Table OPTION SIX: FOUR PERSONS, ROTATIONAL

	Operational Status	Annual O&M/Cyclic MH	Annual O&M/Cyclic $K	Replacement Cost/Date
Staffing: No. 4				
(1 GS-9, 2 GS-7, 1 GS-5)			72.7 (Salary)	
(Step 2, 15% COLA)			2.6 (Training)	
			2.1 (Travel)	
Staff schedule:				
Rotational 5 months on Tern, one off, one person on Oahu)				
Aircraft charter:				
Monthly			26.0	
Boat Charter:				
one 1.5K per day			9.0	
Food:			2.5	
Fuel:			22.0 (not necessary until FY83)	
Onan Generators:	1	655	8.0	10.0 ('85 & '90)
250kw Generators:	3	40	1.0	
Tractor:	1	160	2.5	50.0 ('90)
Pumps/Motors:	1	190	5.0	7.0 ('84,'89)
Whalers: #1	1			6.0 ('83)
#2	1	200	1.5	6.0 ('85)
#3	2			6.0 ('88)
Boat Motors: #1 15HP	1			1.5 ('83,'88)
#2 20HP	1			1.5 ('83,'88)
#3 55HP	1	290	2.0	5.0 ('83,'88)
#4 55HP	1			5.0 ('85,'89)
#5 55HP	1			5.0 ('85,'89)
#6 65HP	1			6.0 ('83,'88)

OPTION SIX: FOUR PERSONS, ROTATIONAL (pg. 2)

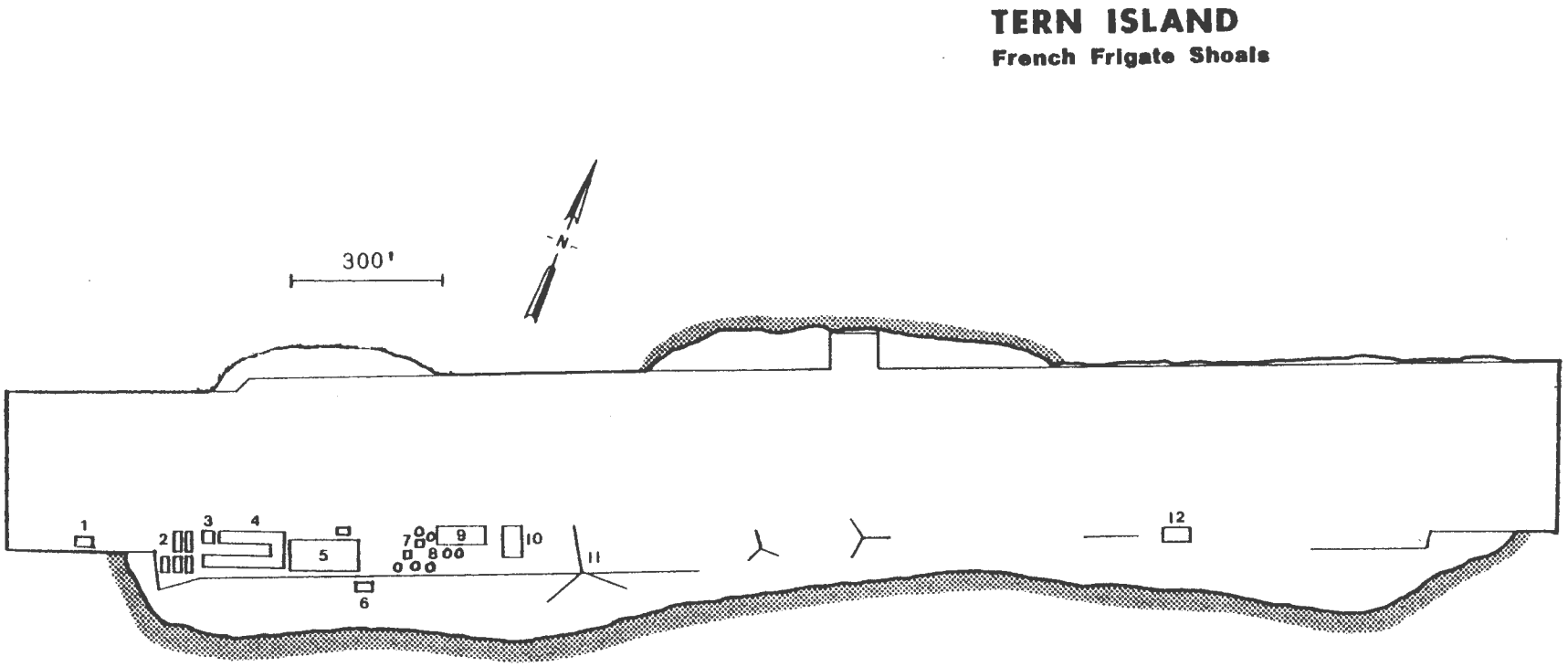
	Operational Status	Annual O&M/Cyclic MH	Annual O&M/Cyclic $ K	Replacement Cost/Date
Trailers:	1-2	25	0.2	1.3 ('83,'85, '88)
Boat Hoist:	1	40	0.7	5.0 ('87)
Refrigeration:	1	25	0.5	1.5 ('82,'87) (replace moto
General Cleaning:	1	254	0.1	
Safety Equipment:	1	40	1.0	
Water System:	1	60	2.0	
Sewage System:	1	10	0.1	
Runway Mtnce:	1	48		
Runway Lighting:	2	4	0.1	
Dock Mtnce:	2	20	0.1	
Communications:	1	80	2.5	6.0 ('85,'90)
Truck:	2	45	0.9	12.0 ('84)
Distillation Unit:				
Bulkheads:	2			
Fuel Tanks:	2	30	0.5	
Water Tanks:	1	30	0.5	2.0 ('84) (major repair)
Channel Dredge:	2			
Basin Dredge:	2			

Table 8: Summary of Tern Island Management Options (Costs in $K)**

	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6
Salary and Overtime	-	39.6	35.9	64.5	64.5	72.7
Training	-	1.0	1.0	2.0	2.0	2.6
Travel	-	-	2.3	4.8	18.9	2.1
Air Charter	4.5	8.4	26.0	26.0	26.0	26.0
Boat Charter	30.0	18.0	9.0	9.0	9.0	9.0
Food	-	1.0	1.0	2.0	2.0	2.5
Fuel*	-	11.0	22.0	22.0	22.0	22.0
O&M Man Hours	400	3250	2747	5672	5672	7206
Total Cost	38.5	106.1	123.2	165.6	179.7	176.0
Additional Replacement Costs and Year						
(1982)	1241.0	12.0	-	2.0	2.0	3.5
(1983)	replacement	32.8	30.8	13.6	13.6	26.3
(1984)	of stolen,	13.0	12.0	35.0	35.0	21.0
(1985)	vandalized	11.0	24.8	23.3	23.3	33.3
(1986)	or deteri-	50.0	62.0	10.0	10.0	-
(1987-1990)	orated items	61.8	67.8	115.8	115.8	115.8

*Fuel costs not anticipated for FY'82 due to fuel now on board station (estimated to last until mid-year FY-83)

**All figures represent 1981 costs.



1. Boat House
2. Fuel Oil Storage Tanks
3. Garage
4. Barracks-Subsistence Bldg.
5. Recreation Court
6. Playboy Club
7. Pump House
8. Fresh Water Tanks
9. Signal Power Bldg.
10. Old Signal Power Bldg.
11. Loran-A Transmitting Antenna
12. Storage Building

Figure 2 Tern Island - existing structures.

Figure 4. Outer Reef, French Frigate Shoals.

Figure 5. Whale-Skate Island, French Frigate Shoals.

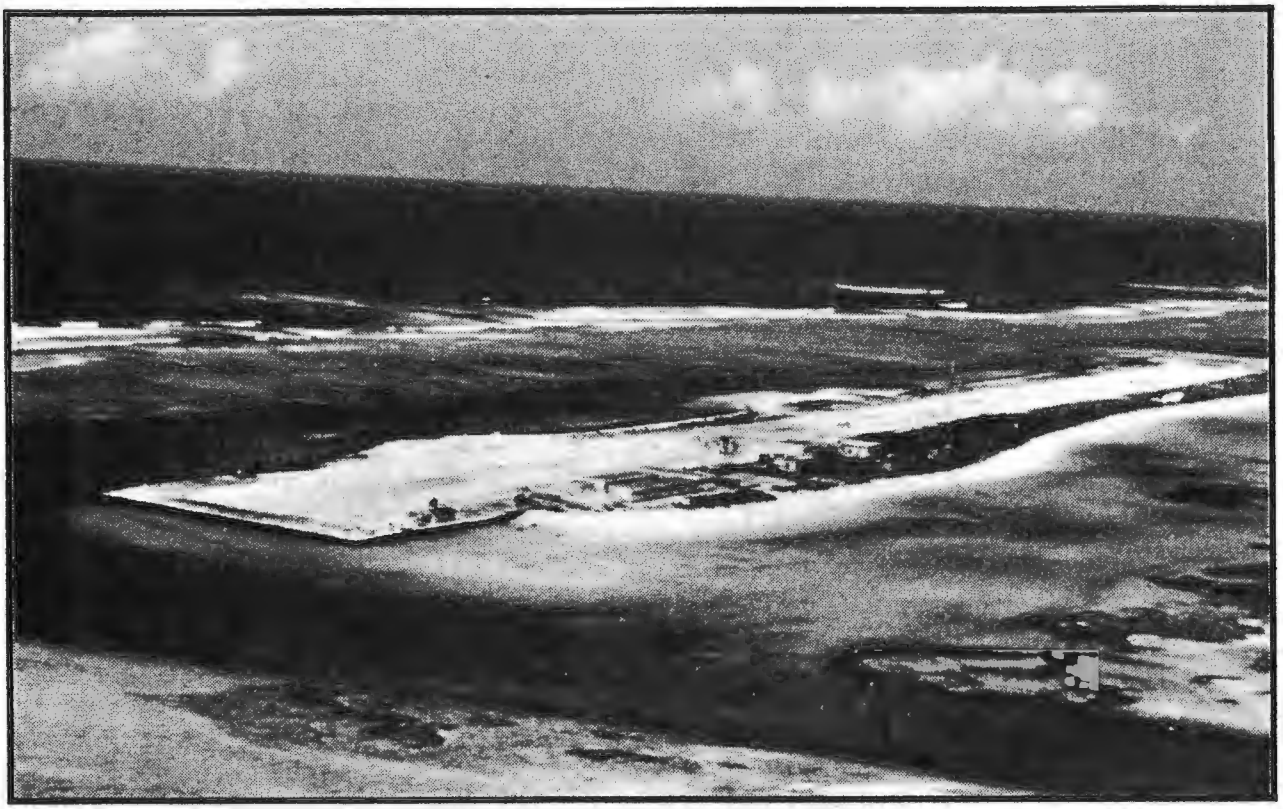


Figure 6. Tern Island - west end in foreground; note dredged channel and turning basin.

Figure 7. Tern Island - U.S. Coast Guard living quarters.

Figure 8. Tern Island - principal area of vegetation along south side of runway.

Figure 9. Tern Island - Sooty Tern colony, east end of runway.

Figure 10. Tern Island – northeast corner of island.

Figure 11. Tern Island – western end of island.