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Historic Ownership Patterns, Wildlife,  
and Related Resources of  
East and Tern Islands, French Frigate Shoals

Hawaii:

**THE EFFECT OF MILITARY DEBRIS AND ALTERNATIVES FOR THE FUTURE**



Report Submitted To:

U.S. Army Engineer Division, Pacific Ocean  
Corps of Engineers  
Building 230  
Ft. Shafter, HI 96858

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GEORGE H. BAKER

Report Submitted By:

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### Executive Summary

Tern and East Islands are low sand islands within the coral atoll known as French Frigate Shoals in the Northwestern Hawaiian Islands. This atoll is 490 nautical miles northwest of Honolulu, situated near the mid-point of the 1600 mile long Hawaiian archipelago. French Frigate Shoals is part of the Hawaiian Islands National Wildlife Refuge, administered by the U.S. Fish and Wildlife Service.

Tern Island is the largest island within French Frigate Shoals with an area of 17 acres. The present configuration of this island is the result of a dredging and sheet piling project completed during World War II to construct a landing strip on an 11 acre sand islet. Post-World War II, the island became a Coast Guard Loran Station which was decommissioned in 1979. Since the abandonment of Tern Island by the Coast Guard, Hawaiian Islands NWR personnel have manned the station.

East Island is an 11.3 acre island located about 6 miles southeast of Tern Island. The Navy used East Island as a base for seaplane operations as early as 1932. During the mid-1940's, a Coast Guard Loran Station was constructed on East Island. The loran station remained operational until 1952 when the station was relocated to Tern Island. Debris left by the military and Coast Guard still litters the island.

French Frigate Shoals hosts a variety of endemic and indigenous plant and animal species. The shoals supports nearly half of the estimated total population of the endangered Hawaiian monk seal and at least 90% of the reproduction of the threatened Hawaiian green sea turtle occurs there. The islets within the shoals furnish a unique habitat on which pelagic seabirds depend for roosting and nesting. Some 100,000 pairs of 16 seabird species nest on these islands.

The legacy of past military presence continues to effect the ecology of the area and to create management dilemmas for the agencies responsible for the resources. Of primary concern is the effect of seawall degradation on the wildlife resource of Tern Island. The seawall is currently severely degraded and causes entrapment hazards for monk seals and green sea turtles. With the continued degradation of the seawall, erosion of the island will occur increasing the potential for entrapment of seals and turtles. In addition, the erosion of the island will likely continue to expose significant debris including glass, defunct machinery, batteries, building materials and extensive lengths of copper wire. Many underground facilities constructed in the past may be exposed. In 1988, twenty, 5,000 gallon underground fuel storage tanks were discovered, many of them still containing fuel. This increased entrapment and entanglement hazard may affect the recovery of the endangered monk seal and threatened green sea turtle. The envisioned erosion of the island interior would also result in a loss of habitat for resting and reproduction for the monk seal, green sea turtle and migratory bird resources.

Recommendations are included for the removal of debris from East Island. Three alternatives for the future of Tern Island are considered. These include (1) no action, (2) remove the seawall and debris, and, (3) rehabilitate the shore protection. Recommendations as to when and how cleanup/restoration activities could proceed and minimize effects on wildlife are discussed.

### Site Description

Tern and East Islands are low sand islands within the coral atoll known as French Frigate Shoals (See Figure 1) in the Northwestern Hawaiian Islands. The atoll is 490 nautical miles northwest of Honolulu, situated near the mid point of the 1,600-mile-long Hawaiian Archipelago (See Figure 2). It lies between the latitudes of 23°37'18" and 23°52'50" North and longitudes 166°03'14" and 166°20'04" West. French Frigate Shoals is part of the Hawaiian Islands National Wildlife Refuge, administered by the U.S. Fish and Wildlife Service through the Department of Interior.

#### **East Island**

East Island lies almost midpoint along the inner reef of the crescent shaped atoll, six miles southeast of Tern Island. It is irregular trapezium-shaped, with the southwest beach being the longest side. It has an area of 11.3 acres, of which 6.7 are vegetated. The island is occupied seasonally by biologists studying Hawaiian monk seals and green sea turtles. Debris left by various military occupations still litters the island.

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Figure 1.

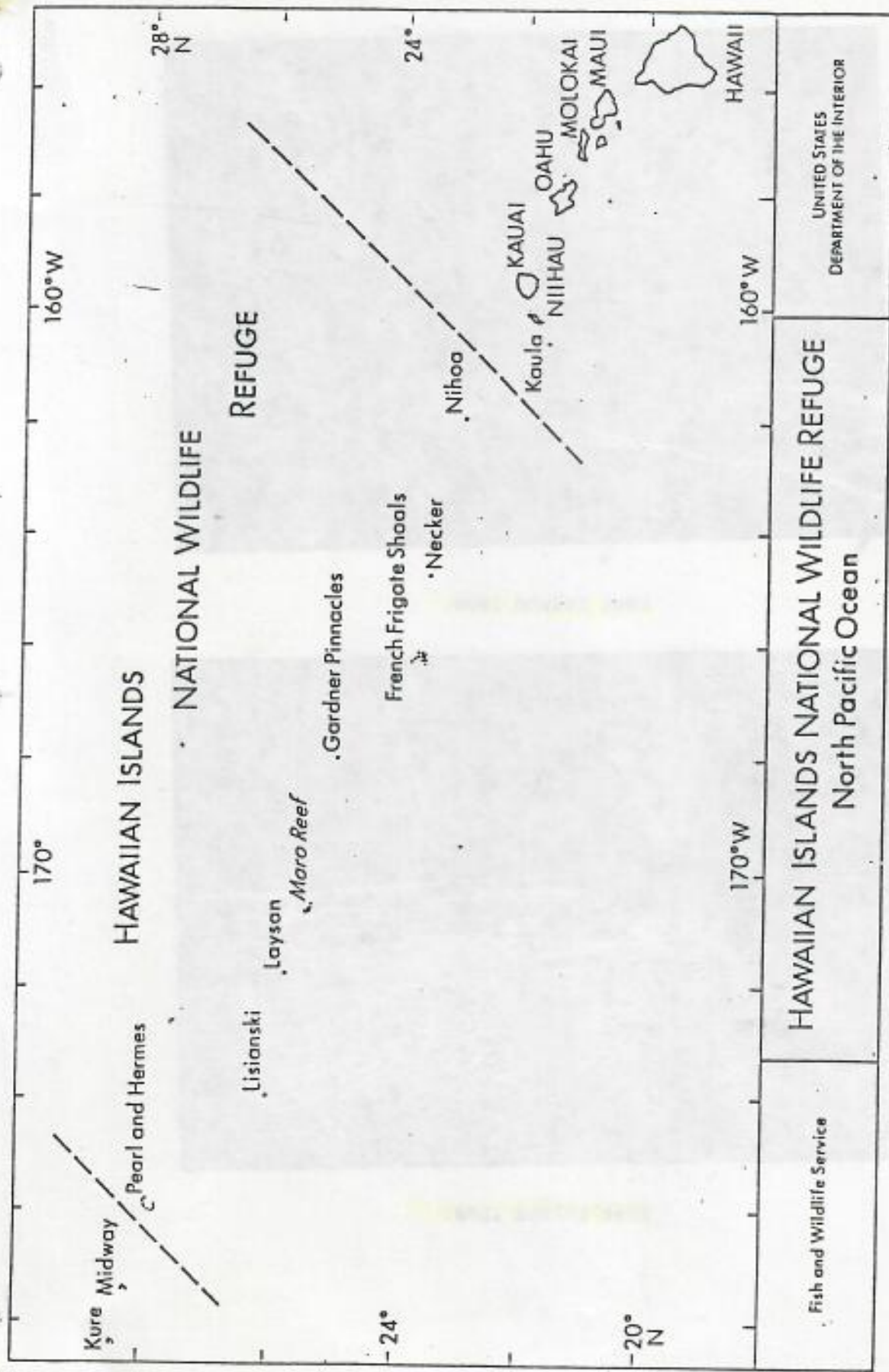
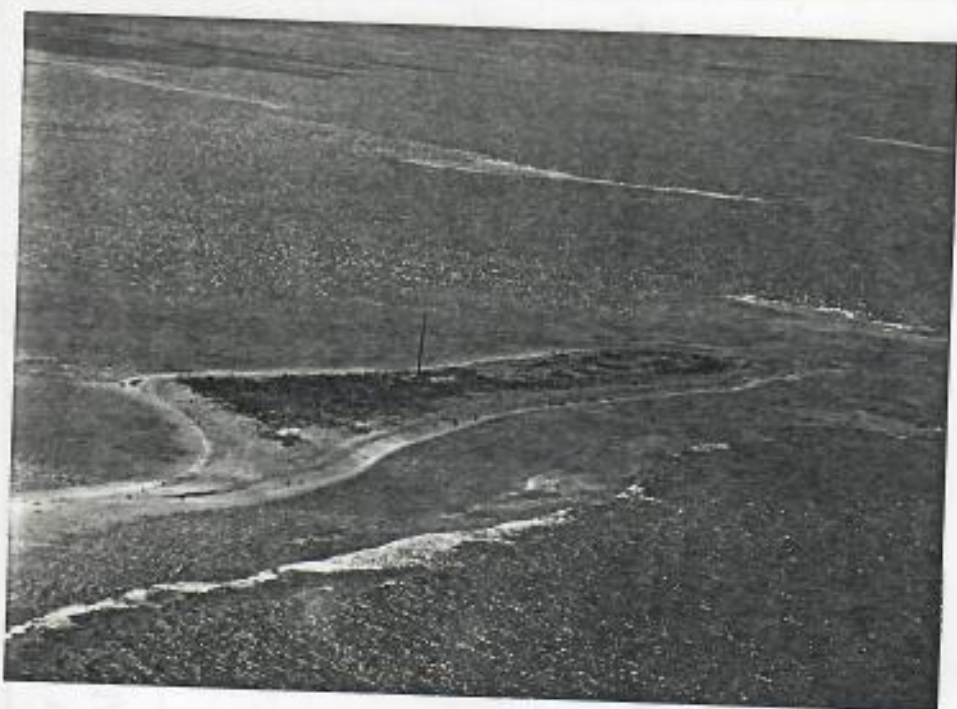


Figure 2.



East Island 1988.



East Island 1988.

## **Tern Island**

Tern Island is the largest island within the atoll with an area of 37 acres. An 11 acre island, with characteristics similar to the other islands within the atoll, originally occupied the site. The present configuration is the result of a dredging and sheet piling project completed during World War II to construct a landing strip. The runway occupies the majority of the island with about 16 acres of vegetation and 1 acre of infrastructure filling the remaining area. The island is currently occupied year round by U.S. Fish and Wildlife Service personnel.



Tern Island 1988.

## Patterns of Ownership/Occupation

### **Federal Jurisdiction**

The United States first took formal possession of French Frigate Shoals on 4 January 1859 in accordance with the U.S. Guano Act of August 1856 (Amerson 1971). By Executive Order No. 1019 (See Exhibit 1) signed on 3 February 1909 President Theodore Roosevelt set aside all the Northwestern Hawaiian Islands, except Midway, as a preserve and breeding ground for native birds. The reserve, including French Frigate Shoals became known as the Hawaiian Islands Reservation, administered by the Department of Agriculture. In 1939, Reorganization plan II, Section 4(A), transferred all lands reserved for wildlife from Department of Agriculture to Department of Interior. In 1940 the name of the Reservation was changed to Hawaiian Islands National Wildlife Refuge by Presidential Proclamation No. 2416 (See Exhibit 2). East and Tern Islands, French Frigate Shoals continue to be administered by the Department of Interior through the U.S. Fish and Wildlife Service as part of the Hawaiian Islands National Wildlife Refuge.

### **Territorial and State Jurisdiction**

The Republic of Hawaii claimed possession of the shoals on 13 July 1895 - after the United States. Hawaii became a territory of the United States on 30 April 1900. Prior to Statehood the atoll was under the jurisdiction of the City and County of Honolulu by virtue of Section 1717 of Chapter 118 in the Revised Laws of Hawaii dated 1925. The atoll became part of the State of Hawaii when the Territory was admitted as the 50th State on 21 August 1959. The atoll continues to fall within the jurisdiction of the State of Hawaii as described in Exhibit 3.

Jurisdictional disputes, especially over Tern Island, have arisen several times between the State and the federal government. The most recent Fish and Wildlife Solicitor's opinion reasserts the position that the Department of Interior holds primary jurisdiction over Tern Island (See Exhibit 4).

### **Navy Occupation (Excerpted from Amerson 1969)**

#### East Island:

The Navy's use of French Frigate Shoals began in 1932. Initially, seaplane operations were conducted near East Island, using the island as a base of operations. Later, through 1942, various operations involving ships, seaplanes, and East Island were conducted. A particularly heavy use of East Island occurred in November of 1935. A large tent city (See Figure 3) was established, including the construction of at least 1 wooden structure. Some blasting also occurred within the shoals at this time to test methods for clearing coral rock.

In April of 1942 two mine fields were laid at the shoals. This was an attempt to exclude Japanese submarines which had used the lagoon to refuel their



seaplanes for reconnaissance missions over Honolulu. Each field used 85 MK VI anchored mines. The first field, a quadruple line of mines, had its northwest end bearing 296° True, 13,150 yards from La Perouse, and its southeast end bearing 260° True, 7,600 yards from La Perouse. The second field consisted of nine quadruple lines of mines: the northwest end of this field bore 215° True, distance 7,050 yards from La Perouse, and the southeast corner bore 183° True, distance 13,850 yards from La Perouse.

On 13 April 1942 a detachment of 13 Navy and Marines were placed on East Island. This detachment remained in place until construction began on Tern Island.

#### Tern Island:

As a result of the Battle of Midway the Navy decided to build a landing strip at French Frigate Shoals. The purpose of the strip was threefold. The first was to provide fueling and landing facilities for ferrying aircraft between Pearl Harbor and Midway. Second was to provide an emergency landing facility for either land or sea planes. Third was to have an outpost for the defense of Pearl Harbor through radio, radar, lookouts, and planes.

The initial investigation into building the strip took place in June 1942 with actual work on the project commencing in July of the same year. The major work to construct the new air strip involved scraping the island of birds and dredging 660,000 cubic yards of fill to cover the original island. The island grew from its original 1,800 by 450 foot to a landing field 3,100 feet long by 250 feet wide, partially rimmed with 5,000 feet of steel sheet piling driven to an approximate depth of 15 feet (this sheet piling was installed without tiebacks and was already bulging by 1945). It stood 6-1/2 feet over the mean tide level. In addition a 12,000 foot ship channel, 200 feet wide and 20 feet deep, was dredged to Tern Island and a seaplane runway, 8,000 feet long and 1,000 feet wide, was cleared adjacent to the island.

After dredging was completed, defenses were installed. These included one 90mm battery, four three inch 50 cal. cannons, four 40 mm. cannons, four 20 mm. cannons, six 50 cal. cannons, and sixteen 30 cal. machine guns placed in gun pits around the perimeter of the island. A large mine field was installed in the entrance of the channel. Many of these mines eventually broke loose, exploding on the coral heads and some landing on the island's beaches.

By March of 1943 the bulk of the construction had been completed (See Figures 4 and 5). Ground facilities for the new air base included: one 20'x 100' Multipurpose building, one buried 16'x 40' Quonset for officer's quarters, two buried 16'x 40' Quonsets for radios and quarters, and one 25'x 60' recreation building. A converted barge was moored on the northwest side of the island and used for additional quarters. Twenty steel tanks were buried to provide storage for 100,000 gallons of aviation gasoline, and one 6,000 gallon tank was buried for storage of diesel fuel. A 90 foot radar tower was installed on the north edge of the runway. Fresh water and electrical power were provided by evaporators and generators.

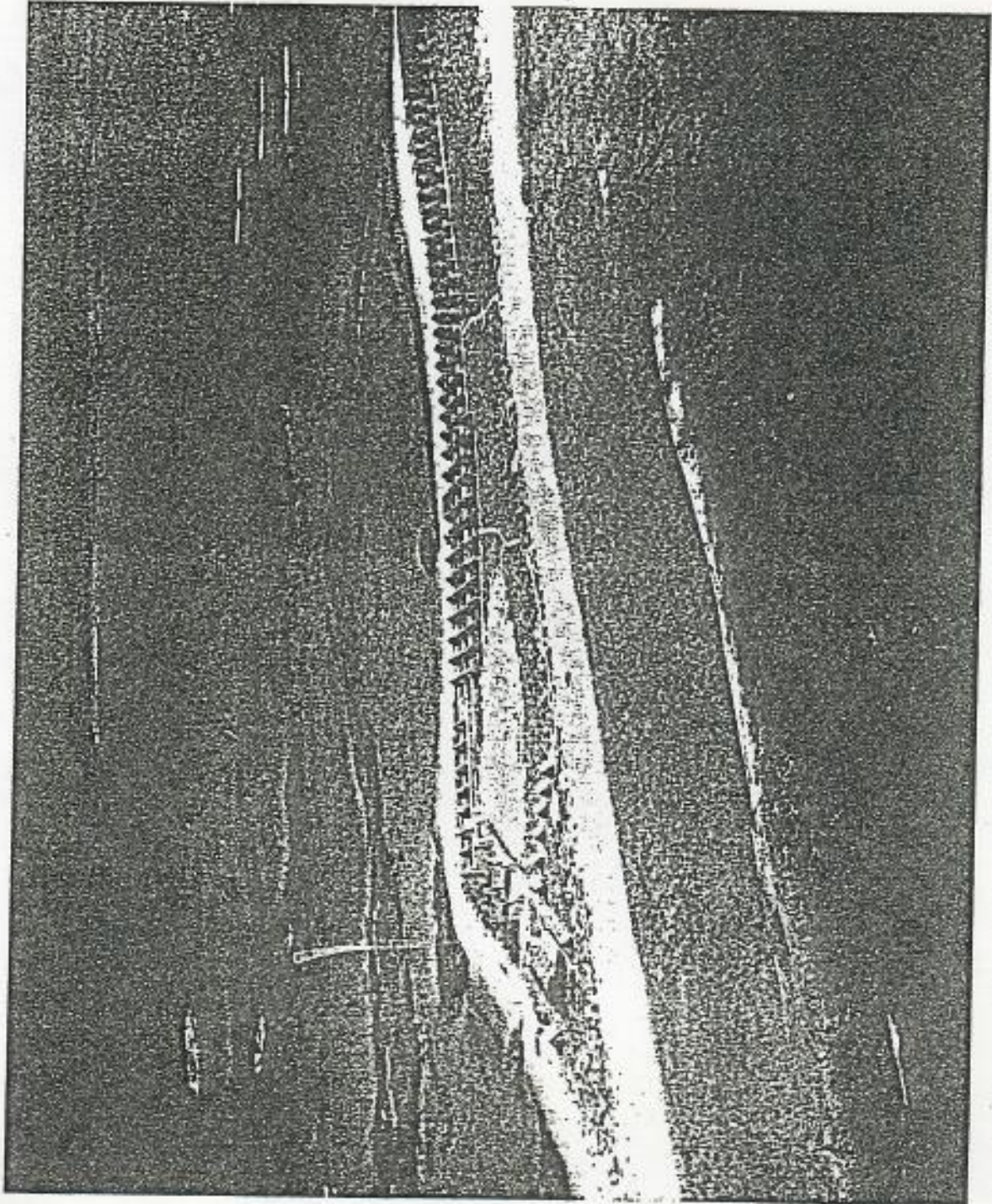


Figure 3. East Island "tent city," 11 November 1935. Official U. S. Navy photograph.  
From Amerson (1969)

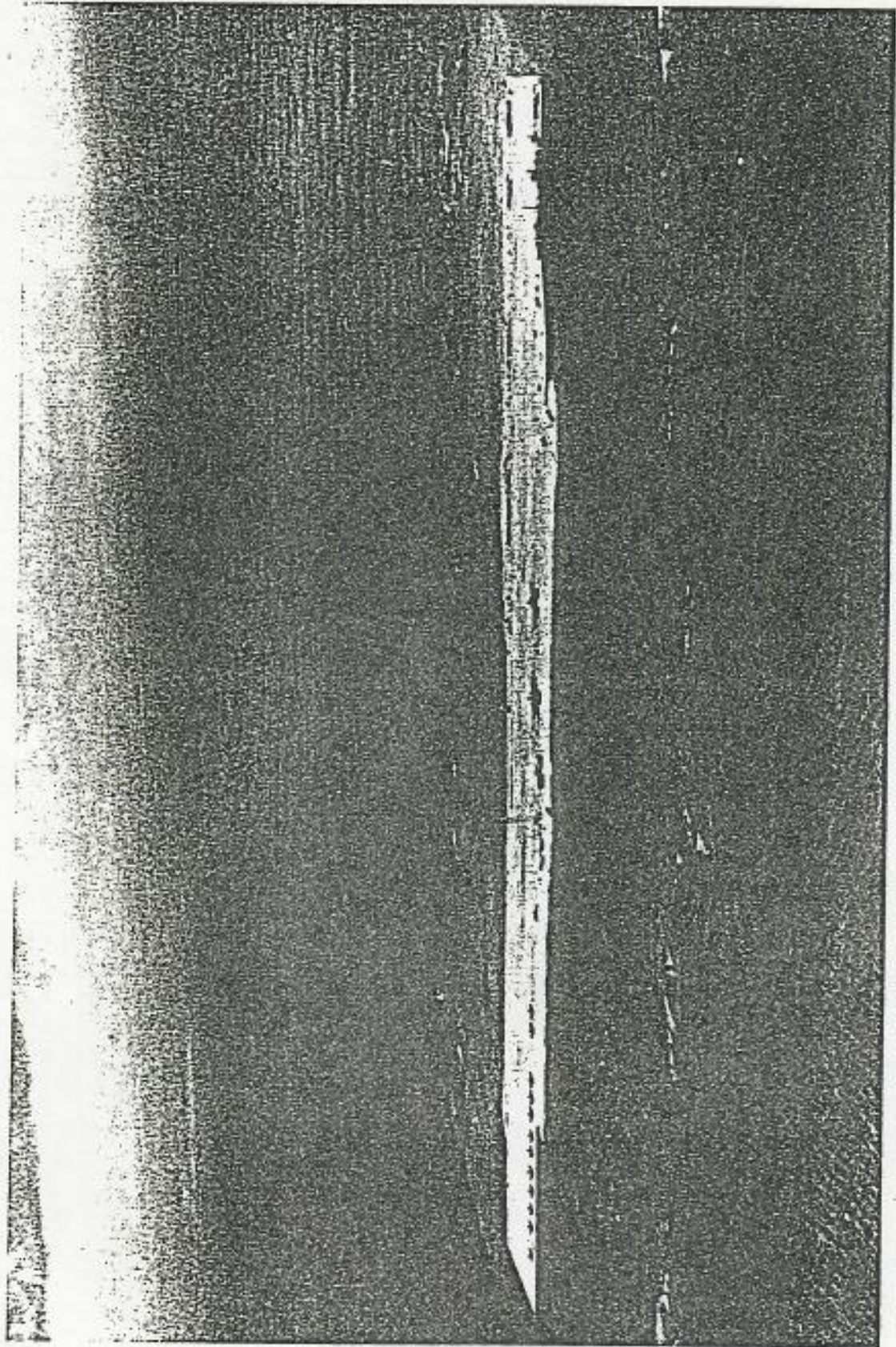


Figure 4 . Newly constructed Tern Island Naval Air Facility, 9 September 1943.  
Official U. S. Navy photograph. From Amerson (1969).

NAVAL AIR FACILITY  
 Proposed Building Locations  
 Drawing No. FN.A.S.-N1-109  
 December 15, 1943

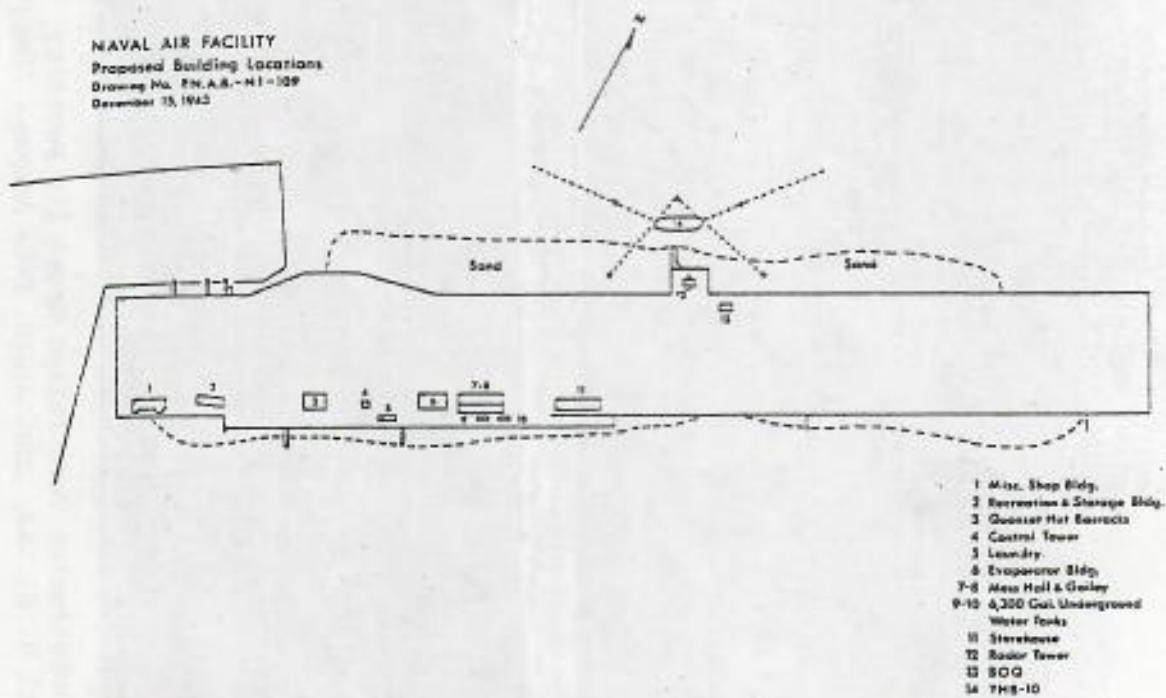


Figure 5. Tern Island Naval Air Facility, 15 December 1943.  
 Redrawn from official U. S. Navy blueprint map. From Amerson (1969)

The new air station was commissioned on 17 March 1943. It was built at a cost of \$2,000,000. The staffing complement included 118 men.

From April to September of 1944 seabees converted the temporary base into a semi-permanent installation. The new facilities consisted of the following (See figure 6):

- 1 - 40'x 80' frame power house
- 1 - 20'x 112' Quonset mess hall
- 1 - 20'x 112' Quonset galley, dry stores, CPO mess, officer mess
- 1 - 20'x 50' buried igloo-type steel ammunition magazine
- 1 - 20'x 60' radio receiving and operating building
- 1 - 20'x 80' radio and radar transmitting building
- 1 - 20'x 30' radio and radar auxiliary power building
- 1 - 20'x 60' officers' barracks
- 1 - 20'x 56' Quonset barracks
- 1 - 16'x 40' hospital and library
- 1 - 16'x 24' aviation repair and operating building
- 1 - 40'x 170' industrial shop
- 1 - 90' steel radar tower
- 1 - 15,000 gallon elevated wood water storage tank, with lines and pumping facilities
- 3 - 5,000 gallon diesel fuel tanks and complete fuel transfer system
- 1 - complete underground power distribution system
- 1 - 1'500 foot steel sheet pile seawall, to complete enclosure of initial development
- 1 - laundry
- 1 - garbage house

At the end of World War II the Navy no longer felt a need for the Tern Island station and placed it in a caretaker status on 7 October 1945. Final disestablishment of the facility took place on 9 June 1946. It is unclear whether any removal of facilities occurred as a result of this abandonment. Reports of use of the island by various territorial fishing interests after abandonment describe the occupants utilizing Navy structures.

The Navy made several efforts to turn responsibility for the island over to the Territory of Hawaii. These efforts were finally successful on 8 November 1948. On this date the Navy transferred the facility to the Territory without monetary consideration. This transfer was in effect illegal, since the Navy never held title to the property (See Exhibit 4 ).

#### **Coast Guard Occupation (Excerpted from Amerson 1969)**

The Coast Guard was ordered to operate as part of the Navy on 1 November 1941 and returned to the Department of Treasury on 1 January 1946 (Scheina 1987). The Coast Guard LORAN station at Tern Island was never part of the Department of Defense (Scheina pers. comm.).

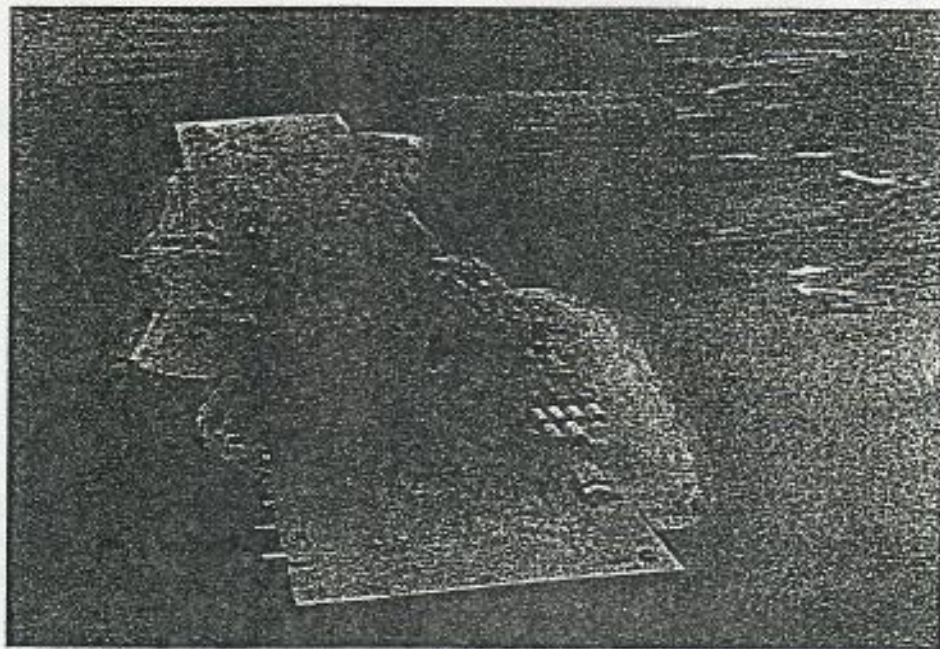


Figure 6 . Abandoned Tern Island Naval Air Facility, 16 August 1949, showing its barren, white-coral expanse. Official U. S. Navy photograph. From Amerson (1969).

### East Island:

On 9 September 1940, after consultation with the Department of Interior, Governor John B. Poindexter of Hawaii signed Executive Order #893 (See Exhibit 5) which set aside East Island for use by the United States Government. It was recognized at this time that the U.S. Navy never had official control over East Island since it had not been placed under their control by Executive Order. They also recognized that the Department of Interior had jurisdiction through Executive Order 1019.

On 16 December 1943 the Chief of Naval Operations directed the U.S. Coast Guard to establish a LORAN station on East Island, French Frigate Shoals. A Coast Guard Construction Detachment arrived at East Island in early June 1944. By the end of July the station was complete and contained 7 Quonset huts, 6 smaller buildings, a 96 foot dock and a 7 pole antenna network (See Figures 7 and 8).

The station was commissioned in August and Commander, Coast Guard District, 14th Naval District assumed control of the station. This station continued operation until 24 October 1952.

### Tern Island:

Because of the problems associated with operating the LORAN station from East Island, the Coast Guard decided it would be economical to move the station to Tern Island. The Coast Guard sought and received a license from the Hawaii Aeronautics Commission permitting them to use and occupy Tern Island (See Exhibit 6). This licensing was in fact illegal since the Territory did not have the power to grant this type of use (See Exhibit 3). The Department of Interior questioned the legality of the Coast Guard's occupation of Tern Island in 1965. This resulted in a formal agreement where the Department of Interior gave the Coast Guard permission to occupy Tern Island (See Exhibit 7).

Because the Navy buildings were still intact the Coast Guard undertook renovation of the existing structures and installation of equipment to operate the LORAN station. On 14 October 1952 the Tern Island LORAN station was formally commissioned.

In February 1959 new sheet piling was installed at the northwest corner of the island. Although other areas of the seawall were badly deteriorated, funds were not available to repair those areas.

Between April and August of 1964 renovations of the facility took place. Major new construction included a LORAN building and installation of new sheet piling. New piling was placed seaward of the old seawall along the east and west ends of the runway.

Blueprints dated 1970 and 1971 have been found, which detailing replacement and rehabilitation of the seawall in the west, northwest, east, and northeast. The date this work was accomplished is unknown.



Figure 7 . Newly constructed East Island Coast Guard LORAN Station, 24 April 1945.  
Official U. S. Navy photograph. From Amerson (1969)



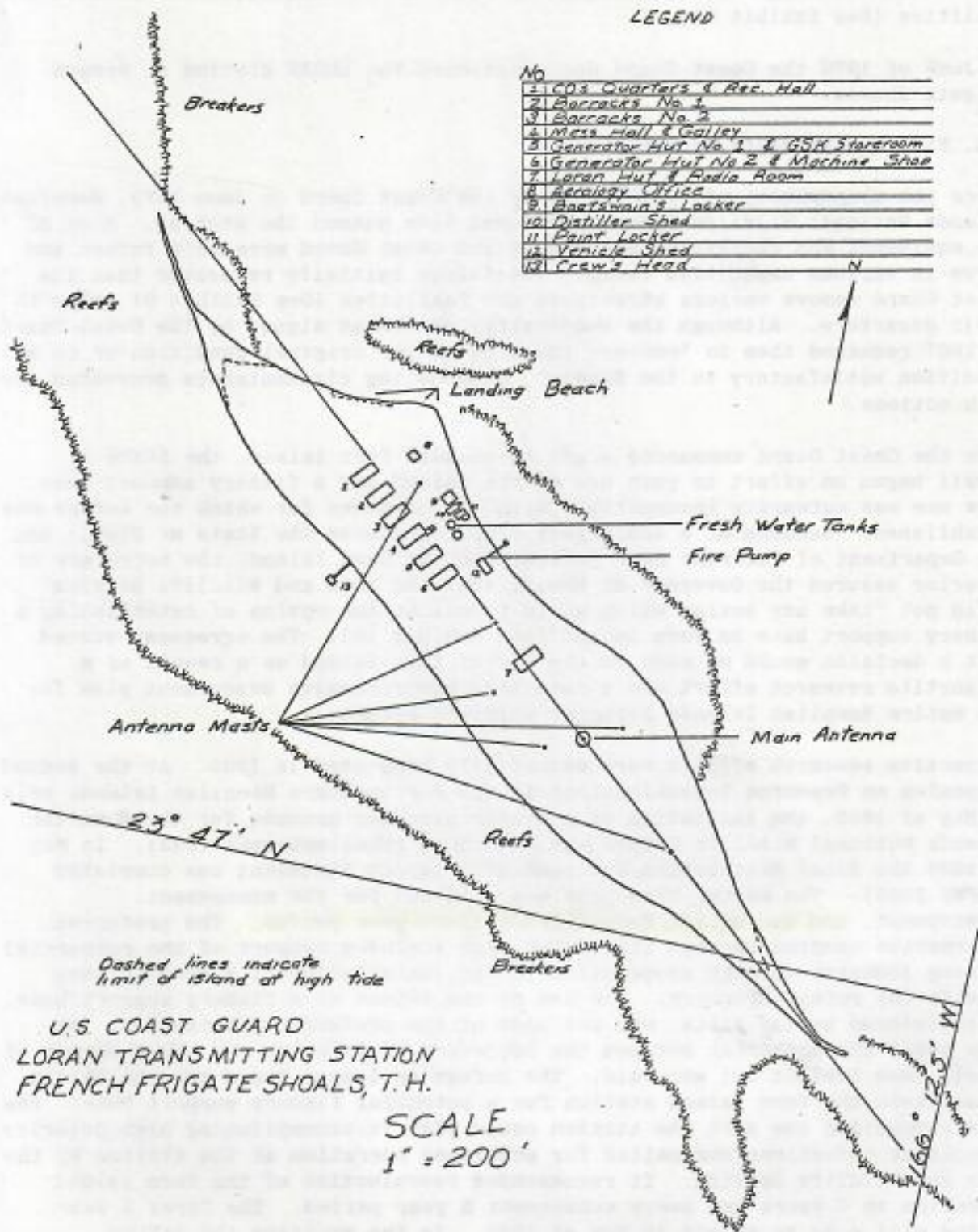


Figure 8. Map of East Island, 1 November 1948. Redrawn from official U. S. Coast Guard Operational Data Report. From Amerson (1969)

The Coast Guard undertook major renovation of the Tern Island facility in 1973. New buildings were constructed as well as the installation of various utilities (See Exhibit 8).

In June of 1979 the Coast Guard decommissioned the LORAN station at French Frigate Shoals.

#### U.S. Fish and Wildlife Service

Since the abandonment of Tern Island by the Coast Guard in June 1979, Hawaiian Islands National Wildlife Refuge personnel have manned the station. Most of the equipment and facilities erected by the Coast Guard were left intact and serve in various capacities today. The Refuge initially requested that the Coast Guard remove various structures and facilities (See Exhibit 9) prior to their departure. Although the cooperative agreement signed by the Coast Guard in 1967 required them to "restore the site to its original condition or to a condition satisfactory to the Bureau", extenuating circumstances prevented any such actions.

When the Coast Guard announced plans to abandon Tern Island, the State of Hawaii began an effort to gain use of the island for a fishery support base. This use was outwardly incompatible with the purposes for which the Refuge was established. Because of a concurrent dispute between the State of Hawaii and the Department of Interior over jurisdiction of Tern Island, the Secretary of Interior assured the Governor of Hawaii that the Fish and Wildlife Service would not "take any action which would foreclose the option of establishing a fishery support base on Tern Island" (See Exhibit 10). The agreement stated that a decision would be made on the use of Tern Island as a result of a Tripartite research effort and a resulting comprehensive management plan for the entire Hawaiian Islands National Wildlife Refuge.

Tripartite research efforts were essentially completed in 1983. At the Second Symposium on Resource Investigations in the Northwestern Hawaiian Islands held in May of 1983, the initiation of a master planning process for the Hawaiian Islands National Wildlife Refuge was announced (Shallenberger 1983). In May of 1986 the Final Master Plan/Environmental Impact Statement was completed (USFWS 1986). The master plan provides guidance for the management, development, and use of the Refuge for a 10-20 year period. The preferred alternative adopted through the master plan includes support of the commercial fishing industry through cooperation in the installation of a mooring buoy outside the refuge boundary. The use of the island as a fishery support base, as envisioned by the state, was not part of the preferred alternative. At this point the agreement between the Secretary of Interior and the Governor of Hawaii (See Exhibit 10) was void. The Refuge no longer had a responsibility to maintain the Tern Island station for a potential fishery support base. The plan recognized the part the station could play in accomplishing high priority management objectives and called for continued operation of the station by the Fish and Wildlife Service. It recommended reevaluation of the Tern Island operation in 5 years and every subsequent 5 year period. The first 5 year period will come to an end in May of 1991. In the meantime the Refuge continues to operate the station in an attempt to meet the objectives of the master plan (See Exhibit 11).

### Flora and Fauna

French Frigate Shoals hosts a variety of endemic and indigenous plant and animal species. It is the stronghold of the Hawaiian monk seal, an endangered species which occurs predominantly on the lands and waters of the Hawaiian Islands National Wildlife Refuge. The shoals supports nearly half of the estimated total population and accounts for over half of the pups born each year throughout its range.

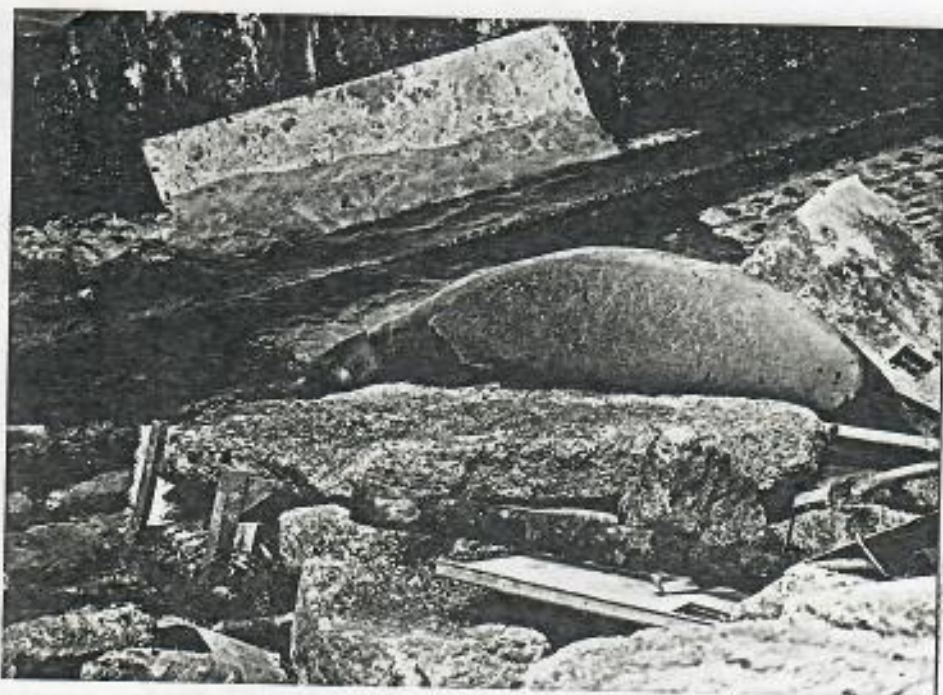
The threatened green sea turtle also uses French Frigate Shoals extensively. Studies have revealed that "At least 90% of all reproduction by green turtles in the Hawaiian Islands occurs at French Frigate Shoals, mainly on East Island" (Balazs 1989). The islets of the atoll also provide significant basking habitat and the lagoon serves as a foraging area.

The islets within the shoals furnish a unique habitat on which pelagic seabirds depend for roosting and nesting. Some 100,000 pairs of 16 seabird species nest on only 73 acres of emerged lands (Fefer et al. 1983). Other migratory species use the islands as wintering grounds.

Although the terrestrial habitat of French Frigate is far from pristine, it retains the essential characteristics and species diversity typical of less human influenced islands in the chain. No endangered plant species occur here.

#### **Historic Change**

Military occupation of French Frigate Shoals had significant impacts on the natural history of the atoll. In general, these impacts were direct results of habitat alteration. Activities such as blasting of reefs, construction of structures, and dredging either eliminated habitat or made it unusable for the duration of the occupation. In the case of Tern Island, where a natural island was permanently altered, natural beaches were modified preventing use by seals and turtles. Early military activities discouraged the establishment of vegetation on Tern to prevent seabird nesting and its associated problems. There is little doubt that incidental disturbance and outright take severely affected populations of some species. The sensitivity of seals to certain types of human disturbance kept seal numbers low on Tern Island from 1942 to 1979. Since military activities ceased, there have been increases in some wildlife populations, but the effects of the presence continue to impact the natural history of the atoll.



Example of potential seal entrapment behind Tern Is. seawall.

## Current Status (East Island)

### Vegetation:

East Island is vegetated by a combination of endemic, indigenous, and alien plant species. Due to the long history of continuous human occupation, the number of alien species are far greater here than on other Northwestern Hawaiian Islands. There are no endangered plant species on East Island. The island is covered with numerous low growing forbs and grasses. A few shrubs (Tournefortia argentea) are present but the island mainly consists of an open habitat type. Species present in abundance include: (Heliotropium curassavicum), (Spergularia marina), (Chenopodium oahuense), (Ipomea pes-caprae), (Boerhavia repens), (Portulaca lutea), (Portuaca oleracea), (Tribulus cistoides), and (Cenchrus echinatus).

### Monk Seals (Endangered Species):

East Island is an extremely important site for the monk seal. More pups are born here each year than anyplace else in the Northwestern Hawaiian Islands. The southwest shoreline provides excellent habitat for pupping. The entire shoreline is used by basking seals. East Island pups account for approximately 30% of pup production throughout the Northwestern Hawaiian Islands and nearly 50% of pups born at French Frigate Shoals (Gerrodette 1985). An average minimum of 44 pups were born here each year between 1983-1988. This is a minimum figure because it is based on the number of pups that survived to tagging age (weaning). Some pups are missed each year due to logistical difficulties (See Table 1). Pups have been documented during every month of the year, though the majority of pupping occurs March - September (Johnson and Johnson 1984).

Counts of seals using East Island are difficult to interpret. There are no years where regular censuses were conducted throughout the year. Gerrodette (1985) developed a technique to estimate numbers of seals using an island from beach counts. His estimate of 64 seals (nonpups) utilizing East must be interpreted keeping several facts in mind. First, the estimate is based on counts made during the summer months when usage of East may be higher because of its importance as a pupping site. Secondly, the method used is based on total counts from a single island (Lisianski Is.) system. The dynamics of intra-atoll movement of seals adds confusion to the exact meaning of the above figure. Finally, the figure may be misleading in that higher use may sometimes occur. Table 2 shows average monthly figures for beach counts during 1984 and 1985. This is the most complete set of counts available for this island.

### Green Sea Turtle (Threatened Species):

East Island provides both nesting and basking habitat for this species. In contrast to Tern Island where nesting occurs mainly along the beach berm, nesting here takes place throughout the interior of the island (See figure 9). Approximately 55% of the turtle nesting activity each breeding season at French Frigate Shoals occurs on East Island (Balazs 1980). The nesting season generally follows that which was documented on Tern Island in 1986-1988 (USFWS 1989) (See figures 10,11,12).

Research into the biology of green turtles has been conducted here since the early 1970s by George Balazs, a zoologist for National Marine Fisheries Service. A coverage rate model was developed from comprehensive tagging data collected in 1974-1975 (Weatherall 1989). Each year nesting is monitored for a portion of the season at East Island and data is plugged into the model to derive a figure for the number of females nesting that season. Estimates of the female nesting population using East Island have been made each year since 1973 (See Figure 13). Weatherall (1988) makes the following comments concerning nesting population trends on East Island:

"In general, the surveys show an increase in the nesting population over the 15- year period, with considerable variation. During the first 8 years of the monitoring period, the average annual nesting population was 127 turtles. During the second 7 -year interval, the average was 196 turtles, an increase of 54%. If the extremely low estimate for 1983 is excluded from the second series of years, the increase amounts to 73%. The twofold variation among annual estimates evident during the first 8 years decreased considerably during the second 7 - year period (excluding the 1983 data). The factors underlying the apparent increase in the East Island nesting population and the year - to - year variability are not understood. The rising trend in the population may be due to a reduction in harvest of mature turtles and subadults; green turtles have been fully protected in Hawaii since 1978."

Some of the debris resulting from 20 years of military occupation was burned by permission of the U.S. Fish and Wildlife Service in 1965. In 1980 a more intensive cleanup by Fish and Wildlife Service and National Marine Fisheries Service staff. Three concrete slabs were broken up and piled in one location and metal and obvious wire and metal debris were removed and taken to Tern Island. Remains of the abandoned Coast Guard LORAN facility still litter the island. The Draft Recovery Plan for the Hawaiian Green Sea Turtle recommends removing this debris, because of its impact as an impediment to nesting.



East Island prior to cleanup (1962).

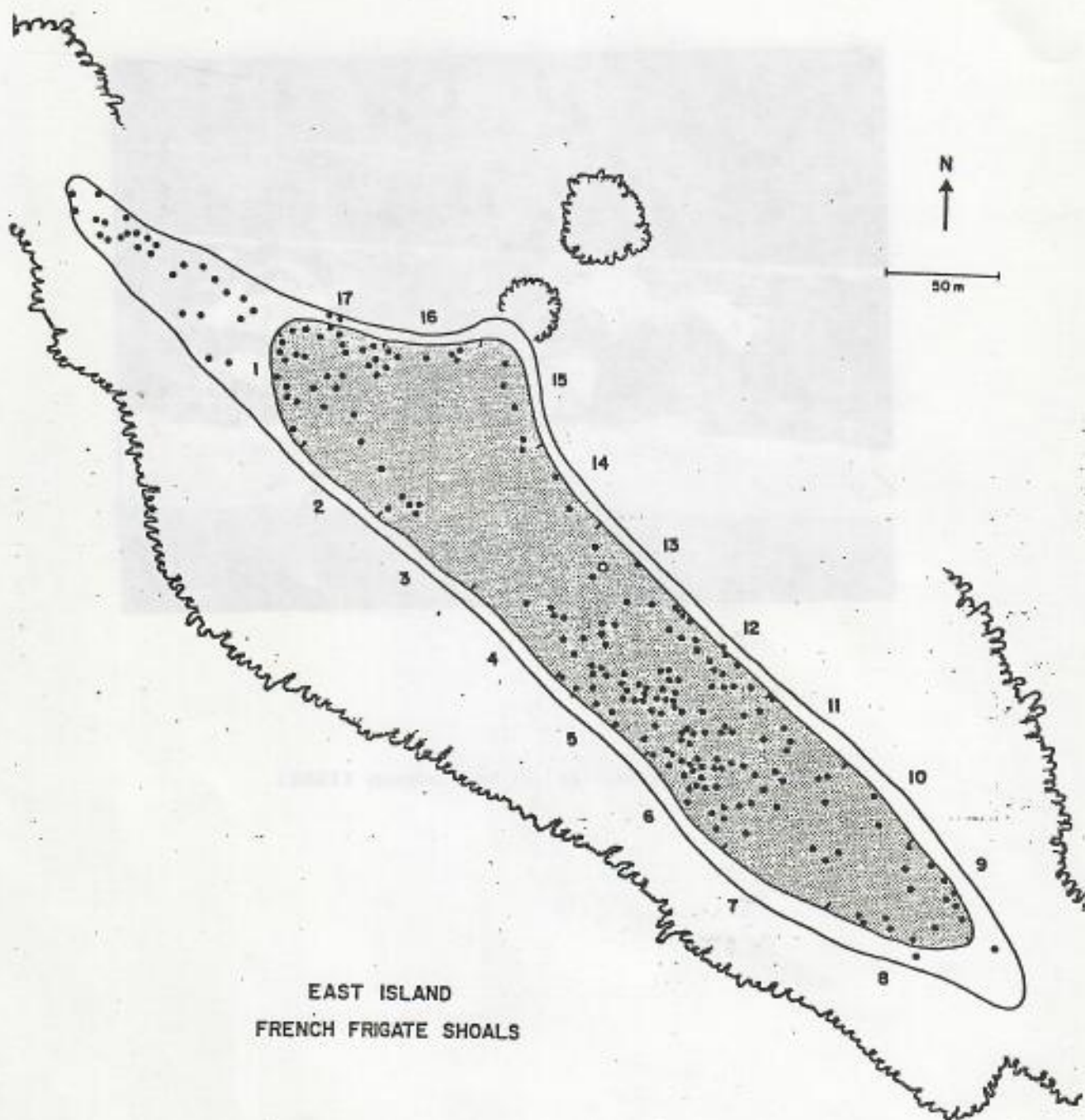


Figure 9. Locations of 220 nests recorded on East Island from June to August of 1974. The numbers on the island's perimeter identify the 17, 50-m long nesting areas that have been established for reference purposes. From Balazs (1980).



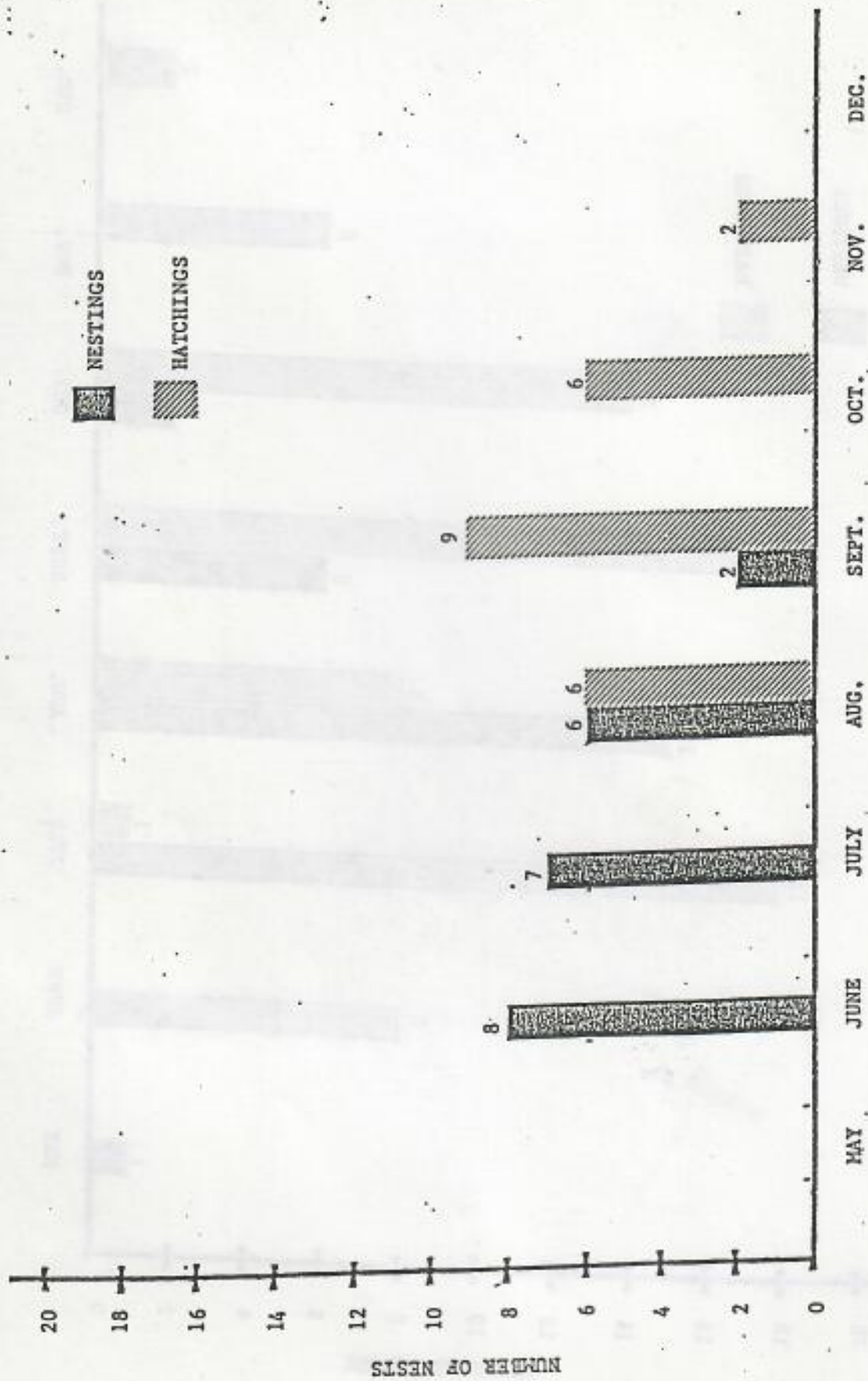


Figure 0. Hawaiian green sea turtle nesting and hatching at Tern Island, French Frigate Shoals, 1986.

Twenty-three nests were found. The first and last nests were laid on 6 June and 22 September, respectively.

All 23 nests hatched; the first on 15 August and last on 16 November.

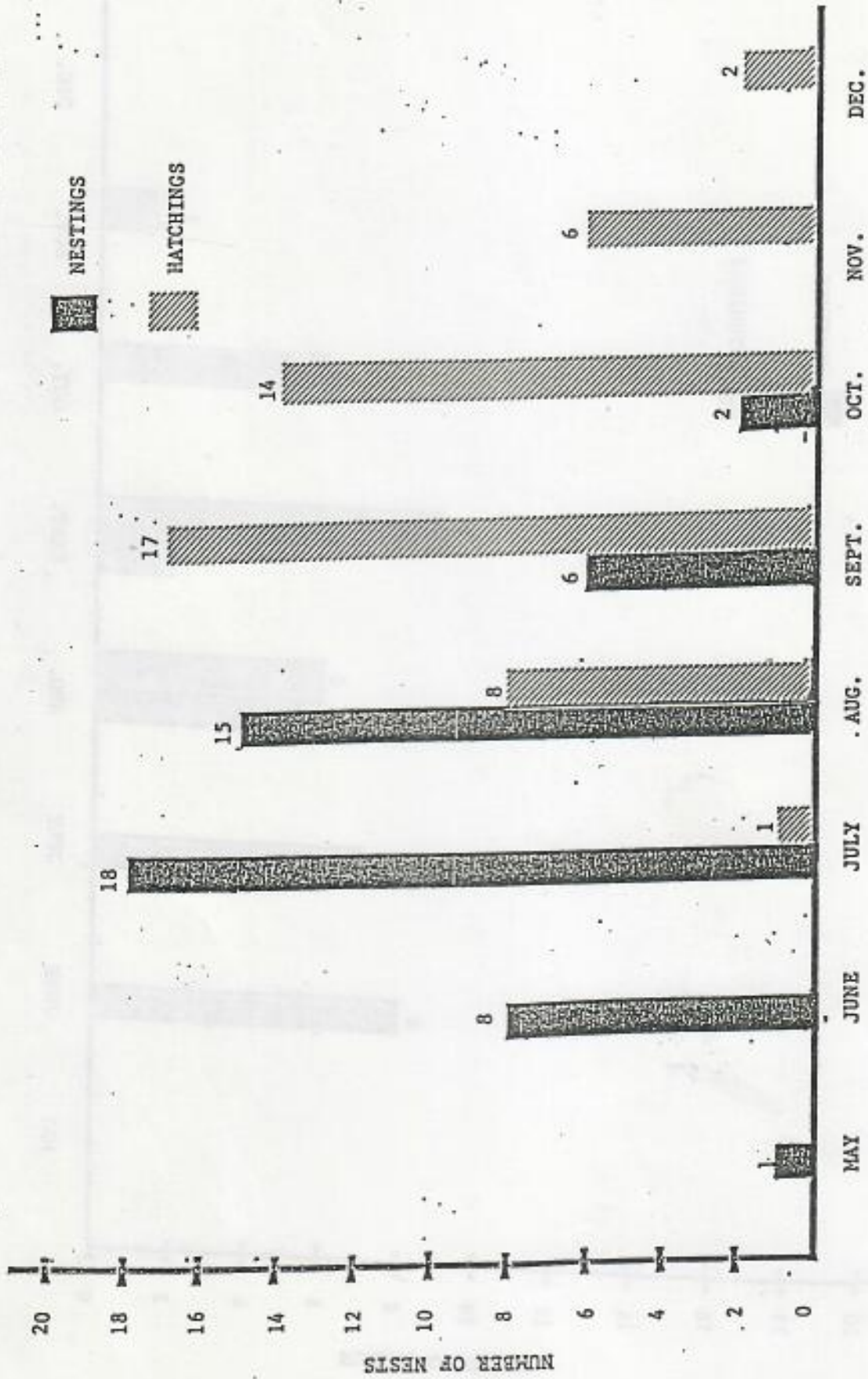


Figure 11. Hawaiian green sea turtle nesting and hatching at Tern Island, French Frigate Shoals, 1987. Fifty nests were detected. The first and last nests were laid on 25 May and 20 October, respectively. Forty-eight nests hatched; the first on 29 July and last on 26 December.

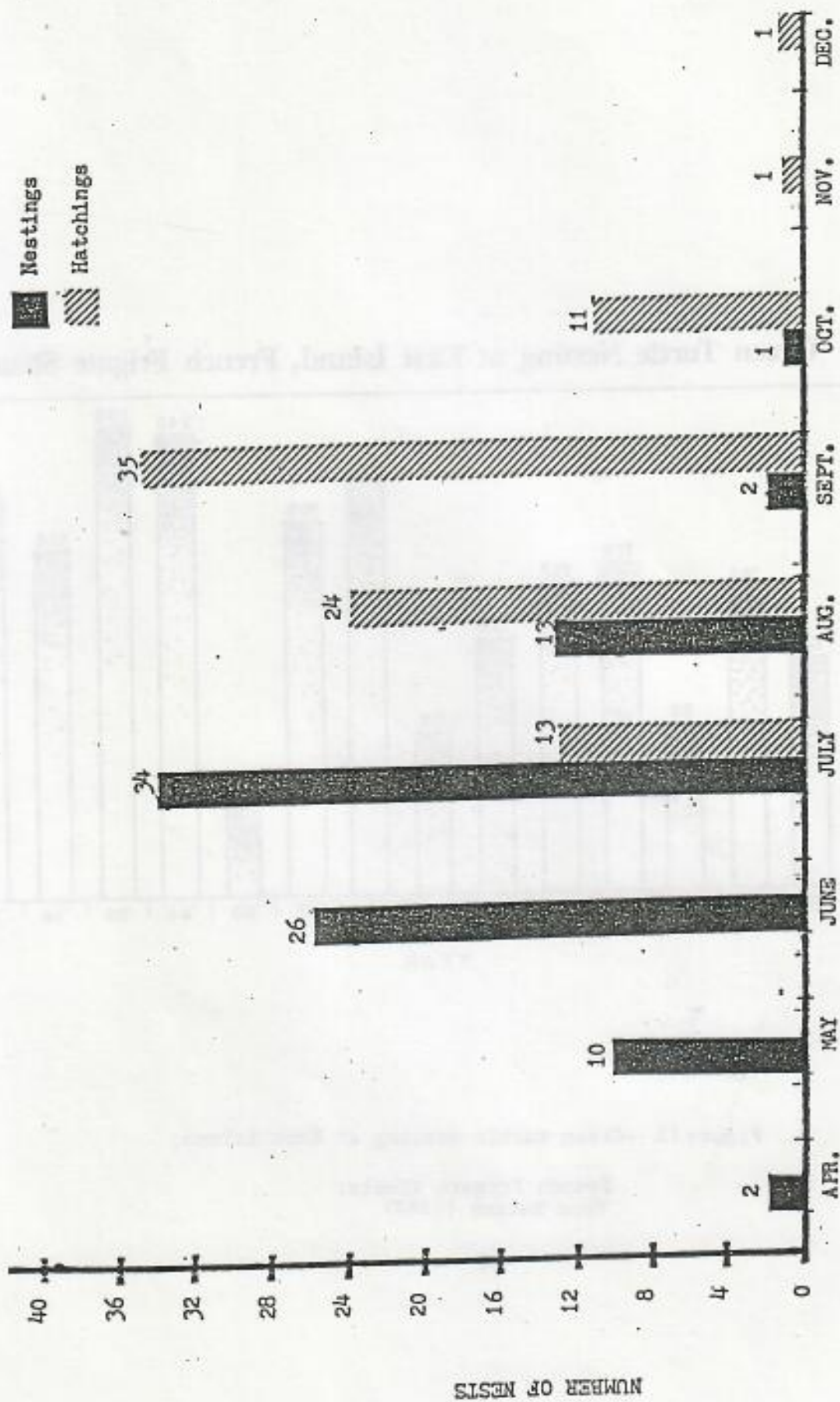


Figure 12. Hawaiian green sea turtle nesting and hatching at Tern Island, French Frigate Shoals, 1988. Eighty-eight nests were observed. The first and last were layed on 26 April and 1 October, respectively. Eighty-five of these nests hatched; the first on 8 July and last on 9 December.

### Green Turtle Nesting at East Island, French Frigate Shoals

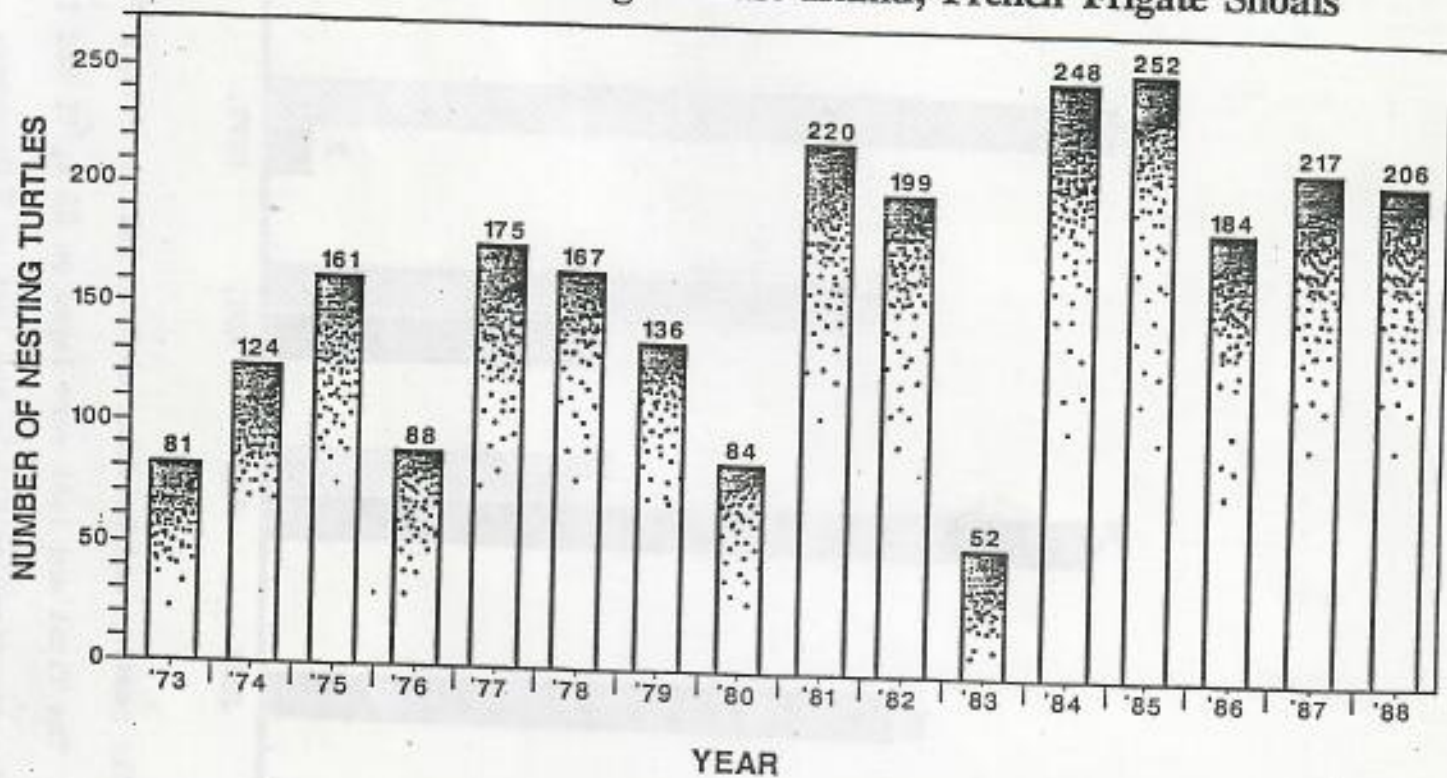


Figure 13.--Green turtle nesting at East island,

French Frigate Shoals.  
From Balazs (1989)

Seabirds:

Seven species of seabirds regularly nest on East Island. These include:

black-footed albatross  
Laysan albatross  
wedge-tailed shearwater  
sooty storm-petrel  
red-tailed tropicbird  
masked booby  
brown noddy

The red-footed booby and great frigatebird have nested here in recent years, but have apparently abandoned the island for more favorable conditions on other islets. Suitable nesting vegetation for these 2 species has all but disappeared from East Island. Because of occasional inundation by seawater and other climatic conditions, this island goes through rather dramatic vegetational changes over the course of several years. There has been a recent record of 1 grey-backed tern nest.

Because of its location, trips to East island to assess seabird populations have been few and inconsistent. Maximum recent counts of nests are shown in Table 3.

The generalized breeding phenology of seabirds at French Frigate Shoals is displayed in Figure 14.

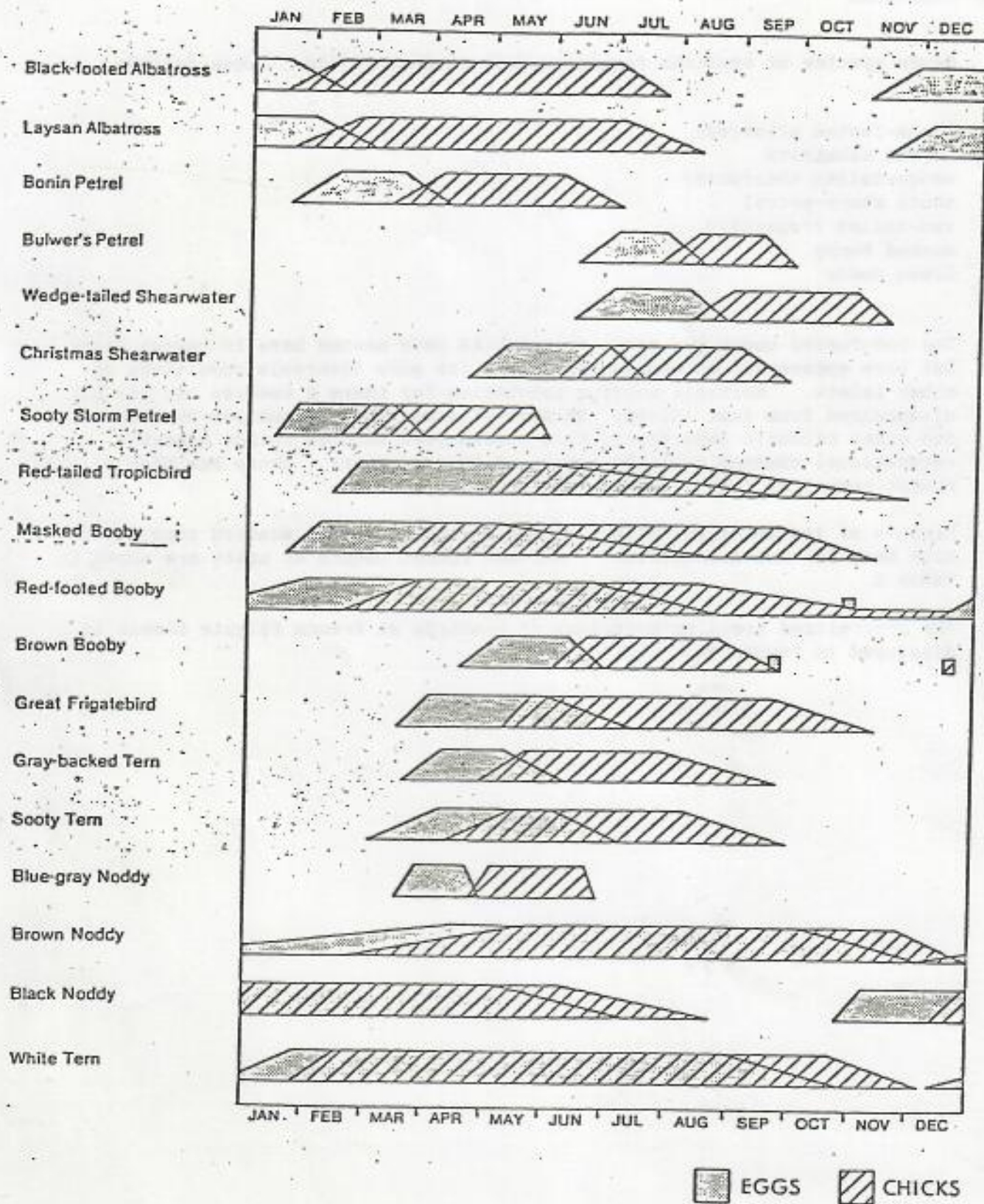


Figure 14 . Generalized Breeding Cycles of Seabirds on French Frigate Shoals.

Most seabirds on East Island are either surface or burrow nesters (See Figure 15). During the months of November through June the vegetated portion of the island is literally covered with nesting albatross. With the addition of shearwater and petrel nests, the island's surface is difficult to traverse without impacting the birds.



Black-footed and Laysan albatross on East Island.

#### Shorebirds:

Several species of shorebird also frequent East Island. These include the ruddy turnstone, golden plover, bristle-thighed curlew, and wandering tattler. The most abundant of these is the golden plover of which a maximum of 25 individuals might be encountered. No systematic censuses have been conducted here.

#### **Current Status (Tern Island)**

#### Vegetation:

Tern Island is vegetated by a combination of endemic, indigenous, and alien plant species. Due to the long history of continuous human occupation, the number of alien species are far greater here than on other Northwestern Hawaiian Islands. There are no endangered plant species on Tern Island.

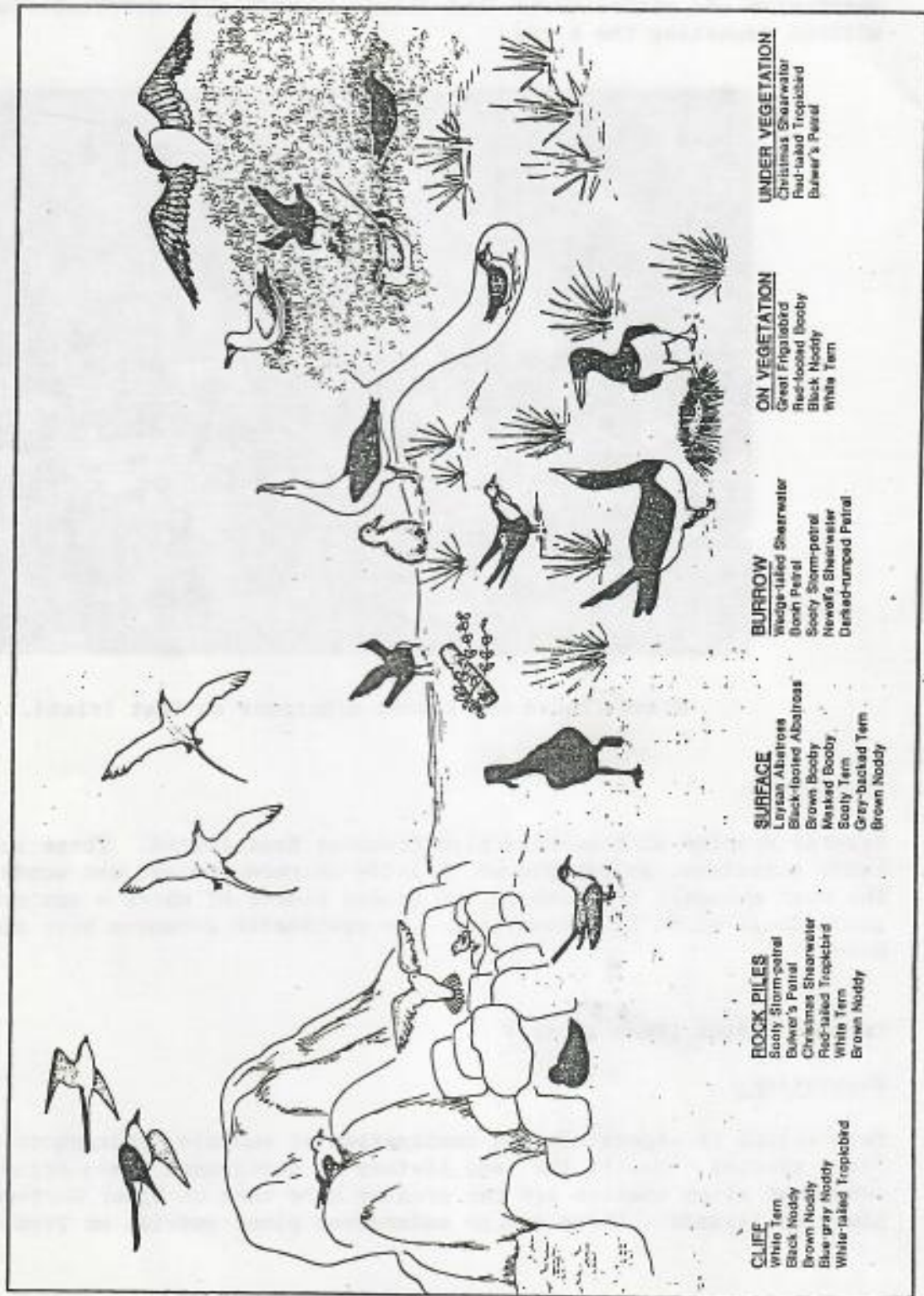


Figure 15. Nesting habitats of NWHI seabirds



Geographically, the vegetated portions of the island can be separated into "north of the runway" and "south of the runway". Figure 16 portrays the vegetation on Tern by habitat type. There are two distinct habitat types: shrub and open. The shrub habitat is dominated by tree heliotrope (Tournefortia argentea), naupaka (Scaevola sericea), and sour bush (Pluchea symphytifolia). The open habitat is covered with numerous low growing forbs and grasses. Species present in abundance include: (Heliotropium curassavicum), (Spergularia marina), (Chenopodium oahuense), (Ipomea pes-caprae), (Boerhavia repens), (Portulaca lutea), (Portuaca oleracea), (Tribulus cistoides), and (Cenchrus echinatus). Several ironwood and palm trees are scattered over the island but form no distinct groups.

#### Monk Seals (Endangered Species):

Tern Island is extensively used by seals for haul out and molting. Still born pups have occurred here in the past, but the first successful (survived to weaning) pupping was in the spring of 1989. The south beaches are the most heavily used areas. The two beaches along the north side of the island are used to a lesser extent, as is an ephemeral sandspit on the east end of the island (See Figure 17).

Beach counts of seals have been conducted at least weekly on Tern Island by Fish and Wildlife Service and National Marine Fisheries Service personnel since July of 1979. Count methods are standardized as to time of day and recording techniques. During Coast Guard occupation (1950-1979) the number of seals using the beach was never more than a few individuals (Amerson 1971; Kenyon 1972; DeLong et al. 1976; DeLong and Brownell 1977; Kenyon and Rauzon 1977). Beach counts of seals have generally increased at Tern since the Coast Guard abandoned the station in 1979 (Schulmeister 1981; USFWS unpubl. data). The reason for this increase is directly related to the reduction in human disturbance associated with the departure of the Coast Guard (Gilmartin and Gerrodette 1986) (See Table 4).



Monk seals hauled out on Tern Island.



Monk seal along Tern Island seawall.

Figure 16. Tern Island Vegetation Types.

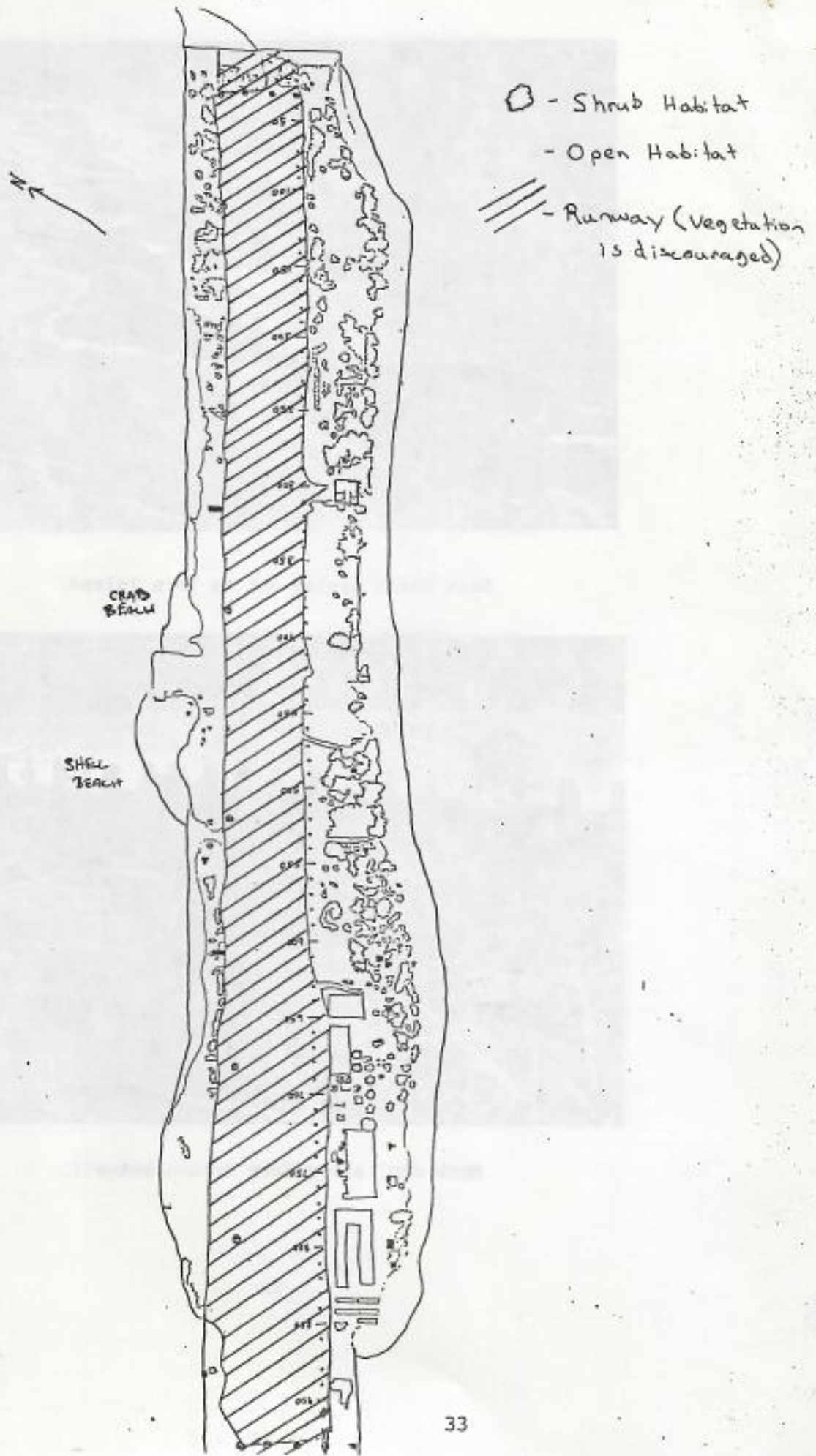
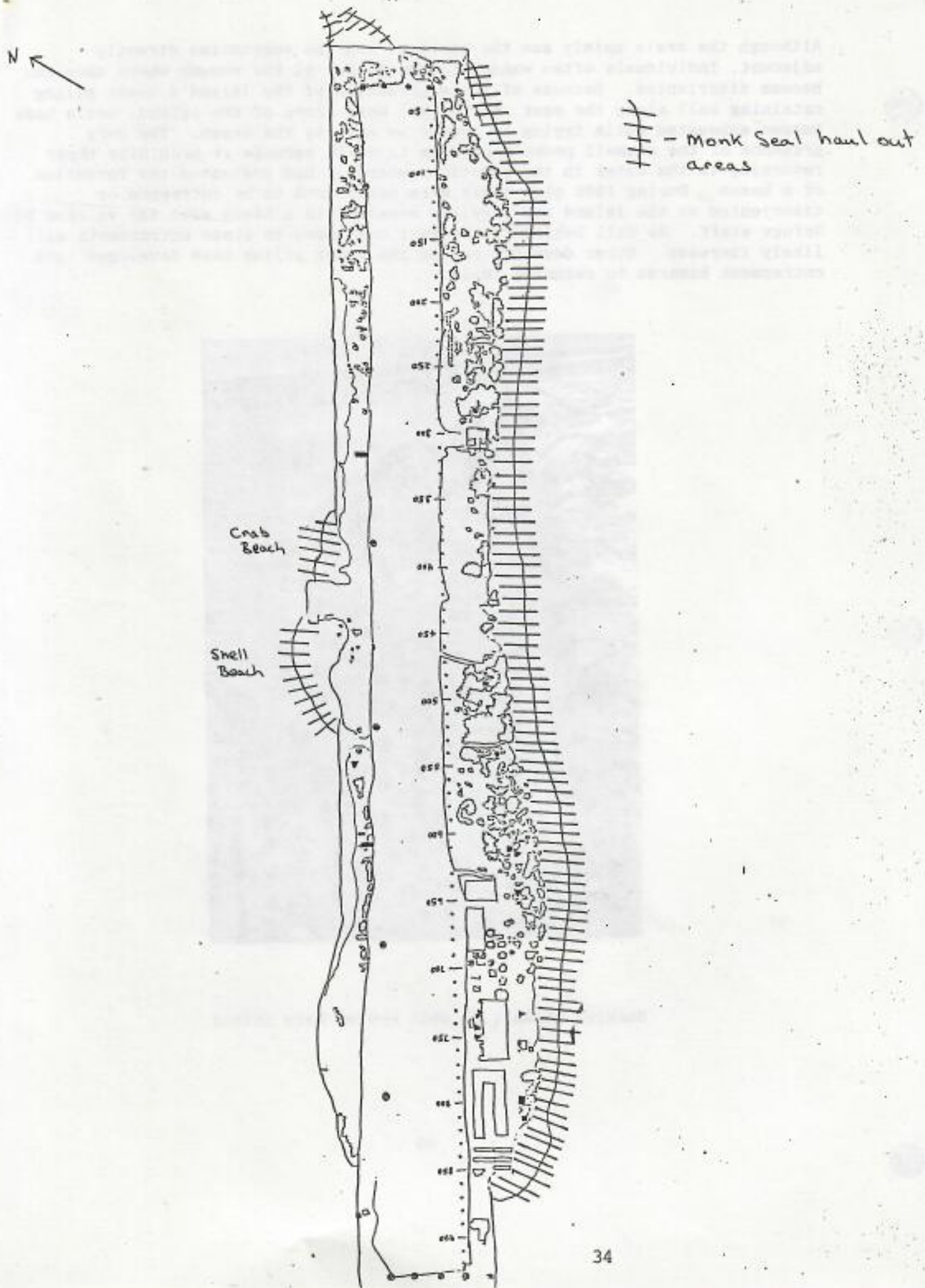
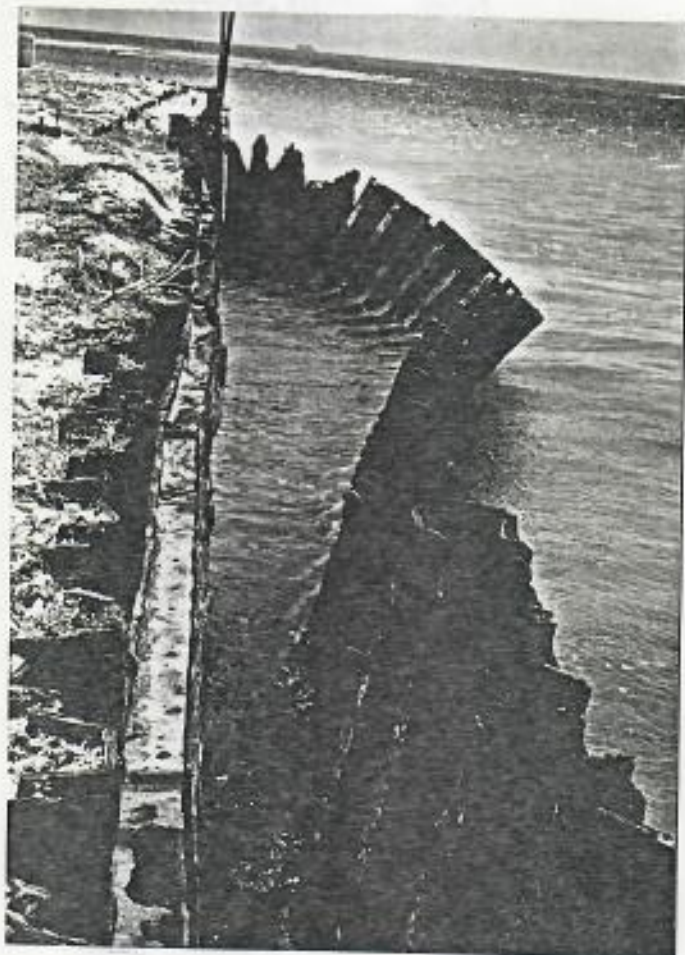


Figure 17. Monk Seal Haul out areas on Tern Island.



Although the seals mainly use the beaches, and the vegetation directly adjacent, individuals often wander inland as far as the runway where they can become disoriented. Because of the degradation of the island's sheet piling retaining wall along the east, north, and west sides of the island, seals have become exhausted while trying to locate an exit to the ocean. The very presence of the seawall poses a problem to seals because it prohibits their returning to the water in the locations where it has prevented the formation of a beach. During 1986 nine seals were determined to be entrapped or disoriented on the island and required movement to a beach area for release by Refuge staff. As fill behind the seawall continues to erode entrapments will likely increase. Other degradations of the sheet piling have developed into entrapment hazards to swimming seals.



Buckled seawall on west end of Tern Island.

Green Sea Turtle (Threatened Species):

Tern Island provides both nesting and basking habitat for this species. About 3000 feet of Tern Island's south facing shoreline provides easy access and good substrate for nesting green turtles. Most of the remaining shoreline consists of exposed seawall or rocky beaches. The exposed seawall prohibits access to the island while rocky beaches do not provide suitable nesting substrate (See figure 18).

The U.S. Fish and Wildlife Service and National Marine Fisheries Service have conducted studies of green sea turtles on Tern Island from 1986 to 1988 (USFWS 1989). The objectives of the studies were to monitor nesting and hatching phenologies, hatching success, extent of nesting, and to identify nesting females. Data was collected most intensively during the 1988 season.

The nesting season at Tern Island has been documented from mid-April to late October. Hatching occurs from July through December. This season varies from year to year within these parameters (See figures 10,11,12). In 1988, 88 nests were located on Tern Island. All but four of these nests were located on the south facing shoreline. The exceptions were one nest at Shell beach and 3 nests on the northeastern sand spit (See Figure 19). Through tag resights and newly tagged turtles, a minimum of 24 females were found nesting on Tern in 1988. Each of the three years of monitoring showed an increase in total nests- 23 in 1986, 48 in 1987, and 88 in 1988. This in itself does not necessarily reflect an increase in the population of nesting females, due to several factors. Green turtles nest cyclically, not necessarily each year, but do apparently nest at least every 3 years (Balazs 1980). Also, nests per turtle could vary between years, making total nests a poor indicator of population increase. The monitoring effort increased in each of the 3 years. The 1988 season was the most accurate, with total coverage of all nests laid throughout the season. It seems likely that Tern Island beaches could be increasingly used as nest sites as disturbance on Tern decreases and more turtles enter the breeding age class.

During the 3 years of monitoring activity on Tern Island, 5 turtles were documented as becoming entrapped or disoriented due to man-made obstructions.

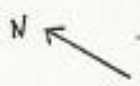
1986 - 1 stranded on runway

- 1 trapped along seawall between shell and crab beach
- 1 trapped along seawall under the diesel fuel tanks
- 1 stranded near Ironwood tree above north seawall

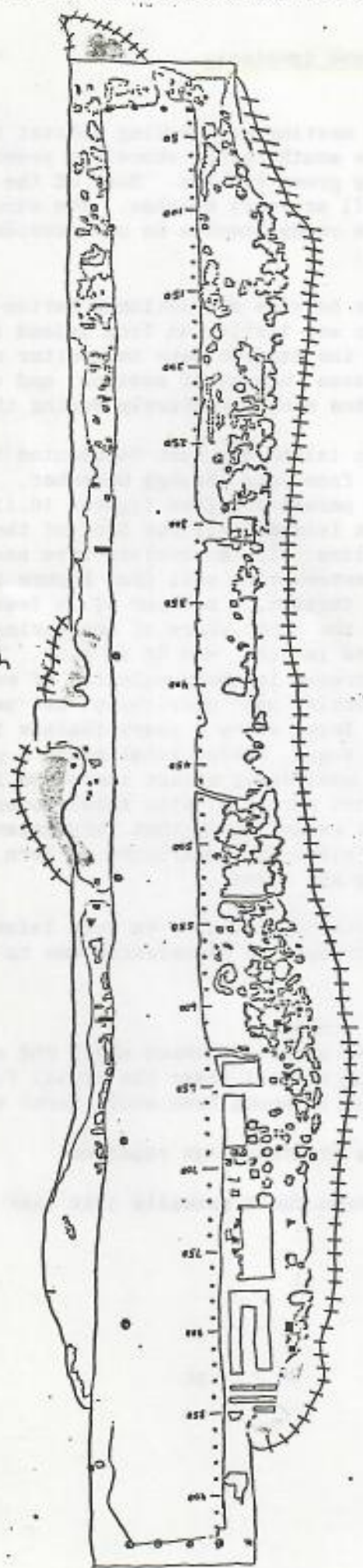
1987 - no entrapments or strandings reported

1988 - 1 trapped between the 2 seawalls just east of the boat shed

Figure 18. Green sea turtle basking and nesting habitat on Tern Island.

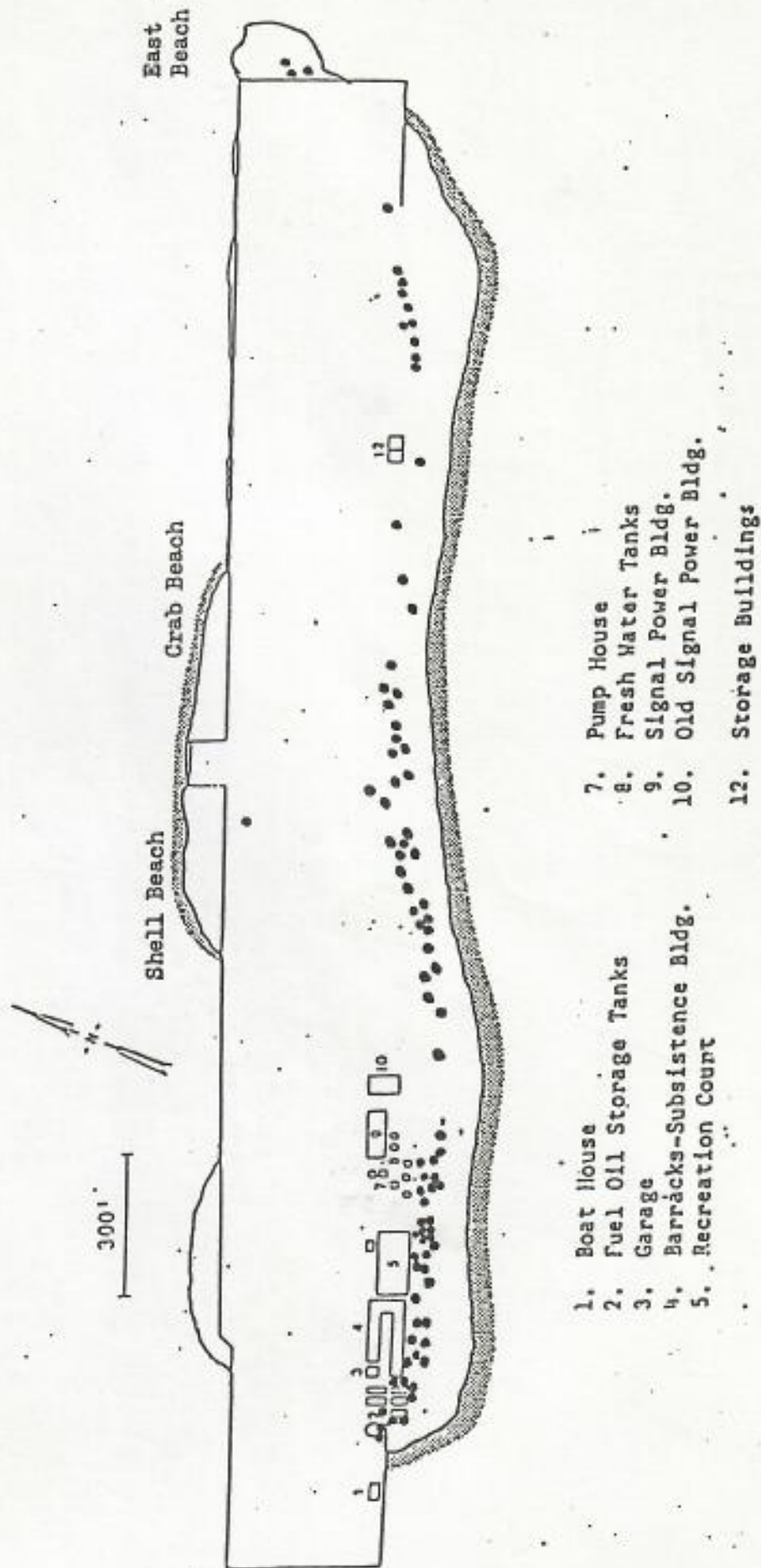


Crab Beach  
Shell Beach



- ++++ - Green sea turtle basking habitat
- ..... - Good turtle nesting habitat
- - - - - Marginal turtle nesting habitat

Figure 19. Locations of 88 green sea turtle nests found on Tern Island, French Frigate Shoals, 1988.





As fill behind the seawall continues to erode, turtle entrapment will likely increase. The Draft Recovery Plan for Hawaiian Green Sea Turtles recommends cleaning up debris that acts as turtle traps on Tern Island. It also recommends removing barriers to nesting, such as sheet pile walls.



Debris unearthed as fill is eroded behind seawall.

### Seabirds:

Fourteen species of seabirds regularly nest on Tern Island. These include:

black-footed albatross	red-footed booby
Laysan albatross	great frigatebird
Bonin petrel	sooty tern
Bulwer's petrel	gray-backed tern
wedge-tailed shearwater	brown noddy
Christmas shearwater	black noddy
red-tailed tropicbird	white tern

Breeding populations of nine of these species have been systematically censused each year since the 1983 season. Methods for these censuses have involved directly counting all eggs and chicks of these species. From 1983-1985 counts were conducted monthly. Starting in 1986 counts were made separately for each species based on its mean incubation period. Table 5 shows minimum nesting populations for each of these species. For all species except albatross the figures are computed by picking the highest nest count (eggs+chicks) from each breeding season. Minimum estimates are the closest we can come to the number of breeding pairs nesting here. Because of confounding factors associated with the reproductive biologies of most of these species, counts of nests at any period of time are a poor indicator of total breeding populations. On the other hand the counts of the synchronous albatross species provide accurate estimates of total breeding pairs nesting on the island for the season. Estimates for the remaining breeding species can be found in Table 6. Estimates of breeding populations of these species are difficult due to their secretive (Christmas shearwater), crevice (Bulwer's petrel), or underground (Bonin petrel and wedge-tailed shearwater) nesting habits or extreme density and abundance as in the sooty tern.

### Shorebirds:

Tern Island provides wintering habitat for several species of shorebird. Five species are common while others are considered vagrants. Table 7 displays relative numbers of the five common species over a year's period. First year birds of some species over-summer but in general there is an influx of birds in the fall starting about August. Some birds may just stop off for a short time before moving on to other Pacific islands, while significant numbers remain. Counts start to decrease in May as breeding age birds move north for the nesting season.

Future Effects and Mitigations of  
Past Military Actions on Tern Island

As has been mentioned in preceding sections of this report, the military's use of Tern Island has had significant impact on the natural resources of the island and the atoll as a whole. The legacy of past military presence continues to effect the ecology of the area and to create management dilemmas for the agencies responsible for the resource. The following discussion will hopefully reveal the major elements of these dilemmas as perceived by Hawaiian Islands National Wildlife Refuge staff.

The Fish and Wildlife Service in managing Tern Island as a National Wildlife Refuge has a diversity of missions. Significant among these is the responsibility to preserve, restore, and enhance in their natural ecosystems (when practicable) all species of animals and plants that are endangered or threatened with becoming endangered and to perpetuate the migratory bird resource. In viewing the future role of Tern Island, in the Hawaiian Islands National Wildlife Refuge Master Plan/EIS, we see cause for concern in being able to carry out stated objectives.

Of prime concern is the effect of seawall degradation on the wildlife resource and the Service's ability to manage it effectively. The seawall is severely degraded along the north side of the island. Representatives from the Fish and Wildlife Service (See Exhibit 12) and U.S. Army Corps of Engineers (See Exhibit 13) have documented this degradation in official reports. As described elsewhere current impacts of this degradation include entrapment hazards for Hawaiian monk seals and green sea turtles. The year-round presence of Fish and Wildlife Service personnel mitigates these hazards as staff are able to free entrapped animals. With the continued erosion of the island along the north side, the future of the runway is in question. A major storm event could curtail further use of the runway at any time. At the point when the runway becomes unusable, full time presence on the island would be impractical for logistic and safety related reasons. Initially, the absence of staff would mean a minimal loss of seals and turtles due to entrapment by the seawall or associated debris. This initial loss of animals may not be significant from a population standpoint, but does represent a failure to assist in the recovery of endangered species populations.

The prospect for future losses of endangered species, as well as, to the migratory bird resource are at the heart of concerns of Refuge staff. As the steel retaining wall continues to degrade and as fill is lost from the island interior, the potential for entrapment/entanglement of seals and turtles will likely increase. This increase could become a significant impact to recovery objectives for monk seals and green sea turtles. The envisioned erosion of the island interior, concomitant with degradation of the seawall, would also mean loss of monk seal basking and pupping habitat, green sea turtle basking and nesting habitat, and seabird nesting and roosting habitat.

The grounds for the above scenarios are as follows. The current state of seawall degradation has already eroded significant areas of the island. Continued erosion will eliminate seabird nesting habit along the north side of the island. Eventually the erosion will affect the entire surface of the

island eliminating existing wildlife habitat as we know it. At the current level of erosion an array of debris has been exposed. This debris includes glass, assorted defunct machinery, batteries, building materials, and copper wire. Portions of the island have no doubt been used as dump sites since the construction of the island. The extent of buried materials on the island is unknown, but to some extent we know the potential. The original construction consisted of several underground buildings and it is likely that these are still present. The island continually reveals long lived copper wiring associated with the Coast Guard LORAN station that was present here from 1952-1979. Significant amounts of this wiring is still underground. Coast Guard rehabilitation plans for the station show notes instructing the contractor to demolish various structures and dispose of it by landfill on site. Twenty 5,000 gallon underground fuel storage tanks were discovered in 1988. Many of these still contain fuel. Other underground tanks revealed in earlier blueprints of the island have not been accounted for and may still be present.

As the seawall continues to degrade over the next 5 - 10 year period, it is not unreasonable to expect that fill will continue to be lost from the interior of the island. Left behind will be the slowly degrading seawall. Some of the seawall perimeter will allow access by seals and turtles either from the south beach or through large gaps in the seawall. What will be found in the interior of the "island" will be a variety of entrapment and entanglement hazards. Although the potential for entrapment of animals exists now and the entrapment hazards will likely increase fairly quickly, significant portions of the seawall will remain far into the future. This conjures a vision of a rusted steel picket fence partially enclosing a landfill in the middle of a unique and remote ecosystem. The site could continue to present entrapment and entanglement hazards to endangered species and migratory birds well into the future.

Confronted with this likely sequence of events the question becomes what should be done. It is here that the dilemma begins. Three alternatives come immediately to mind: (1) take no action, (2) remove the seawall, and/or (3) rehabilitate the shore protection.

Selection of alternative 1 would likely result in the aforementioned scenario. Some of the negative impacts of this scenario could be mitigated by the year-round presence of staff until such time as the presence is unfeasible. Seasonal presence of Refuge staff could continue into the future, but undoubtedly seals and turtles would be lost.

Alternative 2 would entail removing all the sheet piling from the site. This action would partially eliminate the entrapment hazard to wildlife of the atoll, but would leave behind a significant amount of debris with potential for entrapment/entanglement. Selection of this alternative would also require the removal of debris within the perimeter of the seawall. A question arises at this point as to the fate of the island after the removal of the retaining wall. The significant alteration of the reef habitat near Tern Island as a result of the construction of the island and the ship channel may have considerably altered nearby currents. These currents are vitally important to island formation. These altered currents may prevent the future reformation of an island at the site without shore stabilization.

If alternative 3 were selected, the method of rehabilitation should address several concerns: (1) life expectancy of the stabilization should be maximized, (2) elimination of future entrapment potential and (3) providing access and exit for seals and turtles along portions of the island that currently prevent access and prohibit exit. The final section of this report addresses potential impacts of a rehabilitation project.

It is the opinion of this office that although primary responsibility for the island lies with the Fish and Wildlife Service, that because the result of past military use of the island has caused the current problems, the military shares responsibility for effecting solutions. The "Defense Environmental Restoration Account" was established by the Department of Defense specifically to deal with cleanup and/or restoration of abandoned military. The Department of Defense, assuming responsibility for its impacts to Tern Island should consider the above alternatives or others. Upon selection of any alternative, including the no action alternative, the Department of Defense will be required to enter into Section 7 consultation as outlined in the Endangered Species Act.

### **East Island**

Cleanup of East Island would likely require more manpower than equipment. A minimal amount of equipment would be necessary to remove heavier objects to a barge for transport off the island. Other debris such as small metal, wire, and miscellaneous human artifacts could probably be excavated and removed with a contingent of workers and simple implements. Under this type of scenario, timing would be the most critical factor for minimizing disturbance to the wildlife resources. Due to the size of this island and the types and sensitivities of the species that use it, scheduling of any intensive cleanup operation would be difficult and would no doubt involve significant disturbance for some.

#### Monk Seal:

Pupping season is the most sensitive time for seals. The majority of pupping takes place along the southwest facing shoreline. Noise and visual disturbances should be minimized during the pupping season. Monk seals exhibit diurnal haul out patterns. They generally move towards the beach crest in the later afternoon and evening hours, spending the night along the beach crest among vegetation. From early to mid-morning they begin to move back down the berm towards the waters edge. It is important to note that this is a general tendency and that seals can be found at various positions along the beach strand at any time.

#### Green Sea Turtle:

Although turtles can be found basking on beaches at any time during the year, the peak use of East Island for basking and nesting is from April-December. Nesting and basking habitat literally cover the entire island. Any cleanup of the interior of East would be difficult if not impossible during the nesting season. Impacts from any operation that would significantly disrupt the nesting substrate at other times of the year should also be considered.

#### Seabirds:

If seabird species were the only consideration on East Island, a least disturbing time frame could be selected by consulting the phenology chart for the species that occur here (See Figure 14). This period would be during September and the first half of October. Of the species of seabirds that use East Island, the sooty storm-petrel is one of the least abundant. It is also one of the least abundant throughout the atoll and the Northwestern Hawaiian Islands. Additionally, the lack of knowledge of this species' natural history gives it special protection on the Refuge. Other species that nest here are significant when looking at the ecology of the island over the long term. Short term disturbances or nesting failures can be tolerated by the long lived species nesting here. When considering cleanup of this island, the effects the disturbance of soil will have on future burrow nesting should be taken into account.

### Vegetation:

Endemic and indigenous species occurring on atoll islets are fairly resilient. They have evolved, especially on East Island, to survive intense soil disturbance by turtles and likely occasional inundation by saltwater. A cleanup of the island would most likely cause short term loss of habitat, but little effect over the long term.

### Recommendations:

The following recommendations are based on a scenario similar to that mentioned above.

- 1) Assess the positive impact on species affected by debris vs. the negative impact of a major cleanup on all species.
- 2) If the positive impact of a major cleanup wins out, timing would be difficult. Two time frames would be possible, each with their weaknesses.

March - The last 3 weeks of March would eliminate conflicts with turtle nesting season, there would be few seal pups, and albatrosses would have chicks that could be moved and replaced as the cleanup moves near their nest sites. A negative impact would be on sooty storm-petrel chicks that would be half grown. Refuge staff could mark areas of nesting concentration to avoid disturbance and these areas could be cleaned after chicks fledge and before turtle nesting consumes the area.

September-mid October - A cleanup during this time would minimize disturbance to the majority of seabirds. Albatross would be absent and other species would be towards the end of their breeding seasons. The major impact would be to the remaining turtle nests. This could be mitigated by marking nests that would still be present at this time and avoiding them during the cleanup operation. This option would have the advantage of taking place during the most likely time of a cleanup on Tern Island and would require only 1 mobilization of equipment and personnel.

- 3) An alternative option for cleanup would be to remove only the obvious debris with small equipment. No plowing or scraping of the soil would be required. This could be accomplished with a minimum of disturbance during the fall time frame above.
- 4) Any cleanup should involve on site monitoring by refuge personnel.

- 5) Motorized equipment should be kept to a minimum and muffled as much as possible.
- 6) If the more intense scenario is chosen, a program to eradicate exotic vegetation prior to the project is recommended. This would hopefully lessen the chance for further expansion and coverage by exotic plants.

### **Tern Island**

Due to the nebulous nature of specific methodologies for cleanup and restoration scenarios for Tern, resource sensitivity will be discussed only in terms of general biological parameters such as distribution, phenology, and habitat alteration. It is expected that the major effects of a restoration/cleanup would occur along the east, north, and west sides of the runway, so sensitivities specific to these areas will be mentioned.

### Monk Seals:

Pupping season is the most sensitive time for seals. In 1989 the first pupping was recorded on Tern Island. This occurred along the south shore. If pupping increases, it will likely occur slowly. Since there is little haul out habitat along the north shoreline and because this is not prime pupping habitat, it is unlikely that females will pup here. Noise and visual disturbances should be minimized near haul out areas (See Figure 17). Monk seals exhibit diurnal haul out patterns. They generally move towards the beach crest in the later afternoon and evening hours, spending the night along the beach crest among vegetation. From early to mid-morning they begin to move back down the berm towards the waters edge. It is important to note that this is a general tendency and that seals can be found at various positions along the beach strand at any time.

### Green Sea Turtle:

The majority of turtle nesting on Tern Island takes place along the south beach. In 1988, 88 nests were located on Tern Island. All but four of these nests were located on the south facing shoreline. The exceptions were one nest at Shell beach and 3 nests on the northeastern sand spit.



### Seabirds:

Any major construction, disturbances, or habitat alteration along the north shore would have potentially major effects on seabirds occupying this habitat. Species with the most abundant nesting presence along the north side of the runway include; red-footed boobies, great frigatebirds, gray-backed terns, sooty terns, brown noddies, and black noddies. Red-footed boobies, great frigatebirds, brown noddies, and black noddies also use the area for roosting habitat and are present here year-round. By careful timing of the work, significant nesting disturbances could be minimized.

If restoration work involves significant removal of shrub nesting habitat, impacts to populations of species using it could be serious (see below).

### Vegetation:

Restoration of the north seawall area would likely involve significant disturbance of vegetation in the area. Endemic and indigenous species occurring on atoll islets are fairly resilient. They have evolved to survive intense soil disturbance by turtles and likely occasional inundation by saltwater. In other words the vegetation would eventually reestablish. If shrub habitat were destroyed it would take several years for it to return to current conditions, whereas open habitat plants would grow back quickly. Tern Island vegetation has been allowed to grow without interference since the Fish and Wildlife Service took over operations in 1979. There has been significant increase in shrubs since this time with a concurrent increase in use by seabirds dependent upon them for nesting and roosting habitat. Though the loss of the shrubs by itself would not be problematic, the effect on seabird populations on the island and the atoll could be significant.

### Recommendations:

- 1) Schedule work for 1 September - mid-October. This will present the least disturbance to seabirds, seals, and turtles.
- 2) If asynchronous species such as black and brown noddies begin to nest in the affected area at a time that will leave them vulnerable to effects of the restoration, discourage nesting.
- 3) For species such as great frigatebird and red-footed booby and other species with late nesting attempts, egg laying should be monitored. If nests are initiated that will result in later destruction during restoration efforts, these nests should be destroyed early to prevent lengthy parental investment of energy on a doomed nesting attempt.
- 4) Plan for revegetation of any significantly altered shrub habitat with endemic and indigenous species.

- 5) Avoid all areas south of the runway for restoration except for the area west of the barracks.
- 6) It will be critical to plan the project for completion during the time frame indicated. All efforts should be made to insure this occurs.
- 7) Equipment should be noise suppressed as much as possible.

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