

HAWAIIAN ISLANDS
NATIONAL WILDLIFE REFUGE
HONOLULU, HAWAII

ANNUAL NARRATIVE REPORT
Calendar Year 1988



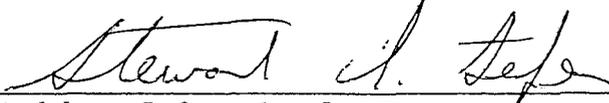
Newly established Midway Atoll National Wildlife Refuge

U.S. Department of the Interior
Fish and Wildlife Service
NATIONAL WILDLIFE REFUGE SYSTEM

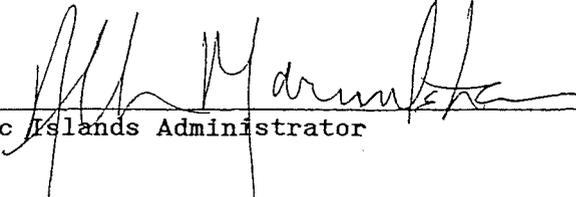
HAWAIIAN ISLANDS NATIONAL WILDLIFE REFUGE
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REVIEW AND APPROVALS


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INTRODUCTION

The Hawaiian Islands National Wildlife Refuge consists of a chain of eight islands, reefs, and atolls extending about 800 miles in a northwesterly direction from the main Hawaiian Islands. Emergent lands total approximately 1,740 acres. The Fish and Wildlife Service considers another 242,700 acres of submerged land to be within the Refuge. Nihoa and Necker Islands, Gardner Pinnacles, and La Perouse Pinnacle at French Frigate Shoals are the cores of old volcanic cones. Sheer cliffs of basalt and the absence of beaches are typical of these islands. Laysan and Lisianski Islands are low, flat sand islands surrounded by submerged coral atolls. Maro Reef has only a couple of small coral heads protruding a few feet above the surface of the ocean. Only one of the islands in the Refuge is presently inhabited. The Service maintains a field station at Tern Island, French Frigate Shoals, manned year-round by two permanent employees and a handful of volunteers during the spring and summer.

Theodore Roosevelt established the Refuge in 1909 by Executive Order as a "preserve and breeding ground for native birds." Four endangered bird species (Laysan duck, Laysan finch, Nihoa finch and Nihoa millerbird) presently breed on the islands along with 18 species of seabirds totaling about 14 million individuals. The Refuge also supports almost the entire population of endangered Hawaiian monk seals, provides nesting beaches; for virtually the entire Hawaiian population of threatened green sea turtles, and furnishes habitat for 13 candidate endangered plants, 32 candidate terrestrial invertebrates and a diverse array of marine fishes and invertebrates.

Midway Atoll National Wildlife Refuge is an overlay Refuge that was established in April 1988 by cooperative agreement between the Navy and the Service. Midway Atoll is located approximately 1,150 miles northwest of Honolulu. The Atoll's fringing reef is roughly circular in shape and 6.5 miles across in average diameter. The atoll encloses two main islands; Sand (1,120 acres) and Eastern (334 acres) and three small islets referred to as the "Spits." Midway Atoll supports the largest Laysan albatross breeding population in the world as well as significant populations of 14 species of seabirds. The short-tailed albatross, an endangered species, regularly occurs there. Hawaiian monk seals and green sea turtles are also found in the atoll.

HAWAIIAN ISLANDS NATIONAL WILDLIFE REFUGE

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A. HIGHLIGHTS

Rehabilitation of the Refuge warehouse facility is completed.

The Tern Island photovoltaic system operates flawlessly during the first year of operation.

Refuge staff visited each of the islands on the Refuge during a month-long expedition in June and July.

Seven research projects were initiated, continued or completed on refuge lands. Refuge staff either participated in or facilitated these projects.

The blowout on Laysan Island shows continued signs of revegetation.

Deputy Regional Director Wally Steucke visits Tern Island on April 6 and 7.

Creation of an overlay National Wildlife Refuge at Midway Atoll was agreed upon by the Navy and the Service in April.

The Refuge initiates cooperative (Service/NMFS) study of French Frigate Shoals green sea turtle population.

B. CLIMATIC CONDITIONS

The portion of the Hawaiian Archipelago included in the refuge extends from Nihoa Islands (23° 03'N, 161° 55'W) to Pearl and Hermes Reef (27° 47'N, 175° 49'W). Weather conditions vary within these latitudes, but, generally, conditions are tropical to subtropical with a fairly constant northeast trade wind.

Tern Island, French Frigate Shoals, weather information is collected two ways, for different purposes. A remote weather station transmits data to a satellite on an hourly basis for use by the National Weather Service. These data are used only for marine weather forecasting, so no long-term records are maintained. Tern Island refuge staff operate a weather station for long-term records. Minimum and maximum temperatures, velocity and direction, and precipitation and cloud cover are measured and recorded on a daily basis.

The following data are from the 1988 station logs:

1988 WEATHER SUMMARY

Month	Mean Max. (°F)	Mean Min.	Daily Mean	Wind Vel. (kt)	Precip. (in.)
Jan	75.1	67.9	71.5	12.0	0.87
Feb	75.8	68.8	72.3	12.0	0.66
Mar	77.6	68.0	72.8	12.0	0.53
Apr	78.2	68.0	73.4	14.0	1.99
May	80.8	70.6	75.7	14.0	4.38
Jun	83.9	74.4	79.1	14.0	0.71
Jul	84.3	74.3	79.3	15.0	2.53
Aug	85.3	76.1	80.7	12.0	1.68
Sept	85.5	76.6	80.8	09.0	1.84
Oct	84.2	75.5	79.9	08.0	1.08
Nov	81.8	74.6	78.2	12.0	4.13
Dec	79.3	70.9	75.1	10.0	4.66
Monthly Mean	81.0	72.2	76.6	12.0	2.09

The mean temperature for 1988 was 76.6° F, the mean maximum was 80.9° F and the mean minimum was 72.2° F. January was the coolest month. The average minimum was 67.9° F and the coolest temperature was 61.0° F on 14 March. September was the warmest month with a mean maximum of 85.5° and a high of 87.5° F recorded on August 1, 1988.

Average wind velocity was 12.0 kt. Mild to moderate trade winds (from the northeast) prevailed throughout the year. Winds during winter months were more variable, influenced by major storm systems. Wind velocities of 40 kt. gusting to 55 kt. were recorded on 4 November.

Precipitation for 1988 was 25.06 inches. The highest rainfall occurred in December with 4.66 inches recorded. March had the least precipitation, with 0.53 inches recorded for the month.

Throughout the Northwestern Hawaiian Islands 1988 was a dry year. Although Tern Island reported an increase of 9 inches over 1987, emergency water rationing procedures were implemented because of low reserves. On Laysan Island low water levels were recorded in the hypersaline lake during the field camp season from February to October. Water levels were also low during 1987.

A review of annual precipitation figures for Tern Island since 1981 indicates mean annual precipitation of 28.7 inches per year. Historical data collected during military occupation from 1954 to 1962 recorded a mean of 45.29 inches per year. This data indicates a 37% decrease for mean annual precipitation for the area. The reason for this decrease has not been investigated. Of more significance to the management of the Refuge is the noting of drastic annual perturbations in rainfall and other climatic factors.

Because managers are only able to make short visits to most of the Refuge islands, they often return with a snapshot view of habitat conditions. For managers who make trips to the islands over the course of several years, these climatic perturbations are realized to be an integral part of these insular ecosystems. Rainfall and other severe storm events which cause overwashing of some small islets can significantly alter the appearance of an island. The lesson for managers is to be cautious with hands on management and with interpretations of short term biological data.

ANNUAL PRECIPITATION FOR TERN ISLAND,
FRENCH FRIGATE SHOALS 1981-1988

YEAR	TOTAL PRECIP.
1981	32.1
1982	37.4
1983	19.6
1984	32.7
1985	33.0
1986	33.0
1987	17.0
1988	25.1
Mean Annual	28.7

C. LAND ACQUISITION

3. Other

The Midway Overlay Refuge proposal, submitted by the Service to the Navy in 1984 was agreed upon with the signing of a Cooperative Agreement in April 1988 by the Service and Navy representatives. The lands and waters of the Naval Air facility at Midway Atoll will be managed as an overlay National Wildlife Refuge per a Management Plan to be developed by the Service which will be incorporated into a Cooperative Agreement.

D. PLANNING

1. Master Plan

The Master Plan for the Hawaiian Islands National Wildlife Refuge has been used as a guiding document for the management program on the Refuge. Many of the preferred alternatives have been implemented as funding and manpower becomes available.

4. Compliance with Environmental and Cultural Resource Mandates

Dr. Paul Cleghorn of the Bernice P. Bishop Museum, Honolulu gathered data to facilitate management of prehistoric resources on Necker and Nihoa Islands in 1984. During 1987, National Register Nomination forms were sent to the State Historic Preservation Office for concurrence and submission to the keeper of the National Register. On June 13, 1988, Nihoa and Necker Islands were formally listed on the National Register of Historic Places. The following article was published on the sites at Nihoa and Necker Islands:

Cleghorn, P.L. 1988. "The settlement and abandonment of two Hawaiian Outposts; Nihoa and Necker Island." Bishop Museum Occasional Papers 28: 35-49.



Religious site (marae) thought to have been constructed by prehistoric Hawaiians on Necker Island. (DKM)

5. Research and Investigation

Refuge staff coordinated and participated in numerous research projects in the Hawaiian Islands National Wildlife Refuge. Projects were conducted by a variety of agencies and personnel. Tern Island, French Frigate Shoals, continued to be a year-round focal point for wildlife studies. Temporary field camps were established on East Island, French Frigate Shoals by NMFS and Service researchers from 15 May through 24 August, 1988 and on Whale-Skate Island, French Frigate Shoals from 25 May to 18 August.

Research efforts were also concentrated on Laysan Island where NMFS, the Service, and the Smithsonian Institution conducted a joint field camp. The field camp was operational on Laysan Island from 28 February to 20 November. Research projects and agency use varied throughout the field season.

An expedition to all of the islands in the Refuge for the general purpose of wildlife surveys including surveys for the presence of alien plants and animals was conducted during 5 June to 7 July, 1988. The Service chartered the F/V FERESA and travelled to the Hawaiian Islands National Wildlife Refuge. Assistant Refuge Manager, D.K. McDermond; Biological Technician, Craig Rowland; Derral Herbst, Botanist for the Honolulu office of Endangered Species and Wayne Takeuchi, Botanist for Bishop Museum, Honolulu were the personnel on the charter.

The field crew landed on Nihoa Island on 7 June and departed 12 June. Phenologies were recorded for all seabird species. Population estimates were also made and recorded. Nihoa millerbird and Nihoa finch transects were conducted and data recorded.

The biologists spent 13 June censusing seabirds, collecting algae, and conducting population estimates of all seabirds, seals, and turtles on Necker Island.

The charter arrived at French Frigate Shoals on 14 June. McDermond reviewed general Tern Island operations and turtle work on East Island. Takeuchi visited each of the vegetated islets to document changes and present status of all vegetation. Herbst collected algae. The field party departed French Frigate Shoals on 16 June.

The F/V FERESA arrived on Laysan Island on 18 June and departed 26 June. The crew accomplished the following major work: great frigatebird, masked booby, brown booby, and red-footed booby censuses; seabird phenologies; drift fence installation and monitoring; masked booby and red-tailed tropicbird chick growth monitoring; Laysan duck censuses; lake salinity monitoring; vegetation documentation; and algae collection.

Lisianski Island was visited on 27 June. Major work completed included a direct count census of red-footed boobies, masked boobies, and great frigatebirds; banding of masked booby chicks, and vegetation description. The crew departed on 30 June.

The field crew visited Pearl and Hermes Reef from 1-3 July. All islands within the atoll were visited and seabirds as well as Laysan finches were censused. Vegetation assessments were made and photographs taken of habitat conditions. The charter picked up 2 NMFS staff from Pearl and Hermes and transported them to Midway.

The last stop on the charter was at Midway Atoll. The F/V FERESA arrived on 4 July. Work here included assisting other Service and Department of Agriculture staff with rat monitoring, full atoll seal census, and vegetation assessment. The NMFS personnel tagged the single pup born here this year. The charter was completed by departing Midway on 7 July flying via MAC aircraft to Honolulu.

The Refuge's monitoring efforts during 1988 focused on seabird monitoring, surveys of endangered landbirds (Nihoa finch, Nihoa millerbird, Laysan finch and Laysan duck), monitoring the reproductive effort of threatened green sea turtles on Tern Island, surveying nesting turtle population at French Frigate Shoals, and surveying the population of Hawaiian monk seals on Tern Island. NMFS research efforts continued on endangered Hawaiian monk seals and threatened green sea turtles. Cooperating scientists were involved in a variety of studies on the Refuge including studies of monk seal mother-pup interactions (Dr. Daryl Boness on Laysan Island), Laysan finch life history (Marie Morin on Laysan Island), and field studies of the bristle-thighed curlew (USFWS-Alaska and Roland Redmond, Wildlife-Wildlands Institute).

NMFS also had field camps on Lisianski Island (16 - 18 May) and on Pearl and Hermes Reef (17 May - 3 July). On Pearl Hermes Reef field camps were located on Southeast Island and North Island.

Numerous volunteers participated in biological studies in French Frigate Shoals. A significant amount of effort was spent by Refuge staff in Honolulu and on Tern Island in providing logistical and other support for investigations having significant potential benefit to Refuge resources. The following research projects were conducted or continued in 1988:

HWN-1-88 Seabird Monitoring Studies

Seabird monitoring studies are conducted by Refuge personnel annually in order to determine the status and health of the seabird populations in the Hawaiian Islands National Wildlife Refuge. These data have been collected since 1979 on indicator species and are compared annually to determine if there are major differences in measured reproductive parameters which may indicate a change in environmental conditions due to natural or man-made causes. These data are useful for measuring affects of commercial fisheries and environmental conditions such El Niño southern oscillations in the vicinity of the Refuge.

During 1988, on Tern Island, population and chronology data were collected for each species at intervals equal to the mean incubation period of the species. Thus, at the end of the year, the total number of nests for each species could be summed to obtain the total breeding population on the island. Irregular counts of breeding populations and determination of chronology were conducted on the islets of French Frigate Shoals. Egg size, reproductive success and chick growth studies were conducted on Tern Island involving red-footed boobies, black noddies and red-tailed tropicbirds. The year-round presence of personnel on Tern Island continues to be instrumental to the seabird monitoring studies. Darcy Hu initiated a study to determine age related effects on the reproductive success of red-footed boobies as part of her Masters program.

On Laysan Island, population surveys were conducted for masked booby, brown booby, red-footed booby, great frigatebird, and black noddy. Chick growth studies were also conducted for masked boobies and red-tailed tropicbirds. Chick growth was measured using a different technique than has been used in prior years. In an attempt to develop techniques for monitoring health of indicator species on islands throughout the refuge, a short term growth measuring methodology was implemented. This in theory should allow us to measure growth of indicator species on short visits (1 week-10 days) to islands. This is desirable due to the cost of establishing long-term field camps to measure reproductive success and estimate populations. If the new method proves to be a reliable measure of growth and if growth can be shown to be related to health by analyzing data collected on Tern Island, we should be able to begin use of the short term growth methodology to monitor health throughout the refuge. Analysis of these data is not yet available.

On other islands visited during the June/July expedition, surveys of conspicuous nesting seabirds were conducted. Trip reports detail biological observations and populations, and breeding chronology information for Nihoa Island, Necker Island, Laysan Island, Lisianski Island, Pearl and Hermes Reef, and Midway Atoll. The following reports completed in 1988 are available in Refuge files:

McDermond, D.K. 1988. Trip report: Honolulu to Midway Atoll, 5 June to 7 July 1988. Administrative Report, U. S. Fish and Wildlife Service, Honolulu, Hawaii.

During trips to Midway Atoll to advise the Navy on wildlife matters, refuge staff conducted population censuses, collected nesting phenology data and conducted a banding program (Sec. G.16). The following reports completed in 1988 are available in Refuge files:

Fefer, Stewart I. 1988. Trip Report, Midway Atoll, 19-25 May 1988. Administrative Report, U.S. Fish & Wildlife Service, Honolulu, Hawaii.

Tyler, Breck W. 1988. Field Report: Midway Islands, 31 March through 8 September. Administrative Report, U.S. Fish & Wildlife Service, Honolulu, Hawaii.

The following article was published resulting from work on the Refuge:

Scott, J.M., C.B. Kepler, C. Van Riper III, and S.I. Fefer. 1988. Conservation of Hawaii's Vanishing Avifauna. Bioscience 38:238-257.

HWN-2-88 Hawaiian Monk Seal studies in the NWHI

Most of the research on monk seals in the Hawaiian Islands Refuge is conducted by personnel from the National Marine Fisheries Service (NMFS). Refuge staff have assisted in many aspects of this research including tagging and resighting individual seals. During 1988, researchers from the Smithsonian Institute also conducted monk seal research involving studies of mother-pup interactions. This study is reported separately under HWN-6-88. The NMFS research activities conducted in 1988 are summarized below for each island of the refuge.

French Frigate Shoals: NMFS personnel and/or volunteers were present on French Frigate Shoals 11 April to 21 May and 6 June to 31 August. Censuses were conducted regularly on all islets; totals are being compiled. Approximately 38 injuries were noted on seals in 1988. This total is preliminary because the data have not been examined to determine if some of the incidents are resightings of the same seal. Some females were seen to have received massive back wounds from probable mass mating attempts. Two seals, a juvenile male and a juvenile female, died during the field season.

Pup production totaled 123 seals known to have been born, and an adult female seal was pregnant when NMFS personnel departed on 31 August. A stillborn fetus was recovered from Tern Island by Service personnel in November.

Tissue samples were collected from the two seals which died during the field season, and the stillborn fetus was sent to NMFS by Service personnel on Tern Island. The skull of a whale, probably Cuvier's beaked whale, Ziphius cavirostris, was collected from Trig Island. The whale had evidently washed ashore during the winter of 1987-88, since the skeleton was old and sun-bleached.

Yellow plastic Temple Tags were applied to 114 weaned pups in 1988.

A juvenile female seal was entangled in plastic screen on Shark Island. The screen was wrapped around the neck of the seal. Human intervention was necessary and the seal was rescued.

Thirty-five hazardous debris items (netting, lines, etc.) were collected and burned or placed in the dump at Tern Island. Total weight was approximately 165 lbs.

Five immature seals were captured and fitted with an adhesive-mounted package consisting of a radio transmitter and a time-depth recorder. A sixth seal was captured and briefly instrumented, but the unit was removed shortly thereafter because the animal rolled and shifted the unit before the adhesive had completely hardened. Three instruments were recovered from seals by NMFS and University of Hawaii personnel, and one instrument was recovered by Service personnel. The sixth instrument package became dislodged from the seal and was lost. Data are still being analyzed, but preliminary results indicate dives up to 160 meters.

The Refuge staff at Tern Island have been counting Hawaiian monk seals hauling out on Tern Island beaches since 1979 when the Service began occupying the station there. In 1988, weekly surveys of monk seals were conducted. Table 1 summarizes counts up to 1988.

The data shows a continuing increase in the number of seals using Tern Island since the Service began regular surveys until a peak in 1985. Mean monthly numbers have increased from 5.7 seals in July 1979 to a peak of 127.6 seals in March 1985. The annual mean number of seals using beaches at Tern has shown a steady decrease since the peak in 1985. No explanations have been offered for this decrease.

Populations throughout the atoll have increased only slightly between 1983 and 1988. Weaned pups are significantly smaller at French Frigate Shoals than at other locations, perhaps indicating the population is near its carrying capacity.

TABLE 1. AVERAGE MONTHLY NUMBERS OF HAWAIIAN MONK SEALS USING BEACHES ON TERN ISLAND, FRENCH FRIGATE SHOALS

Month	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Jan	--	10.8	29.6	33.9	60.2	49.8	96.9	92.8	83.0	77.5
Feb	--	14.2	28.8	31.6	72.5	56.9	107.8	98.3	54.0	71.0
Mar	--	24.5	25.9	39.3	59.4	77.3	127.6	103.2	90.2	64.6
Apr	--	13.9	28.0	36.9	47.3	49.6	81.4	78.0	65.6	56.3
May	--	14.9	22.9	28.4	41.0	34.1	56.1	55.0	68.6	52.4
Jun	--	16.7	19.6	30.5	36.0	48.6	45.9	66.6	57.0	50.8
Jul	5.7	17.7	20.7	43.0	41.4	50.9	83.6	76.0	69.6	78.0
Aug	5.3	21.9	27.3	46.6	53.3	69.4	80.5	92.0	84.0	76.6
Sep	4.3	19.5	28.3	44.3	46.4	56.9	62.7	68.8	77.4	66.5
Oct	2.5	23.4	43.4	49.9	61.3	72.1	81.5	74.8	92.0	102.8
Nov	9.0	22.9	43.5	56.1	68.7	94.5	113.3	102.8	118.3	100.8
Dec	13.7	33.5	37.5	48.6	67.0	90.6	89.7	92.2	95.6	98.6
Annual Mean	--	19.5	29.6	40.8	54.5	62.6	85.6	83.4	79.6	74.7

Laysan Island: NMFS personnel were present on Laysan Island from 28 February to 21 May, 1988 and again from 24 October to 13 November, 1988.

Seal censuses were conducted regularly throughout the field season. Totals are being compiled. Data on behavior of seals were formally recorded on regular "pair watches" to assess adult male activity as it related to aggression and ability to remain with adult female seals during the breeding season. Baseline behavior of adult males was also documented in anticipation of possible behavior modification using injectable hormones in future field studies. Tissue and molt samples were collected for subsequent analysis of DNA to determine parentage of pups.

Eleven seals died during the duration of the NMFS field camp. Approximately 90 injuries were noted on seals. One incident of "mobbing", or mass harassment was witnessed, and several females were seen with fresh back wounds probably received during mass mating attempts.

Forty-five pups were born, four of which died at or shortly after birth. This total represents the highest documented number of pups born at Laysan Island. Also noteworthy is that three of the females which pupped were 5 year-old seals (tagged as pups in 1983). These represent the youngest female seals known to have been parturient.

Tissue samples and parasites were collected from 9 of 11 seals which are known to have died during the field season. Samples of placentae were collected from 13 pups which were born during the field season, (These samples were collected after the pup had broken away from the placenta and had moved away with its mother). Tissue samples were collected during application of tags from the rear flippers of 32 weaned pups and 40 adult or subadult male seals for subsequent analysis of DNA. Molt samples were collected from eight adult males in October-November for the same analysis.

Forty weaned pups and 39 adult and subadult male seals were tagged, of which 19 were tagged for the first time and 20 were new tags applied to replace lost metal tags. Thirty male seals were marked with commercial hair lightener to facilitate identification from a distance.

Seven seals, comprising two juveniles, three subadults and two adults were observed entangled in plastics or netting. All of the animals were restricted in their movements and had to be rescued through human intervention. One of the subadults entangled was a female whose neck was being deeply cut by a fragment of net and would probably have been choked. A large number of netting and line fragments and other items hazardous to wildlife were collected and the data are still being compiled. A preliminary count shows over 500 pieces of hazardous material counted, collected, and burned.

Lisianski Island: NMFS personnel were present on Lisianski Island between 16 May and 18 May and again on 29 August. Because of the short duration of the field camp, no formal seal censuses were conducted. Circuits of the island were made solely to resight tagged seals and to tag weaned pups.

At least 22 pups were born in 1988.

Eight seal mortalities were documented. Seven seal carcasses were present on the island when the field party arrived on 16 May. An eighth seal was found dead on 29 August.

Skulls were collected from four of the seal carcasses found in mid-May.

Eighteen weaned pups were tagged on their hind flippers with green Temple Tags.

Two seals were entangled, one (a weaned pup), fatally. The dead weaned pup was found by personnel ashore for the day on 29 August.

No netting or other debris was collected or burned at Lisianski Island. A single survey to count debris documented approximately 150 items. No weights or size estimates were taken.

Pearl & Hermes Reef: NMFS personnel arrived at Pearl & Hermes on 17 May and departed 3 July. Regular seal censuses of all islets were conducted, and whenever possible the entire atoll was censused within 2 days. Camps were established on North Island and Southeast Island.

Twenty-one pups were born at Pearl & Hermes Reef.

Nine injuries were noted on seals, but no mortalities were documented.

No specimens were collected.

Eighteen weaned monk seal pups were tagged with blue plastic Temple Tags on their rear flippers.

No entanglements were noted.

Approximately 300 pieces of netting, line, or other hazardous debris were collected from the beaches and burned.

A large carcass of decaying flesh reported in 1987 at Seal-Kittery Island was still present in 1988. It had decomposed sufficiently to expose bony ribs, thereby establishing that it is a whale of unknown species.

Publications/reports resulting from Hawaiian monk seal research conducted on the Refuge that were published during 1988 include:

- Alcorn, Doris J., Robert G. Forsyth, and Robin L. Westlake. 1988. Hawaiian monk seal research on Lisianski Island, 1984 and U.S. Dep. Commer., NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SWFC-120.
- Dailey, M. D., R. V. Santangelo and W. G. Gilmartin. 1988. A coprological survey of the helminth parasites of the Hawaiian monk seal from the Northwestern Hawaiian Islands. Marine Mammal Science 4(2): 125-131.
- Forsyth, R. G., D. J. Alcorn, T. Gerrodette, and W. G. Gilmartin. 1988. The Hawaiian monk seal and green turtle on Pearl and Hermes Reef, 1986. U.S. Dep. Commer., NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SWFC-107, 24p.
- Gerrodette, Tim, and Fred R. Frizelle, III. 1988. Checking procedures Hawaiian monk seal census data. NMFS SWFC Admin. Report H-88-13. 140pp.
- Gilmartin, William G. 1988. The Hawaiian monk seal: population status and current research activities. NMFS SWFC Admin. Report H-88-17. 14pp.
- Johanos, Thea C. and Susan L. Austin. 1988. Hawaiian monk seal population structure, reproduction, and survival on Laysan Island, 1985. U.S. Dep. Commer., NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SWFC-118. 38pp.
- Reddy, Michelle L. and Carrie A. Griffith. 1988. Hawaiian monk seal population monitoring, pup captive maintenance program, and incidental observations of the green turtle at Kure Atoll, 1985. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-TM-NMFS-SWFC-101. 35pp.
- Westlake, Robin L. and Paul J. Siepmann. 1988. Hawaiian monk seal and green turtle research on Lisianski Island, 1986. U.S. Dep. Commer., NOAA Tech. Memo, NOAA-TM-NMFS-SWFC-199. 18pp.

HWN-3-88 French Frigate Shoals Hawaiian Monk Seal Pup Rehabilitation Project and Kure Atoll Pup Headstart Project

The Hawaiian monk seal female pup headstart project was initiated in 1981 at Kure Atoll. Female pups born at Kure were placed in an enclosure, fed until they were in good condition and self-feeding, and then they were released. In 1984, underdeveloped female pups from French Frigate Shoals were flown to Honolulu and rehabilitated. After being screened for disease and genetic problems, they were flown to Kure Atoll for eventual release. Three female pups were collected at French Frigate Shoals in 1984, two in 1985 and five in 1986.

In 1986, one male pup was also collected and this animal was converted to a research animal. Three of the female pups collected in 1986 that were in excellent condition and self-feeding were transported to Kure Atoll on 14 April and were placed in a headstart pen there. The transfer was documented by a film crew from the Public Broadcasting Service production "Discover: The World of Science", and formed the basis of a segment which later appeared on the nationally broadcast show. The yearling seals were released from the headstart pen on 22 and 23 June 1987.

One of the seals collected in 1986 died due to renal failure with attendant uremic poisoning shortly after it arrived at the NMFS Kewalo Research Facility in Honolulu.

No pups were collected from the Refuge for rehabilitation during 1987. At least two candidate pups, prematurely weaned, were observed on East Island but these pups disappeared before personnel were able to capture them. The pups were in the vicinity of several lactating females, and because biologists on East Island had documented extensive pup exchange, they thought the pups had an excellent chance of being adopted by another female. Also, because of their proximity to mother pup pairs, these pups could not be captured without risk of disturbance to these pairs. The pups disappeared after approximately 2 days.

During 1988, NMFS removed 8 seal pups from French Frigate Shoals for rehabilitation purposes. Five of these pups died during rehabilitation efforts and the remaining 3 pups were being maintained at the NMFS Kewalo Research Facility. These pups will be maintained at Kewalo Basin until they are in excellent condition and self-feeding. At that time, they will be flown to Kure Atoll where they will be maintained in an enclosure until they are observed catching and consuming live fish. The pups will then be released.



Female monk seal pup is loaded onto charter aircraft for transport to Honolulu.
(KRN)

HWN-4-88 Green Sea Turtles Studies

During 1988, Service and NMFS personnel continued cooperative turtle research efforts concentrated on French Frigate Shoals, the major Hawaiian green sea turtle nesting area. Censusing and tagging were also conducted on other islands and atolls in the NWHI by the NMFS.

French Frigate Shoals: The general objectives of this multi-year study are to monitor nesting populations, hatching phenologies, hatching success, and avian and ghost crab predation of hatchlings. A major consideration in conducting turtle research on Tern Island is related to the condition of the seawall. The Tern Island seawall will need to be replaced, removed, or left to continue rusting away. Information on green sea turtle use of Tern Island (nesting and hatching phenologies, location of nests, numbers of turtles nesting on Tern Island, numbers of hatchlings produced, and etc.) will be an important consideration in making a decision on the fate of the seawall.

On Tern Island, Refuge biologists monitored turtle nesting activity from 26 April through 9 December, 1988 by patrolling the beaches. While females were coming ashore to nest, patrols were conducted 4 or 5 times nightly (about every 2 hours). After nesting activity ceased, nest sites

were checked at sunset and/or in the early morning hours for evidence of hatching. Locations of nests were recorded on maps and data forms. Nest sites were physically marked with a stake placed 150 cm inland of the nest. Tags were applied or tags read for all turtles.



NMFS Volunteers Moriarty and Fukuda mark turtle nest laid the previous night. (DKM)

Hatchling emergence was monitored by observing each nest site starting about 50 days after eggs were laid. If a nest did *not* hatch within 90 days, the nest was excavated and the contents analyzed. (Throughout several years of study, mean incubation length for French Frigate Shoals nests has been between 63 and 68 days; extremes have been 54 to 88 days).

Two to three days after hatching, nests were excavated to determine clutch size and hatching success. Hatching success parameters included the number of eggs that did not hatch (infertile and/or rotten), dead embryos ($\frac{1}{4}$, $\frac{1}{2}$, and $\frac{3}{4}$ developed), dead, fully developed hatchlings, live hatchlings trapped in the nest, and hatchlings that successfully emerged on their own (based on the number of hatched egg shells in the nest).

The diet of great frigatebirds (GRFR) was checked during peak turtle hatchling emergence to determine whether GRFR's are a major predator of hatchlings at French Frigate Shoals. Stomach contents of adult, juvenile, and nestling GRFR's were analyzed during September, 1988. Stomach contents were obtained by inducing regurgitation by pumping water into the GRFR's stomachs. No evidence of any turtle hatchlings appeared in any of the samples. Based upon this data, it seems that GRFR's at French Frigate Shoals do not prey heavily on turtle hatchlings.

Green sea turtles nested on Tern Island between 26 April and 1 October, 1988. 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. Twenty-four different turtles were observed nesting on Tern Island. An additional 10 turtles were observed digging on Tern Island during the 1988 season, but nests were not confirmed for these turtles. A preliminary summary of sightings shows that almost all turtles attempted to nest between 3 to 7 times during the season, with most nesting 5 to 7 times.

Eighty-five of the 88 nests located hatched. The first hatchling emerged on 8 July and the last on 9 December.

The mean incubation period for the 88 nests with lay and hatch dates known was 63.2 days with a range of 53 to 76 days.

The mean clutch was 96.8 eggs with a range of 54 to 146 eggs. Individual nest success ranged from 0 to 100%. Of the 8232 eggs produced in 1988, 80.2% produced viable hatchlings (defined as the number of eggs that produced hatchlings that made it out of the nest alive). Of these, 534 or 6.5% were found trapped (still in the nest upon excavation) and required assistance to emerge. The percentage of bad eggs (rotten or infertile) was 13.8%.



NMFS Volunteers compare data at East Island Turtle Camp. (DKM)

Comprehensive censusing and tagging of nesting green sea turtles was conducted on East Island for 101 nights between 15 May and 24 August. A total of 207 females were seen for the first time ashore in 1988.

Censusing and tagging of nesting turtles was also conducted on Whale-Skate Island in French Frigate Shoals for 74 nights between 25 May and 18 August. A total of 139 female were seen for the first time ashore.

Data collected by NMFS and Service personnel on numbers of females nesting within the atoll will be analyzed by NMFS statisticians. Data collection efforts were expanded in length and locality this season in order to assist statisticians in evaluating the model used to predict atoll nesting populations.

New tags were applied to 212 turtles in 1988 in French Frigate Shoals. Individual tag numbers and an updated version of tag recoveries is available in the refuge files.

An adult turtle became entangled by wire around its neck on East Island. The wire was removed.

Eighty-six female green turtles observed or originally tagged at French Frigate Shoals were resighted during 1988. The longest period between original tagging and any of this year's recoveries was 9 years.

Laysan Island: Basking turtles were regularly counted during seal censuses, and 5 basking turtles were tagged. Three fresh series of turtle pits were sighted in May. No turtles were observed entangled at Laysan Island.

Lisianski Island: Because of the short duration of the field camp, no formal turtle censuses were conducted, no turtles were tagged and no turtles were observed entangled in debris.

Pearl and Hermes Reef: Basking turtles were inspected for the presence of tags, and both basking and foraging turtles were tagged. Seventy-eight turtles were tagged on one or both front flippers with metal, Monel tags. No entanglements were noted.

Significant findings revealed by resightings this year included movement from: East Island, French Frigate Shoals to Hana, Maui in the main Hawaiian Islands; and from East Island, French Frigate Shoals to Laysan Island in the Northwestern Hawaiian Islands.

HWN-3-88 Field studies of Bristle-thighed Curlews on Laysan and Lisianski Islands, Spring/Fall 1988

This study was cooperatively conducted through a Cooperative Research Work Order with the Alaska Fish and Wildlife Research Center and the University of Montana. The research was proposed by R.E. Gill, Jr., Colleen M. Handel, Alaska Fish and Wildlife Research Center and Roland Redmond, Wildlife-Wildlands Institute. Research was conducted during two separate seasons, 13 April through 18 May and 30 August through 20 November, 1988.

A field camp was established on Laysan Island to support the study. Two days were spent on Lisianski Island, 16 May through 18 May, 1988. Two researchers collected the data.

The primary objectives of this study were to: (1) determine the importance of each island to curlews during spring migration, (2) document duration and peaks of spring migration, (3) document changes in flock sizes throughout the period, (4) determine patterns of habitat use, (5) document curlew behavior relative to habitat use, (6) determine rates of turnover of curlews, (7) determine amount of interchange of banded birds among islands, (8) collection of food habits data and (9) attach radio transmitters to curlews to determine usefulness of the transmitters in monitoring local movements and diel patterns of habitat use.

Methodologies used to accomplish the objectives were censusing of curlews and other shorebirds, capture and marking and telemetry.

Curlews were found to be present in all terrestrial habitats on Laysan Island. During April and May, 84 different curlews were captured and banded on Laysan, and another 30 on Lisianski. Two distinct age classes were distinguished on the basis of plumage characteristics, birds hatched the previous year and entering their second year, and older individuals. (i.e., after-second-year). All older birds had fresh, unworn primaries, suggesting a recent molt. Virtually all second-year birds were in the process of molting their primaries and were unable to undertake northward migration to Alaska in time to breed. It was also documented that some ASY curlews remain in the NWHI throughout the summer. This suggests that some individuals do not breed until at least three years of age.

Systematic censuses indicated that 300-350 curlews were present on Laysan throughout the fall. Curlew densities were assessed as being higher on Lisianski than Laysan Island although some of the differences may have been the result of the curlews being easier to detect on Lisianski.

From late August to mid-November, 150 curlews were captured and individually color-marked on Laysan including one recapture of a bird banded at Laysan on 10 September, 1967. This bird currently holds the longevity record for all North American Shorebirds.



Jeff Marks with color marked curlew. (RR)

Other data highlights suggest (1) bristle-thighed curlews become flightless during molt, (2) AHY birds probably molt twice during the nonbreeding seasons, (3) curlews seem to have well defined home ranges (4) emetic and radio transmitters hold promise to monitor food habits and habitats use/movements patterns, respectively, and (5) bristle-thighed curlews potentially are very long lived.

The following reports regarding this subject are available in the Refuge files:

Gill, R.E., Jr. and Roland Redmond. 1988. Trip Report: French Polynesia, 29 March-19 April, 1988. Control Numbers 808 & 809.

Mark, Jeffrey S. and David L. Evans. 1988. Trip Report: Bristle-thighed curlews, Laysan and Lisianski Islands, Northwestern Hawaiian Islands, Spring 1988.

Marks, Jeffrey S. 1988. Trip Report Summary, Laysan Island, Fall 1988.

HWN-6-88 Maternal care behavior of the Hawaiian monk seal (*Monachus schauinslandi*) on Laysan Island, Northwest Hawaiian Islands, 1988.

This study was instituted by Dr. Daryl J. Boness, and conducted by Mitchell Craig and Luciana Honigman, Department of Zoological Research, National Zoological Park, Smithsonian Institution. The major emphasis was on documenting the occurrence of fostering behavior, its potential causes and its impact on the duration of lactation and pup growth during the suckling period.

The primary objective of the study was to quantitatively describe maternal care behavior of the Hawaiian monk seal on Laysan Island for comparison to data collected in 1987 on East Island, French Frigate Shoals, NWHI.

Data collection on Laysan Island began 3 March and continued without interruption until 13 May. Twenty-three of 34 possible mother/pup pairs were observed an average of 7.5 hours each day by two observers.

Specific data collected included: (1) density and location of mother/pup pairs twice daily, (2) activities of and distance between pairs at 15 minute intervals, (3) distance and identifications of nearest lactating females every 30 minutes, (4) specific information relating to separations and approaches between the mother and pup of each lactation pair as often as possible, (5) on teat and overall suckling duration as well as intersuckling intervals, and (6) specific information for each aggressive interaction between lactating females or between males and lactating females.

Preliminary results indicated pup switching and fostering incidence was much lower at Laysan Island than at East Island, French Frigate Shoals. Of 16 lactating females observed from parturition to weaning, five (31,3%) fostered a foreign pup. Each female only fostered a single pup during lactation for an average of 16.4 days (SD = 15.2). These data may be compared with 78% of 31 females fostering an average of 2.3 (range 1-5) pups at East Island, French Frigate Shoals.

Two pups died during the period of study on Laysan Island, but there was no indication that the study contributed in any way to the deaths. The first pup's death suggested a congenital problem. The second pup's death occurred seven days after parturition. This pup seemed to have difficulty getting milk and often had difficulty locating the female's teats. Prior to finding the pup dead one morning, it appeared to be gradually getting weaker by the day.

HWN-7-88 Black noddy reproductive biology, Tern Island, French Frigate Shoals

This study was conducted by Vanessa Gauger, Master's Degree Candidate, from the University of Hawaii - Honolulu. Research was conducted during two periods, from mid-November, 1987 through mid-January, 1988, and from mid-March through late August, 1988.

Primary objectives of the study were: (1) to study mate and nest-site fidelity, both throughout the season and from season to season, (2) to look for correlations between switching of mates and/or nest sites, and previous reproductive failures, (3) to determine the maximum number of nesting attempts by a pair per season, and the percentage of successful attempts, (4) to find out how many pairs successfully raised two chicks per year, (5) to determine aspects of the species' reproductive life history, including length of incubation and brood shifts, frequency of parental feeding of the chick, post-fledgling feeding duration, and the possible presence of helpers at the nest, (6) to examine the degree of synchronization in nesting within sub-colonies, and to examine the relationship between time of season and reproductive success, (7) to determine important characteristics of nest sites, and to look for possible correlations between these characteristics and the adult's reproductive success at these sites, (8) to determine the age at first reproduction in this population.

Methodologies used to accomplish the objective were color banding and marking adults and color banding hatch-year chicks, interval nest checks, and band reading island-wide. As of late August, 310 adults and 61 hatch-year chicks were banded with Service and color bands.

Black noddies were found to be successfully nesting more than once per year. It was also observed that parents were able to successfully raise more than one chick per year. All previous population studies were based on the assumption that parents were raising one chick per year. Based upon this data population studies will be revised accordingly. Analysis of data collected is ongoing.

HWN-8-88 Northwest Hawaiian Island Endangered Passerine Research - Laysan Island, 1988

This research project was conducted by Dr. Sheila Conant and graduate student Marie Morin, University of Hawaii, Honolulu. Morin and Joel Simasko set up a field camp on Laysan Island on 14 May, 1988 and remained on the island until 30 August, 1988. This was the 3rd field season for Marie's work towards a Ph.D.

Objectives of the study were (1) determinations of the basic parameters of breeding biology of the species (e.g., duration of breeding season, nature of mating systems, nest building behavior, incubation period, and

care of young), (2) morphometric studies including comparative studies between the two species of finches in the NWHI and between the two populations of Laysan Finches, including studies of growth rates, survival, and inheritance of morphological characters, (3) completion of studies of feeding behavior including studies directed at comparing the two finch species, (4) identification of habitat requirements, (5) examination of causes of morphological variation.

Methodologies utilized in this research included (1) trapping, banding, censusing and measuring Laysan Finches of all ages and both sexes, (2) recording plant phenology, (3) recording finch feeding observations in five different vegetation types, (4) locating, marking, and studying finch nests, eggs, and chicks, including growth measurements.

A total of 381 Laysan Finches were banded from 16 May to 26 August, 1988. Censusing indicated that Laysan Finches were not as abundant on Laysan Island in 1988 as they had been in the past two seasons. From summer 1987 through February, 1988, food may have been limiting for the finches.

Literature/publications regarding this subject are as follows:

- Conant, S. In Press. Geographic variation in the Laysan finch. (Telespyza cantans). Evolutionary Ecology.
- Conant, S. 1988. Saving endangered species with translocation: Are we tinkering with evolution. Bioscience, 38:254-257.
- Conant, S. and R.C. Fleischer. 1988. Translocating endangered species: some unexpected consequences. Meetings of the Western Section of the Wildlife Society. 10-12 February, 1988, Hilo, Hawaii.
- Conant, S. and R.C. Fleischer. 1987. Genetic and morphological differentiation among the native Laysan and the introduced Pearl and Hermes populations of the Laysan Finch. Meetings of the American Ornithologists' Union. 10-13 August, 1987, San Francisco.
- Conant, S. 1986. Morphological variation in two populations of Laysan Finch (Telespyza cantans). Abstracts. Meetings of the Wilson Ornithological Society, 17-20 April, 1986, Gatlinburg, Tennessee.
- Conant, S., Collins, M., and C.J. Ralph. 1981. Effects of observers using different methods upon the total population estimates of two resident island birds. Studies in Avian Biol. 6: 377-381.
- Morin, M.P. 1987. Laysan Finches drown as a result of marine debris. 'Elepaio. 47
- Morin, M.P. 1988. Trip Report: USFWS Files, Honolulu, HI.

E. ADMINISTRATION

1. Personnel

	<u>CS</u>	<u>Full-Time</u>	<u>Part-Time</u>	<u>Temp.</u>	<u>Total</u>
CY-86	1	6	-	2	9
CY-87	1	6	-	4	11
CY-88	1	4.3	-	5	9.3

Ken McDermond, Assistant Refuge Manager received an upgrade from GS-7 to GS-9 in March.

Two Biological Aids were hired to assist with a cooperative (Service/NMFS) study of green sea turtle nesting at French Frigate Shoals. Vanessa Gauger was on board from April to August. Holly Freifeld worked from April to June.

Jeff Holm transferred from Tern Island to fill the wildlife biologist position with the Hawaiian Wetlands Refuge Complex in May.

Breck Tyler was hired effective June 15, 1988 as a Temporary Intermittent Wildlife Biologist to conduct a rat survey for Midway, Atoll NWR. He worked from June to Sept.

Lynn Denlinger transferred from Bureau of Land Management, Alaska to fill the GS-7 Tern Island Assistant Manager position in July.

Darcy Hu remained on leave without pay status while attending the University of California at Davis until April. She entered LWOP status again in August to return to school.

Michael Moser was hired in October as a Temporary, Intermittent Bio-Aid to assist with organization of biological data, data input and miscellaneous field tasks.

The change in personnel levels is a result of temporary funding for the Hawaiian/Pacific Refuge Complex and organizational changes within the complex. The complex received \$500,000 in add-on funding for FY88. Because of reprioritization of Refuge programs within the complex, Hawaiian Islands ranked lower in importance and was funded primarily with add-on money. The previously permanent biological technician position for the Refuge was filled as a temporary. Because of organizational changes involving recognition of separate Refuge groups the complex manager is recognized as only a 1/3 part of each of the Refuges within the complex.

2. Youth Programs

Lack of funding and personnel to offer continuous supervision to the work crew precluded a YCC program at Tern Island during 1988.

4. Volunteer Program

A large number of volunteers continued to play an important role in daily operation and research activities conducted on Tern Island, particularly when the refuge was short-handed while refuge staff were on leave. An ongoing effort has been made to fully utilize the experience, training talents, and interests of those people during their stays.

Volunteers also played an important role in our field camp efforts on East Island and Whaleskate Island, French Frigate Shoals, conducting green sea turtle research, and in the annual charter to Refuge Islands.

Volunteers Patrick Ching, Scot Andersen, Vanessa Gauger, Holly Freifeld, Lisa Haggblom, Bengt (Ove) Rud, David Kuwahara, Joel Simasko, Alice Gibb, Wayne Takeuchi, Mike Fedorko, and Jennifer Megyesi conducted seabird monitoring studies, Hawaiian monk seal and green sea turtle surveys, banded seabirds, maintained data files, and provided assistance to the staff and visiting researchers. Volunteers also assisted with maintenance and biological tasks.



NMFS Volunteer Fukuda and Service Volunteer Gibb prepare to make beach cleaning patrol at Tern Island. (KRN)



Biological Aid Holm and volunteer Rud dig garbage pit on Tern Island. (KRN)



Volunteer Simasko installs drift fence on Laysan Island. (DKM)

5. Funding

The Hawaiian Islands National Wildlife Refuge is part of the Hawaiian/Pacific Islands National Wildlife Refuge Complex. During 1988, the Refuge Complex in Hawaii received a \$500,000 congressional add-on to the budget appropriated by the Service. The base budget is divided among the Refuges in the entire complex. The Hawaiian Islands National Wildlife Refuge received approximately \$191,000 of funding in FY88. This included one resource project which received special funding for revegetation on Laysan Island. An additional \$15,000 was received for non-game wildlife resources work on Midway Atoll National Wildlife Refuge.

6. Safety

Because of Tern Island's remote location, safety is of paramount concern both during work and free time. Any serious injuries or illnesses requiring a Medivac face a delay of 7 to 10 hours before the patient can obtain treatment in Honolulu. For this reason, safety precautions are taken seriously.

Dr. Ken Nakasone of the Honolulu Medical Group continued to act as medical advisor for Tern Island personnel and was called upon numerous times for medical advice over the radio. He also visited the island to discuss medical procedures with staff and evaluated the stock of prescription drugs, first aid and other medical supplies.

Volunteers and NMFS personnel were briefed on emergency procedures, including the use of radios in emergency situations. Practice sessions were also conducted.

Weekly radio checks were conducted with the U.S. Coast Guard. This routine procedure becomes a lifeline during emergencies. Information pertaining to flights, flight plans, weather and injured personnel was relayed through U.S. Coast Guard channels. The assistance in this regard has been greatly appreciated.

Emergency supplies were organized in waterproof buckets for each Boston Whaler. Buckets with tools, extra spark plugs, lubricants, wire and rags were also assembled for each boat.

7. Technical Assistance

Refuge staff provided a variety of technical assistance to other government agencies, and institutions.

Refuge staff provided logistical support and technical advice on necessary mechanical repairs to National Marine Fisheries Service field camps at French Frigate Shoals and other refuge islands. In addition, numerous radio checks were conducted for safety purposes and to relay messages between Honolulu and other camps. Tern Island personnel regularly monitored intra-atoll radios in support of NMFS research.

The Honolulu office assisted with transportation arrangements for one trip to Tern Island by the National Weather Service. Tern Island personnel also performed regular preventative maintenance and emergency repairs to the RAMOS weather station.

Tern Island personnel recorded information from the University of Hawaii tide gauge and performed regular and emergency maintenance.

Technical assistance was provided to the U.S. Navy Command at Midway regarding activities which may affect migratory birds and migratory bird permitting requirements and compliance.

8. Other

Refuge Manager Duane K. McDermond attended the Pacific Seabird Group Annual Meeting in Washington D.C.

F. HABITAT MANAGEMENT

2. Wetlands

The Hawaiian Islands National Wildlife Refuge consists of extensive shoreline and coral reef habitats. However, studies in these areas are limited due to the remote nature of the area. These wetland areas are protected through the administration of Special Use Permits for entry. The State of Hawaii and Service dispute ownership of these areas.

The Laysan lagoon or lake is the most significant unique "inland" wetland on the Refuge. The lake supports the Laysan duck and substantial populations of migratory shorebirds. During 1988, studies of the lake were limited to measurements of salinity and water level. In addition, Laysan duck surveys were conducted (Sec.G.2).

6. Other Habitats

Tern Island: Sooty terns nest in great numbers on Tern Island and have a special affinity for the east and west ends of the runway. To discourage sooty tern use (thereby minimizing bird strikes by aircraft), large sheets of heavy black plastic have been laid on the ground in past years. This effort must be repeated each year as the plastic deteriorates. In 1987 the plastic was placed on the west end of the runway as usual, but on the east end only half of the area was covered and

the other half was scraped clear of vegetation just prior to sooty tern nesting. The scraped ground proved to be just as effective as the plastic. It also required less maintenance, cost, and wastage. The plastic was removed from the west end of the runway during 1988 and Tern Island staff will continue with routine clearing of vegetation.

Helene Takemoto and Tom Litke from the Army Corps of Engineers visited Tern Island in September. The purpose of their visit was to survey French Frigate Shoals for presence of abandoned military debris. The Corps of Engineers (COE) manages the environmental restoration activities at closed or formally owned installations using funds from the Defense Environmental Restoration Account (DERA).

Of prime concern to the refuge is the steadily degrading seawall at Tern Island which was constructed by the Navy during World War II. In the course of the COE survey twenty 5,000-gallon underground storage tanks were discovered along the north side of the Island.



Tom Litke (COE), Helene Takemoto (COE), and Refuge Manager Niethammer, sample contents of underground storage tank on Tern Island. (DKM)

Although the seawall was built by the military and would qualify for DERA funding - replacement, renovation, or removal may not rank as a high priority project. On the other hand initial feelings from the COE are that the underground tanks which still have fuel in them may rank high enough for clean-up in the near future. Local COE staff feel that the seawall is also an important project and will attempt to justify replacement with a revetment.

At the end of the year the COE was awaiting the Refuge's biological report on the project which was contracted out to us as part of the DERA survey

Laysan Island: Laysan Island had been modified extensively by human activity during the latter 19th and beginning of the 20th century. Guano mining and defloration by feral herbivores caused extensive sand and soil shift, changing island topography and reducing the lake depth considerably. In 1980, Service personnel observed that an area of vegetation on the central eastern portion of Laysan Island had been covered by drifting sand. During this and subsequent trips, observers noted that sand was beginning to encroach on the boundary of Laysan's lake and that the freshwater seeps on the eastern portion of the lake were beginning to fill with sand. Also, due to the drifting sand the dune height in this area had decreased. The decrease in dune height could increase the likelihood of flooding of the lake due to the storm surge. If the ocean flooded the lake, major changes in the lake's ecology could occur. In an attempt to arrest the drifting sand and allow the vegetation to reestablish in the area in hopes of preserving the freshwater seeps for the Laysan duck, a drift fence was constructed in 1984 (two lines totaling 640 feet) and 1985 (two lines totaling 2,700 feet). Observations made during the summer of 1986 revealed that the drift fences had caused the formation of dunes of varying heights and widths. Vegetation had not yet reestablished in this area in 1986. It was thought that the increase in dune height might result in the decrease in the westward drift of sand.

During the June 1987 visit to Laysan, it did appear that vegetation was beginning to reestablish on the lakeside of the innermost fence. Ipomea pes-caprae was creeping inward from both sides of the blowout and Scaevola taccada seedlings were found growing on the lake side of the innermost fence. This new growth was not dramatic but encouraging.

An inspection of the fence did reveal some problems. The innermost fence had a breach which caused a severe cut through the innermost dune. This section of fence was repaired and sand was piled against the windward side in hopes that the dune would reform. It was also found that sand was continuing to encroach on the vegetation at the S end of the innermost fence. It appeared that there was enough room between this fence and the middle fence to allow the wind to reestablish and carry sand to the S of

the inner fence. It was decided that a new section of fence should be erected to connect the S end of the innermost fence to the S end of the middle fence, hopefully stopping the wave of sand that is encroaching here. Estimates indicated that this would require another 450 feet of fence.



Field crew rests during transport of drift fence from beach to blowout. (DKM)

Four hundred fifty feet of drift fence was shipped to Laysan on the F/V TOWNSEND CROMWELL in mid-May, 1988. The fence was fumigated prior to shipment. On 20 June, the NWHI Charter crew began erecting the fence between the S ends of the W and Middle fences which were previously constructed. Vegetation in this area had largely succumbed to blowing and drifting sand since the 1987 field season. On a more positive side, vegetation in other areas of the blowout was noticeably increased since 1987. Most noticeable was the encroachment of vegetation from the NW section. There was a dramatic response in one area where the fence was repaired the year before. A ravine had developed due to a breach in the W fence and little vegetation was present. This season the ravine had dramatically revegetated. Eragrostis, Scaevola, Ipomea, Nama sandwichensis were plentiful throughout the area.



Break in drift fence prior to repair in 1987. (DH)



Area of break in 1988. (DKM)

The crew established photo monitoring plots for the entire blowout area, as well as, sand accumulation monitoring stakes on either side of the new fence. These posts should also give reference points for interpreting photos. These procedures were developed to act as a stop gap means of monitoring the blowout area. This scheme should be established as a regular job for future trips to the island. Instructions, forms, and maps should be developed to simplify and standardize data collection. Ideally, aerial photos should be taken at least annually to document changes in this area.

10. Pest Control

Pest control in the Hawaiian Islands National Wildlife Refuge involves prevention of alien introductions, monitoring existing and potential new introductions, and planning and implementing control procedures for problem introductions on a case by case basis. During 1988, pest control primarily involved implementing procedures to prevent the introductions of exotic organisms. Also during visits to the refuge, the status of exotic organisms was monitored.

The Refuge used \$15,000 of non-game money to determine the status of rats on Midway Atoll National Wildlife Refuge. The presence of rats on Midway has caused major declines of burrow nesting species at this location. Control of rats here is felt to be among the top management priorities for the newly created refuge.

A cooperative agreement was established with the Animal Damage Control (ADC) division of the Department of Agriculture to develop rat population monitoring techniques, assist in the monitoring, and make recommendations on control. Breck Tyler (Service) and James Murphy (ADC) sampled rat populations from 30 June to 25 August. Black rats (Rattus rattus) were found to be abundant on all islands of the atoll. Although the military controls rats with bait stations in housing areas, most of the wildlife habitat exists outside these areas. The report produced by this cooperative effort recommends expanding the bait station control methods currently employed on the island with possible modification of baits. Also considered and recommended is attempting to eradicate rats from Eastern Island and if successful also on Sand Island.



Breck Tyler prepares trap line to monitor rat abundance on Sand Island, Midway Atoll.
(JM)



Results of a night's trapping. (JM)

The following report was produced from this study:

Murphy, J.G. and W.B. Tyler. 1988. Rat population monitoring and control assessment on Midway Atoll. Prepared for U.S. Fish and Wildlife Service by U.S. Department of Agriculture.

The islands of the Hawaiian Islands National Wildlife Refuge are extremely sensitive to the introduction of alien species. The natural history of these islands is full of examples of problems when alien species are intentionally or unintentionally released on the islands. The introduction of rabbits on Laysan Island caused the extinction of the Laysan rail, Laysan millerbird and Laysan honeycreeper early in this century. The problem of rodents on Midway and Kure in the Northwestern Hawaiian Island chain serves to warn us about introduction of rat species on Refuge islands. Introductions of alien plants have caused problems on Southeast Island, Pearl and Hermes Reef and Sand Island and Midway Atoll where introduced plants compete with native plants important on these islands. The introduction of house flies on Laysan Island is another example of a major insect infestation resulting from an introduction. The introduction of mosquitoes on the Refuge islands could result in catastrophic consequences if malaria was transmitted to the native landbirds. The endemic finches are thought to be highly susceptible to malaria. On Midway Atoll where mosquitoes have been introduced, avian pox, which is carried by mosquitoes, has caused problems for the large Laysan albatross population which nests there. These are just a few of many specific examples of the potential problems with exotic introductions. It is for these reasons that Refuge staff take great precautions when transporting equipment and visiting the remote islands. Material transported to these islands must be packed in cleaned plastic or metal buckets that are sprayed with insecticide, not wood or cardboard boxes that may harbor insects, eggs, and/or plant seeds. Material that may carry seeds, insects, or eggs is fumigated before transport. For example, the fencing material which was transported to Laysan Island was professionally fumigated prior to transport. Many articles are frozen as an extra precaution to kill insects. Certain types of foodstuffs are not permitted on the islands. The Refuge stipulates transport procedures for all islands through the Special Use Permits issued to Refuge cooperators and monitors transport to ensure compliance with procedures required in the permits authorized.

G. WILDLIFE

2. Endangered and/or Threatened Species

The islands within the Hawaiian Islands National Wildlife Refuge harbor four endangered land birds (all endemic to single islands), the endangered Hawaiian monk seal, and the threatened green sea turtle. The endangered land birds are the Laysan duck, Laysan finch, Nihoa millerbird, and Nihoa finch. Research conducted on the Laysan finch was described in a preceding research section (Sec. D.5.). In addition to research, specific management practices directed toward the protection of endangered and threatened species on the refuge include strict control of all research and other activities. The following are among the measures taken:

- 1) Entry onto the refuge is prohibited to all but persons with Special Use Permits. Permits are generally given only to activities which are likely to directly benefit the resources or improve management practices, so many requests are turned down.
- 2) All Special Use Permits include provisions to avoid disturbing endangered species and degrading endangered species habitat.
- 3) Movement of all personnel on Tern Island is restricted to areas not frequented by seals and turtles.
- 4) Fishermen are given information indicating the boundaries of the Refuge and regulations pertaining to entry.

Activities conducted on the Refuge that may impact endangered or threatened species are also submitted to Section 7 (Endangered Species Act) consultation with the Service and the National Marine Fisheries Service.

The Hawaiian Islands National Wildlife Refuge has only one resident waterfowl species, the Laysan duck. It is an endemic and endangered species, inhabiting a hypersaline lake on Laysan Island. During 1988, Laysan duck populations were surveyed from April to October.



Female Laysan duck and brood in Cyperus. (DKM)

On 18 October 345 ducks were counted. This is the highest count in recent years. It had been anticipated that adults would be more conspicuous during this period when the nesting season is over and females have completed molting, but it is rare for personnel to be present at this time.

Two Laysan finch surveys were conducted on Laysan during 1988. The breeding census conducted on 28 May counted 153 birds resulting in an estimate of 5,201 finches +/- 1211. Populations were lower than in previous years. The August 15 and 16 census should be considered a post-breeding census. The total count was 275 birds. The estimated population was 9,349 finches +/- 1915. The estimate was also lower than corresponding estimates for previous years. It is suspected that the dry summer and fall of 1987 had a devastating effect on the survival of hatch year birds (1987 fledglings) due to a lack of sufficient food and moisture. Methodologies and objectives for Laysan finch studies are described in the research section (Sec.D.5).

At Pearl and Hermes Reef transect censuses were conducted on each island where the Laysan finch occurs. The censuses were carried out by the field crew on the NWHI Charter on 1, 2, and 3 July. The first census on Southeast Island was done in the heat of the afternoon and revealed what

seemed to be too few birds. For this reason a second census was completed the following day in the morning. This census revealed more birds and is the one used to calculate the population estimate. The following are census results by island.

<u>ISLAND</u>	<u>POPULATION ESTIMATE</u>
Southeast	159
North	34
Grass	22
Seal-Kittery	18
<hr/>	
Total	233

On Grass and Seal-Kittery Islands, fewer transects were run than were recommended. The reason for this was that transects could not be placed so that birds were not being recounted. It may be necessary to recompute total vegetation area on these islands, since it may have decreased since the census was designed. This would account for what appears to be too many transects for the area covered. Nests were found on Southeast Island.

Dry conditions over the past two years have caused significant changes in vegetation on the islands. This has likely been the cause of the downward trend in the finch numbers.

Two endemic passerine birds inhabit Nihoa Island--the Nihoa millerbird and the Nihoa finch. Populations of these species were surveyed on 8 and 9 June 1988. Transects surveys were conducted for this purpose. The population estimate for Nihoa finches were 2,123 to 4,587 or (3,355 +/- 1,232). Estimates for the previous year indicated a population of 555 to 1,337 or (946 +/- 391). These 1987 estimates were from censuses conducted during the month of May. During the 8 and 9 June censuses, a total of 30 Nihoa millerbirds were seen. Only one sighting was made on transect counts. This sighting was questionable due to the inexperience of the observer.

Information on populations of endangered Hawaiian monk seals and threatened green sea turtles is presented in Section D.5 of this report.

3. Waterfowl

The general lack of suitable habitat for waterfowl and the distance from major waterfowl migratory routes accounts for the rarity of this group within the Refuge. The only resident waterfowl is the endemic and endangered Laysan duck which inhabits the hypersaline lake on Laysan Island. Studies of this species are described in the Endangered and/or Threatened Species section (Sec. G.2) above.

During 1988 waterfowl observed in the Northwestern Hawaiian Islands were the northern pintail and the Eurasian wigeon.

5. Shorebirds, Gulls, Terns, and Allied Species

The Hawaiian Islands National Wildlife Refuge provides habitat for some of the largest and most important seabird colonies in the world. The islands harbor approximately 5.4 million breeding pairs of 18 species. The composition and number of breeding birds varies throughout the year. Because of the significance of the Hawaiian seabird population, indicator species of seabirds are emphasized in the monitoring program conducted on the islands. Baseline data on population size, phenology, egg size, reproductive success, chick growth rate, and food habits are collected from black noddies, red-footed boobies, and red-tailed tropicbirds on Tern Island and Laysan Island. These measurements are compared to those for prior years to detect changes due to natural or man-caused factors. Early detection for potential changes can avert significant population declines. Additional information on the seabird monitoring program is presented in Section D.5, HWN-1-88.

In 1988, breeding birds (i.e., number of nests) were censused at Tern Island at intervals of the mean incubation period for each species. Prior to 1987 breeding birds were counted island wide once a month on Tern Island. Due to this inconsistency in methods data are not directly comparable between all years. An attempt was made to analyze census data prior to 1987 with this in mind. In short all monthly counts were not included in Table 2 figures in order to mimic as close as possible counts made on species incubation periods.

During 1987 and 1988, censuses of other islands in the atoll were too infrequent to develop a population estimate for the atoll as a whole. The estimate for 1986 was based on opportunistic counts, whereas in previous years atoll-wide counts were conducted semi-annually on specific dates. The total number of nests for the atoll have been estimated for prior years in Table 3.

TABLE 2. TOTAL NUMBER OF NESTS ESTIMATED FOR TERN ISLAND 1983-1988

Species	1983	1984	1985	1986	1987	1988
Black-footed albatross	193	221	292	304	448	451
Laysan albatross	852	854	720	588	1,032	990
Red-tailed tropicbird	201	308	527	734	538	782
Red-footed booby	404	629	898	809	957	1,468
Great frigatebird	1	0	186	547	814	624
Gray-backed tern	56	48	121	272	78	510
Sooty tern	12,500	13,000	--	41,788	--	--
Brown noddy	921	927	890	1,861	2,134	3,451
Black noddy	726	615	1,201	1,094	1,333	2,369
White tern	34	34	34	54	73	120
TOTAL (w/o sooty terns)	3,388	3,636	4,869	6,263	7,407	10,765
(w/sooty terns)	(15,888)	(16,636)		(48,051)		

TABLE 3. FRENCH FRIGATE SHOALS ATOLL-WIDE NEST COUNTS 1984-1986

Species	1984		1985		1986 (results from multiple counts)
	3/84	6/84	4/85	8/85	
Black-footed albatross	2,490*	2,769	2,760	0	2,823
Laysan albatross	1,109*	901	1,380	0	1,339
Red-tailed tropicbird	163	327	352	365	754
Masked booby	380	337	127	226	493
Red-footed booby	540	611	618	510	818
Great frigatebird	470	308	368	375	693
Gray-backed tern	72	50	33	13	275
Sooty tern	9,879	0	8,300	--	41,788
Brown noddy	857	1,407	1,150	200	2,496
Black noddy	461	197	618	95	1,094
White tern	18	20	27	8	54
Sooty-storm petrel	--	--	--	--	13
TOTAL	16,439	6,749	15,733	1,792**	52,640

Includes: Tern, Trig, Whale-skate, East, Gin, and Little Gin Islands.

Includes: Tern, Trig, Whale-skate, East, and Little Gin Islands.

Includes: Tern, Trig, Whale-skate, and East Islands.

*Whale-skate not censused for albatross.

**Does not include sooty tern nests.



Great frigatebird sub-colony on Tern Island, during male courtship display. (DKM)

An estimate of the current numbers of breeding pairs and their distribution for the entire Northwestern Hawaiian Islands is presented in Table 4. These numbers are from population surveys conducted in recent years. Due to the magnitude of the seabird population on these islands, the diverse phenology of the species, and the remoteness of the island colonies, it is not possible to survey all of the populations on each island in every year. Thus, during visits to the islands, populations of indicator species are surveyed, and every five years detailed population surveys are scheduled to determine population trends.

The following vagrant and overwintering species were observed at French Frigate Shoals in 1988:

Black-crowned night heron	Hawaiian coot
Black-legged kittiwake	Lesser frigatebird
Blue-gray noddy	Pintail
Cattle egret	Red-billed tropicbird
Dunlin	Ruff
Eurasian Wigeon	Semipalmated plover
Franklins' Gull	Western sandpiper
Great blue heron	Herring gull

TABLE 4. ESTIMATE OF BREEDING PAIRS OF SEABIRDS, NORTHWESTERN HAWAIIAN ISLANDS

	Location				
	Nihoa	Necker Island	French Frigate Shoals	Gardner Pinnacles	Laysan Island
Black-footed albatross	40 to 60	200 to 250	4,000 to 4,500	0	14,000 to 21,000
Laysan albatross	1 to 5	450 to 550	900 to 1,000	10 to 15	105,000 to 132,000
Bonin petrel	0	0	30 to 50	0	50,000 to 75,000
Bulwer's petrel	75,000 to 100,000	250 to 500	200 to 500	10 to 15	1,000 to 2,000
Wedge-tailed shearwater	30,000 to 40,000	1,500 to 2,500	1,500 to 1,750	25 to 50	125,000 to 175,000
Christmas shearwater	200 to 250	0	15 to 20	0	1,500 to 2,000
Sooty storm-petrel	2,000 to 3,000	+	+	0	500 to 2,500
Red-tailed tropicbird	250 to 300	100 to 150	550 to 600	20 to 25	1,500 to 2,500
Masked booby	250 to 300	250 to 300	500 to 600	125 to 150	400 to 425
Brown booby	150 to 200	20 to 25	40 to 60	5 to 10	34
Red-footed booby	1,500 to 2,000	650 to 750	550 to 600	0	250 to 300
Great frigatebird	3,500 to 4,500	700 to 900	350 to 375	0	2,000 to 2,500
Sooty tern	10,000 to 25,000	12,500 to 25,000	60,000 to 78,000	250 to 500	375,000 to 500,000
Gray-backed tern	9,000 to 12,000	3,500 to 4,500	750 to 1,000	1,500 to 2,500	5,000 to 10,000
Blue-gray noddy	2,000 to 2,500	1,000 to 1,500	+	+	0
Brown noddy	25,000 to 35,000	10,000 to 15,000	5,000 to 7,500	1,000 to 1,500	10,000 to 15,000
Black noddy	1,000 to 5,000	300 to 500	750 to 850	200 to 300	1,500 to 2,500
White tern	1,000 to 5,000	100 to 300	500 to 750	150 to 250	600 to 1,000
TOTAL	235,115	52,725	98,155	5,315	943,760

NOTE: + indicates breeding occurs but there was not significant data to make a quantitative statement;
 ? indicates breeding is suspected but no nests were found.

TABLE 4. ESTIMATE OF BREEDING PAIRS OF SEABIRDS, NORTHWESTERN HAWAIIAN ISLANDS
(continued)

	Location				Total
	Lisianski Island	Pearl and Hermes Reef	Midway Islands	Kure Atoll	
Black-footed albatross	2,800 to 3,800	8,000 to 11,000	6,500 to 7,500	700 to 1,300	49,410
Laysan albatross	23,000 to 30,000	9,000 to 12,000	150,000 to 200,000	3,000 to 4,000	379,570
Bonin petrel	150,000 to 250,000	400 to 600	2,500 to 5,000	400 to 600	331,250
Bulwer's petrel	50 to 100	10	0	0	103,125
Wedge-tailed shearwater	10,000 to 30,000	5,000 to 10,000	500 to 1,000	900 to 1,100	261,400
Christmas shearwater	400 to 600	10	25 to 50	20 to 30	2,960
Sooty storm-petrel	?	1,000 to 2,000	0	?	7,500
Red-tailed tropicbird	900 to 1,300	40 to 60	4,000 to 5,000	1,000 to 1,300	11,235
Masked booby	300 to 350	140 to 160	5 to 10	65 to 75	2,370
Brown booby	15 to 25	50 to 60	0	50 to 60	474
Red-footed booby	350 to 450	40 to 60	450 to 500	400 to 450	5,110
Great frigatebird	750 to 850	300 to 400	60 to 75	200 to 250	9,850
Sooty tern	400,000 to 600,000	35,000 to 45,000	30,000 to 45,000	8,000 to 12,000	1,330,500
Gray-backed tern	15,000 to 20,000	650 to 750	100 to 200	30 to 50	51,000
Blue-gray noddy	0	0	0	0	4,000
Brown noddy	7,500 to 15,000	1,700 to 2,000	500 to 1,000	700 to 800	92,800
Black noddy	500 to 1,000	75 to 125	2,000 to 6,000	0	16,275
White tern	50 to 100	10 to 20	5,000 to 7,500	5 to 10	14,930
TOTAL	953,575	84,255	278,835	22,025	3,673,759

On March 22, 1988, Tern Island researchers began conducting shorebird counts every other week. Counts were continued through the end of December. A summary of the species and numbers observed are presented in Table 5.

The following vagrant species were seen on Laysan in 1988.

Laughing gull	Franklins' gull
Sanderling	Bar-tailed godwit
Hawaiian coot	Garganey
Ruff	Common goldeneye
Lesser scaup	Northern pintail
Northern shoveler	Green-winged teal
Red-necked phalarope	Sharp-tailed sandpiper
Pectoral sandpiper	Cattle egret
Dunlin	Long-billed dowitcher
Red phalarope	Short-eared owl

The following vagrant species were seen on Midway Atoll in 1988.

Sanderling
Northern shoveler
Franklins' gull
Common moorhen
Greater scaup

6. Raptors

A peregrine falcon and a short-eared owl were observed at French Frigate Shoals in December of 1988.

9. Marine Mammals

Spinner and bottlenose porpoise are regularly seen at French Frigate Shoals and Pearl and Hermes Reef.

Monk seal observations and research are described above in Section D.5.

14. Scientific Collections

Because of the many endemic and unique wildlife species found in the Hawaiian Islands National Wildlife Refuge, specimens are valuable to museums, educational institutions, and for research purposes. For specimens salvaged in fresh condition, the refuge attempts to make these available to the National Wildlife Health Center for diagnosis. Other specimens are provided to museums which make requests and have appropriate permits. During 1988, some specimens were collected for the diorama for the new Kilauea Point National Wildlife Refuge Visitor Center.

TABLE 5. RESULTS OF BI-WEEKLY SHOREBIRD CENSUS ON TERN ISLAND 1988

Species	DATE OF COUNT							
	3/22	4/01	4/15	4/29	5/15	5/31	6/24	7/12
Ruddy Turnstone	401	443	426	439	138	89	57	88
Lesser Golden Plover	38	35	38	30	16	10	9	6
Sanderling	5	7	5	9	0	0	0	0
Wandering Tattler	1	0	0	1	0	2	0	1
Western Sandpiper	1	1	2	3	1	1	1	0
Bristle-thighed Curlew	11	19*	13	20*	10	8	8	9
Dunlin	--	--	--	--	1	--	--	--

* Some curlews may have been counted twice. (Per Researcher notes).

TABLE 5. RESULTS OF BI-WEEKLY SHOREBIRD CENSUS ON TERN ISLAND (continued)

Species	DATE OF COUNT								
	8/05	8/19	9/02	9/16	10/1	10/4	10/28	11/11	11/25
Ruddy Turnstone	172	365	487	501	501	573	456	526	399
Lesser Golden Plover	13	51	120	124	128	167	79	64	70
Sanderling	--	4	2	3	2	2	1	4	2
Wandering Tattler	5	3	2	1	0	0	0	0	0
Western Sandpiper	1	1	--	1	1	1	0	0	0
Bristle-thighed Curlew	8	4	12	11	11	10	11	12	8
Dunlin	--	--	--	--	--	--	--	--	--

Bird specimens salvaged in 1988 as skins, skeletons and frozen carcasses from the Hawaiian Islands National Wildlife Refuge included: (numbers of specimens in parentheses):

Eurasian wigeon (1)	Red-footed booby (1)
Black-legged kittiwake (1)	Lesser yellowlegs (1)
White tern (1)	Herring gull (1)
Black noddy (1)	Laysan finch (2)
Franklins' gull (1)	

Bird specimens collected in 1988 from the Hawaiian Islands included: (numbers of specimens in parentheses)

Wedge-tailed shearwater (2)	White tern (1)
Red-tailed tropicbird (2)	Bristle-thighed curlew (2)
Masked booby (1)	Great frigatebird (3)
Brown booby (1)	Sooty tern (8)
Red-footed booby (1)	Laysan albatross egg (1)
Black noddy (3)	

Two heavily oiled red-footed boobies were captured in June, 1988, on Tern Island, French Frigate Shoals for rehabilitation purposes. The first bird was captured on June 16, 1988, cleaned, fed and was to be kept in a cage until it fully recovered. This booby escaped on June 22, 1988. It is not known whether or not the bird survived.

The second red-footed booby, also heavily oiled, was captured for rehabilitation purposes on June 16, 1988. The bird was cleaned, fed and released on June 23, 1988. Its survival is unknown.

A third, heavily oiled, red-footed booby, was captured on July 24, 1988, on Tern Island. This bird was sent to Sea Life Park in Honolulu to be rehabilitated. The bird was cleaned, fed and released from Sea Life Park on August 24, 1988. Its survival is unknown.

The National Marine Fisheries Service has been conducting research on "headstarting" underdeveloped pups from French Frigate Shoals by feeding these pups and transporting them and releasing them at Kure Atoll. This collecting and re-release program is described in the Research and Investigations section of this report (Sec. D.5).

15. Animal Control

Refuge staff provided technical assistance to Animal Damage Control personnel in their efforts to discourage nesting and roosting of Laysan albatross on and near airfields in Hawaii.

16. Marking and Banding

A variety of animals are marked and/or banded annually on the Refuge islands. Hawaiian monk seals are tagged as part of the monk seal research project conducted primarily by NMFS research program. Data on green sea turtles and monk seals are presented in the discussion of these projects in the Research and Investigations section (Sec.D.5).

Birds are banded as part of the refuge effort to monitor seabirds and migratory shorebirds which use refuge islands. Banding efforts focus on species which are studied as part of the seabird monitoring effort. Productivity of various age classes, age at first breeding, and other factors relating to interpretation of the reproductive parameters are measured as part of the monitoring effort. Staff of this refuge coordinated the banding program throughout the Hawaii/Pacific Complex.

Seabird banding remains a priority at French Frigate Shoals. The emphasis in 1988 was on young birds produced at Tern Island, especially those species which are monitored each year.

A summary of 1988 banding activity follows:

TABLE 6 - HAWAIIAN ISLANDS & MIDWAY ATOLL NWR BANDING TOTALS FOR 1988

Species	Nihoa	Necker	FFS	Laysan	Lisianski	Pearl & Hermes	Midway	TOTAL
Black-footed albatross	--	--	346	--	--	--	--	346
Laysan albatross	--	--	923	--	--	--	193	1161
Bonin petrel	--	--	14	--	--	--	--	14
Bulwer's petrel	--	--	1	--	--	--	--	1
Wedge-tailed shearwater	--	--	146	--	--	--	--	146
Christmas shearwater	--	--	6	--	--	--	--	6
Red-tailed tropicbird	--	--	314	--	--	--	129	443
Masked booby	--	--	118	7	55	--	--	180
Red-footed booby	--	--	753	--	--	--	--	753
Great frigatebird	--	--	96	--	--	--	--	96
Gray-backed tern	--	--	252	--	--	--	--	252
Blue-gray noddy	--	--	5	--	--	--	--	5
Brown noddy	--	--	1220	--	--	--	--	1220
Black noddy	--	--	1429	--	--	--	--	1429
White tern	--	--	32	--	--	--	--	32
Bristle-thighed curlew	--	--	4	--	--	--	--	4

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Significant recoveries of banded birds in 1988:

A black noddy banded as a local on Tern Island, French Frigate Shoals on January 28, 1988 was found entangled and dead near Funafuti Atoll in the Tuvalu Islands on November 25, 1988. This is a migration of approximately 2,100 nautical miles.

Another black noddy banded as a local on Tern Island on June 8, 1988 was evidently found at the same time as the above bird. The banding lab is being contacted to try to discover the circumstances of the entanglement.

A black noddy banded as a local on Tern Island on September 14, 1984 was shot near Nauru Island, approximately 2,300 miles away on June 23, 1987.

A black noddy banded as a local at Tern Island on June 10, 1986 was found near Nauru Island in June of 1987.

A black noddy banded as a local at Tern Island on March 25, 1984 was found dead near Nauru Island on June 23, 1987.

A sooty tern banded on East Island, French Frigate Shoals on August 21, 1966 was found dead on Johnston Atoll on January 30, 1988.

A Laysan albatross banded as a local on East Island, French Frigate Shoals on June 11, 1967 was found alive at Sand Island, Midway Atoll on April 5, 1983.

A Laysan albatross banded as a local at Tern Island on June 17, 1988 was found dead near Papua, New Guinea on September 2, 1988.

A Laysan albatross banded as a local on Necker Island on July 1, 1984 was found alive in Honolulu, Hawaii on February 8, 1988.

A black-footed albatross banded as a local at Tern Island on June 6, 1985 was found dead near Waldport, Oregon on June 12, 1988.

A masked booby banded at Kure Atoll as an SY on June 10, 1967 was found alive on Laysan Island on April 20, 1986.

Several Laysan albatross were recovered alive near airfields on the north shore of Oahu by Animal Damage Control personnel. Several of the birds had been banded at the Pacific Missile Range facility at Barking Sands, Kauai.

H. PUBLIC USE

1. General

Public use of the Hawaiian Islands National Wildlife Refuge is highly restricted because of the presence of endangered species and the high potential for introduction of exotic organisms to the fragile environment. In order to maintain public support for our programs, we attempt to keep the public informed by encouraging and assisting artists, journalists, and photographers in their effort to obtain information and photographs. This is done either at the Honolulu headquarters or by arranging for people to visit the refuge (usually Tern Island). No photography, journalism, or art permits were issued in 1988.

6. Interpretive Exhibits/Demonstrations

Refuge staff routinely provided information, leaflets and brochures to various interested groups. Refuge manager McDermond presented a talk on the "Birds of the Northwestern Hawaiian Islands" to volunteers at Kilauea Point National Wildlife Refuge.

17. Law Enforcement

Since the Hawaiian Islands National Wildlife Refuge is comprised of isolated, inaccessible islands which are closed to the public, law enforcement is not a major activity. Law enforcement in the Hawaiian Islands National Wildlife Refuge consists primarily of monitoring Special Use Permits, Migratory Bird Permits, and Endangered Species Permits issued to cooperators conducting studies on the refuge. In addition, refuge staff coordinate with the Coast Guard concerning potential illegal entry inside refuge boundaries, which they monitor by irregular aircraft and vessel patrols.

Nearly all law enforcement activities within the refuge occur at French Frigate Shoals and pertain to fishing vessels. With a permanent field station at Tern Island, the shoals can be closely monitored. Many vessels pass near the shoals, or rendezvous with other vessels in this area, as French Frigate Shoals is a half-way point for boats operating out of Honolulu.

All fishing boats observed from Tern Island are contacted by radio. They are informed of refuge boundaries and rules governing the use of the buoy before their approach in order to reduce conflicts. This method has proven effective in establishing good working relationships with the captains.

I. EQUIPMENT AND FACILITIES

1. New Construction

Construction of the block storage building at the Kapahulu warehouse facility was completed in early 1988. The paving contract let at the end of 1987 was also completed. This allowed the Refuge to vacate the older storage building which was shared with the Cooperative Fisheries Unit and move into the new building. Now each program has ample storage space. In addition the refuge has a more desirable area for preparing for field camps because of the removal of exotic weed species in the area.



Kapahulu Warehouse facility. (DKM)

2. Rehabilitation

Rehabilitation of equipment and structures is an ongoing effort at Tern Island, where low elevation (6 feet above sea level), small area (57 acres), and constant winds carrying salt spray result in much corrosion.

Renovation of a small caretakers cottage attached to the old warehouse at Kapahulu was completed this year. This project was completed by issuing purchase orders for the services of several small contractors. This facility will provide lodging for the numerous volunteers and staff who stay in Honolulu for short periods in transit to or from remote field camps and stations.



Renovated apartment attached to old storage building. (DKM)

3. Major Maintenance

Regular maintenance activities at Tern Island included scheduled servicing of the photovoltaic system (PV), diesel and gasoline generators, outboard engines, tractor, ATV, boat hoist, Boston Whalers, fresh water system, salt water system, sewage system, buildings, fuel supplies, refrigeration systems, and the runway. Also included were the servicing of fresh water cistern and saltwater pumps, water storage tanks, kitchen appliances, and shop tools.

4. Equipment Utilization and Replacement

Since the installation of the new photo-voltaic (PV) power system in late 1987, the system continued to perform faultlessly throughout 1988. Diesel generators were used for the boat hoist, cistern and saltwater pumps and the washing machine. A gasoline generator was used to run power tools in the woodshop. The system is designed to provide 3 days of electricity without input from the sun. A few times in 1988, during periods of prolonged cloudiness, the small diesel generator, incorporated in the system was used to recharge the storage batteries for the PV system.



A 17-foot Boston Whaler purchased in 1987 finally arrived at French Frigate Shoals in 1988. (DKM)

Tern Island facilities ran smoothly for all of 1988. Few major breakdowns occurred because of the newness of most of the equipment.

5. Communication System

Since Tern Island is a remote field station with the nearest assistance 500 miles away in Honolulu, radio communication is vital to the operation of the Refuge. Daily radio contact is made with the Honolulu headquarters (except on weekends and holidays). Because of its proximity to other remote island refuges, Tern Island provides radio checks with seasonal field camps at Laysan and Lisianski Islands and Pearl and Hermes Reef, and relays information to Honolulu. In addition to two, redundant, high frequency, single-side band radios, a VHF radio provides short range communication between refuge staff and fishing vessels. The radio systems were new in 1987 and continued to function with little problem during 1988. A repeater system purchased in late 1987 was not functional by the end of 1988 due to an impedance mismatch between the transmitter and antenna. This system will provide better inter Atoll communications.

Several incidents over the past few years required radio contact with the Honolulu Refuge staff outside of office hours. The U.S. Coast Guard provided assistance in reaching Service personnel at home by phone patch.

To insure this reliable means of communication, weekly radio checks with the Coast Guard were conducted on an assigned frequency. The Coast Guard is to be commended for its efforts in relaying information and establishing phone patches when needed.

7. Energy Conservation

With the change in power generation at Tern Island, during 1987, fossil fuel consumption was significantly reduced. Because of Tern Island's location, logistical problems, safety hazards associated with fuel deliveries, and government regulations, procurement and consumption of fuel have been annual concerns. Annual consumption was reduced to about 491 gallons of diesel per year down from 6,000 gallons per year. With close to 2,000 gallons of diesel fuel on hand and consumption reduced, obtaining fuel was no longer a problem. Once the current supply is depleted, the small amount of fuel required can be transported in 55 gallon drums on an opportunistic basis. This is currently how propane and gasoline are transported to the island.

8. Other

Numerous hours are spent annually in the coordination of flights and boat trips which support Tern Island. During 1988, the logistics of 16 flights were handled, including developing orders for parts and equipment, coordinating volunteers, facilitation of transportation, and shopping lists to provide adequate, economic purchases of supplies for resident staff, visiting Honolulu staff, technicians and volunteers. Two of the flights were funded by the NMFS, one by the National Weather Service, one by the Army Corps of Engineers, and one flight was a private flight by an aircharter contract bidder.

The Refuge was still without a flight service contract for Tern Island at the beginning of 1988. Flight Service was obtained through a rental agreement with Scenic Air Tours which used a Beach-18 to perform the job. This plane provided a payload of 800 pounds for Service personnel and supplies at a cost of approximately \$6,500 per round trip flight. This was more than twice the cost of service under the previous OAS contract with Hawaiian Sky Tours. In addition Scenic Air Tours charged a total cost of two round trip flights when asked to remain overnight. Needless to say, costs were excessive under the rental agreement, especially when considering the decrease in payload from the previous air service.



Rental aircraft departs Tern Island. (KRN)

Three attempts were made through OAS solicitations, starting in September of 1987, to obtain air service more reasonable in cost and capacity. The first two solicitations were terminated. The first due to the two bidders inability to meet the requirements of the contract. The second solicitation resulted in the same two bidders. This time the lower bidder didn't meet the specifications, the second lowest bidder's price was deemed excessive. The third solicitation was issued in July of 1988 with opening scheduled for August. Several amendments to this solicitation eventually pushed the opening date to December 10th. At the end of the year three bids had been received and were being evaluated.

The Refuge Manager and Assistant spent inordinate amounts of time over the course of 1988 attempting to obtain safe and cost effective air service for the Tern Island operation. Significant impediments to reaching this goal were the uniqueness of the mission, lack of long range aircraft in Honolulu, and difficulties in coordinating with a 2nd party agency, OAS.

Repeated contacts with fishing and research vessels were necessary to arrange transport of personnel, nonperishable foods and heavy items to the island. The NOAA vessel TOWNSEND CROMWELL continued to provide free transport of supplies, food, fuel, equipment, personnel and correspondence.



R/V TOWNSEND CROMWELL offloads equipment to Service whaler at French Frigate Shoals.
(KRN)

The F/V FERESA also made several stops at Tern Island to deliver mail, personnel, and other supplies in 1988.

J. OTHER ITEMS

4. Credits

This narrative was prepared by Lynn Denlinger, Stewart Fefer, and Ken McDermond.