

HAWAIIAN AND PACIFIC ISLANDS NATIONAL WILDLIFE REFUGE COMPLEX

TRI-ANNUAL NARRATIVE REPORT

Calendar Years 1978-1980

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

PERSONNEL (1978-1980)

1. John Andre	Ass't. Refuge Manager GS-7 (CS)	EOD 3/9/80 (Tern)
2. Noreen Bautista*	Clerk-Typist GS-3 (PTT)	EOD 10/1/79 (Kauai)
3. Gordon Black	Maintenance Worker WG-6 (CS)	Term. 9/20/80 (Honolulu)
4. Barry Brady	Ass't. Refuge Manager GS-9 (PFT)	EOD 10/8/78 (Honolulu) 8/28/80 (Kauai)
5. G. Vernon Byrd	Ass't. Refuge Manager GS-9 (PFT)	Term. 4/20/80 (Kauai)
6. Richard Coleman	Wildlife Biologist GS-9 (PFT)	(Honolulu)
7. Elisabeth Cummings*	Ass't. Refuge Manager GS-11 (PFT)	EOD 11/6/80
	Ass't. Refuge Manager GS-11 (PFT)	EOD 1/15/78 (Honolulu)
8. J. Brent Giezentanner	Refuge Manager GS-12 (PFT)	Term. 12/15/80
9. Jon Gravning*	Ass't. Refuge Manager GS-7 (CS)	Term. 8/12/79 (Honolulu)
10. Tokumatsu Gushiken*	Maintenance Worker WG-7 (Int.)	EOD 3/23/80 (Tern)
11. Craig Harrison	Wildlife Biologist GS-11 (CS)	Term. 9/21/80 (Kauai)
12. Eric Knudtson	Bio. Tech. GS-5 (Temp.)	(Honolulu)
		EOD 2/11/79 (Honolulu)
		Term. 10/31/79
		EOD 4/28/80
		Term 6/27/80
13. Gerald Ludwig	Ass't. Refuge Manager GS-11 (PFT)	EOD 2/24/80 (Honolulu)
14. Daniel Moriarty	Bio. Tech. GS-5 (Temp.)	EOD 8/27/78 (Kauai)
	Maintenance Worker WG-6 (CS)	EOD 10/5/80
15. Maura Naughton	Bio. Tech. GS-5 (Temp.)	EOD 2/25/79 (Honolulu)
		Term. 12/15/79
	Ecologist GS-5 (CS)	EOD 1/21/80
16. Audrey Newman	Bio. Tech. GS-5 (Temp.)	EOD 2/25/80
		Term. 10/5/80 (Honolulu)
	Ecologist GS-7 (Temp.)	EOD 12/28/80
17. Doris Ray*	Clerk-Typist GS-3 (Temp.)	Term. 2/2/78 (Honolulu)
18. Robert Schulmeister	Ass't. Refuge Manager GS-9 (CS)	EOD 8/26/79 (Tern)
19. Robert Shallenberger	Supv. Wildlife Biologist GS-12 (PFT)	EOD 3/5/80 (Honolulu)
20. Elizabeth Winstedt	Administrative Clerk GS-5 (PFT)	(Honolulu)
21. David Woodside	Maintenance Worker WG-6 (CS)	EOD 11/30/80 (Honolulu)
22. Yvonne Wright	Refuge Clerk GS-5 (PFT)	EOD 5/20/79 (Honolulu)
23. Susan Schulmeister	Volunteer	(Tern)
24. Ruth Ittner	Volunteer	(Tern)

*Not shown in photos on following pages.

Review and Approvals


Submitted By _____ Date 4/20/82


Regional Office Review _____ Date 4/27/82

(sgd) Dale T. Coggeshall

APR 20 1982

Area Office Review

Date

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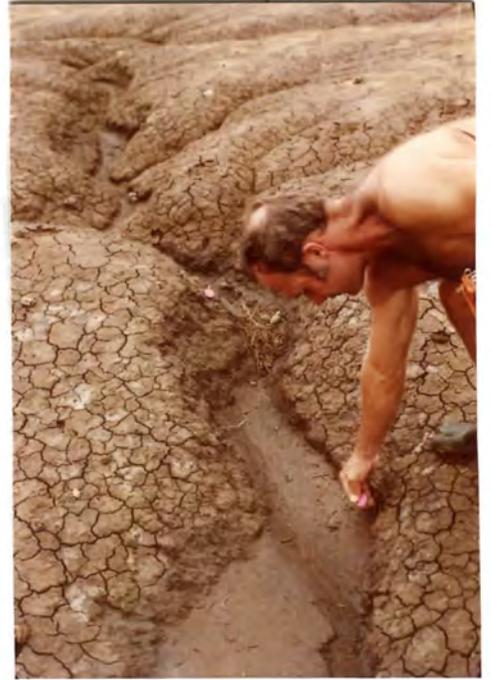


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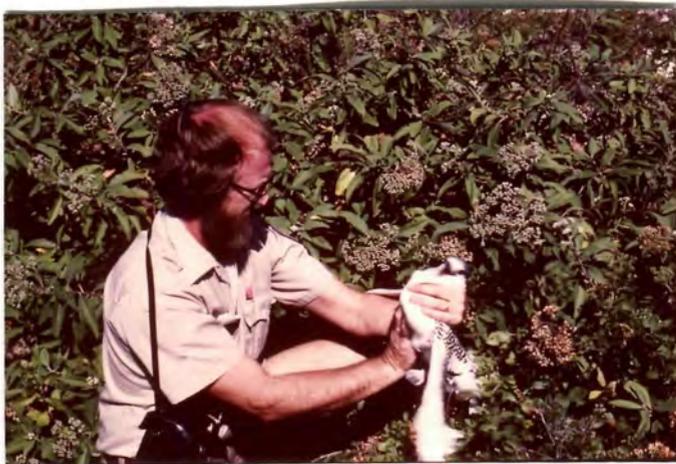
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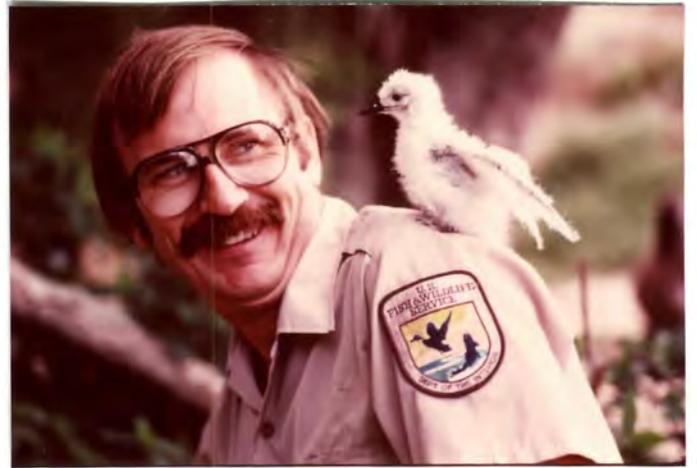


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Organizational Chart as of 12-31-80
Refuges and Wildlife Resources

Supervisory Wildlife Biologist
Dr. Robert J. Shallenberger
GS-486-12/13 (PFT)

Refuge Clerk
Yvonne L. Wright
GS-301-5 (PFT)

YACC Clerk Typist
Sheila Mendoza

Wildlife Biologist
Craig Harrison
GS-486-11 (CS)

Ecologist
Maura B. Naughton
GS-408-7 (CS)

Ecologist
Audrey L. Newman
GS-408-7 (FTT)

Refuge Manager (Wetlands)
Dr. Richard A. Coleman
GS-485-11 (PFT)

Maintenanceman (Oahu)
David Woodside
WG-4749-6 (CS)

Refuge Manager (Kauai)
Barry Brady
GS-485-9 (PFT)

Youth Programs
YACC Park Workers (3-4)
YCC Enrollees 1

Maintenanceman (Kauai)
Daniel Moriarty
WG-4749-6 (CS)

Clerk Typist (Kauai)
Noreen Q. Bautista
GS-322-4 (PFT)

Refuge Manager (Remote Is.)
Gerald M. Ludwig
GS-485-11 (PFT)

Refuge Manager (Tern Is.)
Robert P. Schulmeister
GS-485-9 (CS)

Refuge Manager (Tern Is.)
John B. Andre
GS-485-7 (CS)

Refuge Manager (Tern Is.)
Jon V. Gravning
GS-485-7 (CS)

1 When in operation

HAWAIIAN AND PACIFIC ISLANDS NATIONAL WILDLIFE REFUGE COMPLEX

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A. HIGHLIGHTS

This complex is made up of 11 National Wildlife Refuges and one Wildlife Administrative Site. Five wetland refuges on Oahu, Kauai and Molokai are inhabited by endangered water birds unique to the Hawaiian Islands and by a variety of migratory waterfowl and shorebirds that visit Pacific islands during winter months. Six remote island refuges in Hawaii and the Central Pacific support literally millions of breeding seabirds, unique land birds and a variety of other marine species including endangered seals and turtles that inhabit extensive nearshore reefs and lagoons. The twelfth unit within the complex is the Kilauea Point Wildlife Administrative Site on Kauai. This site provides habitat for several resident seabird species and doubles as the Service's primary visitor interpretation site and Kauai refuge office. The Complex is administered from within the Honolulu Area Office in the Federal Building.

Highlights for the 1978-1980 period on wetland refuges included the initiation of major BLHP habitat development projects at Hanalei NWR, James Campbell NWR and Pearl Harbor NWR. The Hanalei project, when completed, will involve major rehabilitation of the water delivery system, permitting a near doubling of taro lands. The James Campbell NWR project, initiated in late 1980, will rehabilitate additional impoundments and install new pumps and water control structures to permit effective habitat manipulation for endangered water birds. At Pearl Harbor NWR, a BLHP equipment rental contract enabled habitat improvements including nesting islands, a perimeter moat and new impoundment construction. A recording water level guage was installed at Kakahaia NWR and water bird use was monitored, but no major habitat development was initiated.

Among the remote island NWR's, most personnel time was focused on the Hawaiian Islands NWR. A Tripartite Cooperative Agreement between the Service, National Marine Fisheries Service and the State of Hawaii was signed in 1978. This Agreement resulted in the initiation of a comprehensive resource investigation in the Northwestern Hawaiian Islands, including lands and waters of the Hawaiian Islands NWR. A mid-point symposium on research results was held in April, 1980. The Service also took occupancy of the former Coast Guard facility at Tern Island, French Frigate Shoals, when the LORAN station was decommissioned in July, 1979. Service refuge staff were hired to operate the facility on a rotational basis. Refuge activities on the Central Pacific NWR's was limited to infrequent field surveys. Logistical constraints continue to hinder effective management of these areas. The American Samoa Government has expressed interest in harvest of clams at Rose Atoll NWR, so cooperative field surveys to investigate marine resources were initiated in 1980. At Johnston Atoll NWR, continuing coordination with the Defense Nuclear Agency included planning for onsite interpretive exhibits. Baker, Howland and Jarvis NWR's were visited at least once each year. Efforts to control feral cat populations, particularly on Jarvis, were accelerated.

Kilauea Point Wildlife Administrative Site drew considerable attention during this period with the design of a BLHP funded interpretive exhibit, to be installed during 1981. With the help of a new YACC program and summer YCC camps, Kauai refuge staff were able to complete major landscaping, remodeling and seabird research projects.

C. LAND ACQUISITION

During the 1978-1980 period, Refuge staff were involved in acquisition studies for three areas of prime wildlife value in the State of Hawaii. Kealia and Opaepa ponds are wetland areas of major importance to endangered water birds, particularly Hawaiian stilt. Midway Atoll, located northwest of the Hawaiian Islands National Wildlife Refuge, supports a large population of breeding seabirds and remnant populations of threatened green turtles and endangered Hawaiian monk seals. The following narrative explains progress made on these acquisition studies during the 1978-1980 time period:

Kealia Pond

Background. Efforts to acquire Kealia Pond from A&B were initiated in 1971 when Director Greenwalt approved the appraised price of \$502K for acquisition of 747 acres of endangered and migratory bird wetlands. Delays in acquisition occurred as a result of stalemated negotiations due to price differences and undetermined locations of several Kuleanas.

1978. The Kuleana concerns, regarding undetermined locations of land within Kealia Pond, were resolved and the original appraisal of \$502K was revised to \$3.2M for 500 acres. A draft EIS was completed after which opposition arose from the County of Maui, who opted for harbor development, and G.A.O. and the State, who objected to Federal purchase. G.A.O. recommended cessation of Federal acquisition as according to them the acquisition was not consistent with the Service's criteria relating to the SE program. Acquisition was delayed pending resolution of the problems.

1979. Efforts to acquire Kealia Pond continued. Objections of G.A.O. in 1978 to Federal acquisition of Kealia Pond were rebutted by Secretary Joseph and acquisition efforts continued. However, A&B's new reappraisal of the 500A at a value of \$4.5M exceeded the Service's appraisal price by \$1.3M. Therefore, negotiations on a settling price were delayed. Although the State indicated a desire to purchase the Pond, budgetary restraints prevented their action from materializing.

1980. Biological data continued to be gathered in 1980, justifying preservation of the area for endangered water birds. Numerous State/Federal coordination meetings occurred that resulted in the consummation of a Cooperative Federal/State Habitat Protection Agreement on Sept. 5, 1980.

This agreement opened the way for joint acquisition efforts whereby Federal acquisition would commence with the State option to purchase when funds became available. Reappraisals of the Pond area (500A) were undertaken by both the Service and A&B that resulted in a wide discrepancy of land values. The Service's appraised value for 500 acres was \$3.3M while A&B's appraisal was \$14.5M. The excessive difference in appraisals, \$11.2M, resulted in delaying acquisition although \$4.5M of Service funds were available.

Opaeula Pond

Background. An agreement of purchase for Opaeula Pond was executed on June 4, 1976 for the purchase of 32.22 acres of endangered water bird habitat from Bishop Estate for \$532K. The agreement was subject to Service acquiring all necessary permits.

1978. Applications were made for the required State and County of Hawaii regulatory permits for acquisition and development of Opaeula Pond. Approval of the Small Management Area (SMA) permit was obtained on February 16, 1978 and that for a road variance on April 13, 1978. However, both permits were subject to approvals of a Conservation District Use Application (CDUA) for a land subdivision and government use permit. Delays in acquiring the CDUA permit occurred when the State, as a result of the recently passed CZM plan, required the Service to prepare an EIA. Limited time prevented initiation of an EIA.

1979. Coordination with the State Department of Land and Natural Resources occurred concerning review of additional alternatives to Federal acquisition for Opaeula Pond. Efforts commenced to develop a Federal/State Cooperative approach for natural resource protection of the area.

1980. Federal/State coordination continued throughout the year in developing a cooperative approach to preservation of Opaeula Pond. A draft Habitat Protection agreement was completed and directed to the State on April 21, 1980. Additional meetings were held with Bishop Estate personnel concerning extension of time to December 31, 1980 for the County subdivision variance permit. Although an extension of time was granted, the permit was voided at the end of the year as a result of non-completion of the State/Federal Cooperative Agreement. As a result of delays in obtaining the required State permits, causing further delays in acquisition, Bishop Trustees terminated the 1975 agreement of sale for \$532,000.

Midway Atoll

Background. Midway Atoll, under the administration of the United States Navy, has always been recognized as an important atoll for wildlife

including migratory birds, monk seals and green sea turtles. In July, 1972, a cooperative Service/U.S. Navy agreement was signed for the conservation and management of fish and wildlife on the island. The agreement continues to be in effect.

1978. Discussions commenced with the Midway Navy Command in April concerning the possibility of obtaining refuge status for Sand and Eastern Islands. The need for additional island wildlife protection was brought about as a result of the Navy's plan to reduce operations and the State's proposal to establish a commercial fishing station on the island under a one-year Naval trial permit. A draft cooperative agreement for a NWR overlay was submitted to the Regional Director for approval and meetings were held with the Navy to encourage support. Coordinating efforts continued throughout the year.

1979. The 1978 Midway refuge overlay proposal and agreement with the Navy was delayed in consideration of additional refuge alternatives. Two of the new alternatives involved a revision of the Sikes Act agreement, however, NWR overlay status was deferred until results of the Tripartite Study were in, jurisdiction questions regarding HINWR boundaries were adequately addressed, and a comprehensive resource management plan was developed for the Hawaiian Islands NWR. Data collection was initiated regarding the foregoing concerns.

1980. Coordination continued with the U.S. Navy concerning impacts on wildlife of the military's operational scale-down plan and the State's proposed development of a long-term fishing supply station on Midway. Data were compiled while developing additional alternatives for the long-range protection of island wildlife.

D. PLANNING

1. Master Plan

MKGG/Yamamoto, Inc. was contracted in September, 1978, to develop a Master Plan for five NWR's on the main Hawaiian Islands (excluding Pearl Harbor NWR). Despite numerous conferences with refuge and RO personnel, the fourth and final draft, submitted to the Service in September, 1979, was a very poor quality document. The many factual errors and poor editing of this report rendered it useless for public review. A supplementary Master Plan for all five wetland refuges (excluding the Kilauea Point Wildlife Administrative Site) was initiated in November, 1980. Vernon Byrd, former Assistant Refuge Manager (Kauai), was detailed to Honolulu for three weeks to work on the first draft of this plan. A final master plan for these wetland refuges is expected to be finalized in 1982.

E. ADMINISTRATION

1. Personnel

Major changes in refuge personnel occurred during the 1978-1980 period. Increases in staffing occurred as a result of (1) expansion of the Tripartite research effort in the Hawaiian Islands National Wildlife Refuge, (2) increasing visitor demand and habitat development projects on Kauai and (3) establishment of a Service operated facility on Tern Island, French Frigate Shoals.

Refuges and Wildlife Resources (RWR) staffing was reorganized in 1980 to accommodate increasing work loads and facilitate personnel management. The principal change involved splitting of the one primary assistant refuge manager position in the Honolulu office into two parallel positions for Remote Islands and Wetlands. The Refuge Manager position was changed to Supervisory Wildlife Biologist. In the reorganization, Tern Island staff were placed under the Assistant Refuge Manager (Remote Islands) and the Kauai staff under the Assistant Refuge Manager (Wetlands).

The following chart summarizes the staffing changes which have occurred between FY76-FY80:

	<u>C/S</u>	<u>Permanent</u>		<u>Temporary</u>	<u>Total</u>
		<u>Full-Time</u>	<u>Part-Time</u>		
FY76		4	1		5
FY77	1	3	2	1	7
FY78	1	5	3	1	10
FY79	5	5	1	3	14
FY80	5	5	1	4	15

2. Funding

The following table summarizes funding for Refuges and Wildlife Resources between FY76-FY80. Additional narrative explains the funding changes which occurred during the period.

<u>FY</u>	<u>Total Staff</u>	<u>1210</u>	<u>1210 (O&M)</u>	<u>1220</u>	<u>1230</u>	<u>1240</u>	<u>1400</u>	<u>Total</u>
76	5	32.0				16.1	85.7	133.8
77	7	47.0	16.8			20.0	96.3	180.1
78	10	104.0	9.0			10.1	108.0	231.1
79	14	117.0	122.0			13.5	100.5	353.0
80	15	117.0	190.0	10.0		13.5	100.5	431.0

- FY76: Base funding for 1210 was 12.7K, augmented by 0.3K in March and 19K in August. 1400 base funding was 99.0K: 1.7K pay act was added in March and a total of 16.7K was withdrawn in August. 1240 base funding was 19.1K with 3K withdrawn in September.
- FY77: Base funding in 1210 was 47K, augmented by 1.8K pay act and 15K BLHP O&M added in June. 1400 base funding was 96.3K with 1.7K pay act added in June. 1240 base funding was 10K with 10K BLHP O&M added in June.
- FY78: Base funding for 1210 was 104K with 4K pay act and 5K refuge "add-on" added in June. 1240 base funding was 9.8K with 0.3K pay act added in June. The substantial increase in 1210 was to initiate Service involvement in the Tripartite cooperative studies. A wildlife biologist was hired to conduct this work.
- FY79: Base funding for 1210 was 113K, augmented by 4K pay act in July. 1210 (one time O&M) was 142.0K to cover a proposed cat eradication trip to Jarvis NWR (21K), rehab of the Kapahulu warehouse (30K), and Tern Island station start up costs (81K). This total was decreased by 20K in August because Kapahulu work was not done. 1240 base funding was 10.1K, 3K cyclic maintenance added in January and 0.4K pay act added in August. 1400 base funding was 100.5K.
- FY80: 1210 base funding was retained, including funds for Tripartite research staffing/O&M. Anticipated O&M for 1921 (reimbursables MB) of 11,760 (NMFS share of boat charter) received in July. Substantial increase in 1210 one time O&M to permit additional staffing and O&M funds for Tern Island station. 1220 funds of 10K transferred from AO in August to cover Sikes Act work with military agencies.

In the Complex, migratory bird funding (1210) has been directed primarily at the management of remote island refuges while endangered species funding (1400) focused on the operation of wetland refuges for endangered water birds. Increases in 1210 funding associated with the Tripartite commitment in the Hawaiian Islands NWR reflect our primary research focus on resident seabirds. Although initial start up funding for the Tern Island station came from the 1210 account, the station also performs an important function in the management of threatened (green turtle) and endangered (monk seal) species. For this reason, costs of station operation should appropriately be shared between the migratory bird and endangered species accounts.

3. Safety

Safety items of interest that are specific to individual refuges are

addressed in later sections of this narrative report.

Classes in cardio-pulmonary resuscitation (CPR) were attended by RWR staff members in Honolulu in November, 1980.

Assistant Refuge Manager (Remote Islands) Gerald Ludwig was appointed as a RWR representative to the AO safety committee in 1980.

4. Technical Assistance

Refuges and Wildlife Resources staff played a substantial technical assistance role during the 1978-1980 period. Assistance activities involving refuges are discussed in later sections of the report. Technical assistance off refuge lands and waters involved military installations (Sikes Act), state agencies, county agencies and private citizens. Technical assistance to Ecological Services (Honolulu AO) was provided upon request in the form of input and review to Corps permit applications, environment impact statements and other documents.

Principal areas of technical assistance during the 1978-1980 period are summarized below:

Technical Assistance (1978-1980)

<u>Location/Agency(ies)</u>	<u>Project</u>
(1) Kaneohe Marine Corps Air Station (U.S. Marine Corps, Hawaii Dept. Land & Natural Resources)	Cooperative wildlife management including wildlife survey, breeding bird studies, banding, habitat development, predator control, etc. Also assisted in seabird management and review/development of base management plans. In 1980, assisted in rerouting of training access road to minimize disturbance to endangered water birds. Eggs of doomed stilt nests collected and hatched in captivity.
(2) Midway Atoll (U.S. Navy)	Cooperative wildlife management pursuant to signed coop agreement. Included wildlife surveys, disease investigation, law enforcement, wildlife information, etc.

<u>Location/Agency(ies)</u>	<u>Project</u>
(3) Kaula Island (U.S. Navy, Hawaii DLNR)	Cooperative studies of seabirds to evaluate effects of military bombing and other activities. Included documentation of population, breeding status, phenology, etc.
(4) Kure Atoll (U.S. Coast Guard, Hawaii DLNR, Natl. Marine Fisheries Service)	Assisted in wildlife management program through survey of seabird populations. Coordination of actions to minimize disturbance to monk seals.
(5) Northwestern Hawaiian Isl. (Hawaii DLNR, NMFS, Sea Grant)	Cooperation in implementation of Tripartite Agreement to assess fish and wildlife resources in the NWHI. Provided resource data, logistical support (i.e. Tern Island station), field camp management and other assistance. Participated in April, 1980 Tripartite research symposium and on Tripartite Coordinating Council.
(6) Honolulu Zoo. (Hawaii DLNR)	Captive hatching and rearing of Hawaiian stilt eggs taken from doomed nests at several locations. Testing of auxiliary markers.
(7) Statewide (Hawaii DLNR)	Cooperated in banding and auxiliary marking of Hawaiian water birds. Also conducted semiannual water bird censuses together with State biologists.
(8) Hawaii (DLNR, NMFS)	RWR staff participated as members on Hawaiian water bird and Hawaiian monk seal recovery teams.
(9) Tern Island (U.S. Coast Guard)	Before the Coast Guard LORAN station was decommissioned, in July, 1979, RWR staff provided tech. assistance in wildlife management and station operation.

<u>Location/Agency(ies)</u>	<u>Project</u>
(10) French Frigate Shoals (U.S. Coast Guard, NMFS, Hawaii DLNR, EPA)	RWR participated on Regional Response Team during salvage of grounded freighter at FFS in April-May, 1980. Staff assisted on site with logistical support.
(11) Johnston Atoll (Defense Nuclear Agency, U.S. Coast Guard)	RWR staff assisted on site military personnel in wildlife management, review of military activities, wildlife information, etc.
(12) American Samoa (Office of Marine Resources, ASG)	RWR staff cooperated with ASG staff in review of fishery proposals for Rose Atoll NWR, law enforcement, information and education.
(13) Lowe Aquafarm (Campbell Estate, Lowe, Inc.)	RWR staff assisted in the study and control of migratory birds that were impacting prawn farm production.

5. Other Items

Refuge and Wildlife Resources staff have played a dual administrative role since establishment of the Honolulu Area Office. Refuge headquarters are located within the AO in the Federal Building in Honolulu. AO staffing (3) has been inadequate to handle the volume of AWP reporting and other tasks without substantial support from RWR and ES staff. Project leaders, in particular, have worn two hats. Not surprisingly, this dual role has impacted the ability of refuge staff to keep up with the normal volume of work involved in the operation and management of 12 refuges and other technical assistance roles.

J. OTHER ITEMS

1. Cooperative Programs

The primary cooperative program underway during the 1978-1980 time period was the Tripartite Cooperative Study, pursuant to an agreement signed by FWS, National Marine Fisheries Service and the Hawaii Dept. of Land and Natural Resources in May, 1978. This agreement calls for a five year cooperative study of fish and wildlife resources in the Northwestern Hawaiian Islands (see Hawaiian Islands National Wildlife Refuge).

Cooperative programs were also underway with State biologists, involving banding, auxiliary marking and the semiannual statewide census of resident and migratory water birds. Cooperative programs with National Marine Fisheries Service focused on support for turtle and monk seal research in the Northwestern Hawaiian Islands.

During this period, the Service also began an investigation of the feasibility of a Cooperating Association for the Kilauea Point Wildlife Administrative Site (see individual narrative report).

2. Items of Interest

In reward for exceptional performance during the 1978-1980 period, the following RWR employees received special achievement awards or quality step increases:

Daniel Moriarty	Special Achievement	April, 1980
Robert Schulmeister	Special Achievement	January, 1980
Robert Shallenberger	Special Achievement	October, 1980
Elizabeth Winstedt	Quality Step Increase	July, 1978

Assistant Refuge Manager Gerald Ludwig proved his photographic skills in the Service photo competition in 1980 when he won 2nd Place in the General category and 3rd Place in the Public Use category.

3. Credits

Virtually all RWR staff contributed in one way or another to the completion (albeit late) of this narrative report. The unfortunate delay in completion of the 1978 and 1979 reports was aggravated by an extended period in which several positions, including the Refuge Manager slot, were unfilled. This also resulted in a substantial turnover of staff with the obvious result that by mid-1980 very few of those on board were familiar enough with the 1978-1979 period in order to provide substantive detail. Nevertheless, the combined efforts of many finally made it possible. The principals included Elizabeth Cummings, G. Vernon Byrd, Barry Brady, Richard Coleman, Gerald Ludwig, Yvonne Wright, Shirley Hernandez and Robert Shallenberger.

Photo credits are indicated by initials.

Hawaiian and Pacific Islands NWR Complex

Tri-annual Narrative Report
1978-1980

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HANAIEI NATIONAL WILDLIFE REFUGE

Hanalei, Kauai, Hawaii

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16. Other Non-Wildlife Oriented Recreation	NTR
17. Law Enforcement	10
18. Youth Programs	10
19. Cooperating Associations	NTR
20. Concessions	NTR
21. Volunteers Program	NTR

I. EQUIPMENT AND FACILITIES

1. New Construction	10
2. Rehabilitation	NTR
3. Major Maintenance	NTR
4. Equipment Utilization and Replacement	NTR
5. Communications Systems	NTR
6. Energy Conservation	NTR
7. Other	NTR

J. OTHER ITEMS

1. Cooperative Programs	Complex
2. Items of Interest	Complex
3. Credits	Complex

K. FEEDBACK

NTR

A. HIGHLIGHTS

Over 80 acres of noxious hau trees were removed from the refuge along the Hanalei River during the 1978-1980 period. This major undertaking resulted in reclaiming potential endangered species habitat and diminishing a flood hazard. A new water delivery system for the taro farming operation on the refuge was designed in 1978 and a partial contract for its construction was awarded in December, 1980. The new water delivery system will increase endangered species habitat on the refuge by providing more water for taro farming and other wetlands.

The refuge staff expanded during the period from one assistant refuge manager, who was in charge of all three refuges on Kauai (Huleia, Kilauea, and Hanalei), to a three-person crew (clerk, maintenance worker and manager). A YACC camp was established in 1978, and it was active throughout the reporting period.

The opening scene of the motion picture "Raiders of the Lost Ark" was filmed along the eastern boundary of Hanalei NWR in September, 1980. The USFWS was acknowledged in the film credits of this movie.

B. CLIMATIC CONDITIONS

The nearest weather recording station, Princeville Ranch, is located approximately ½ mile north of the refuge. The following station summary for the period 1978-1980 reflects the climatic conditions at the refuge:

	<u>Average</u>	<u>1978-1980</u>
Temperature	(see Kilauea Pt.)	<u>Extremes (dates)</u>
Rainfall	80"	-

D. PLANNING

4. Compliance with Environmental Mandates

Wilson Okamoto and Associates, Inc. was contracted in September, 1978, to design alternative water delivery systems to irrigate wetland taro fields on the refuge. A new system was needed to replace the decaying 2 miles of an ancient open ditch system and increase water available for expansion of taro fields. This contractor also drafted the final EA on the alternative system selected (IV) (March, 1980) and the complete set of engineering drawings for the project (July, 1980).

The Bernice P. Bishop Museum was contracted in May, 1979, to conduct a surface reconnaissance of archaeological features on the land that would be disturbed by the construction of the new water delivery system. The scope of this contract was subsequently expanded to include areas in which hau clearing by heavy equipment was necessary. The results of this study were presented in a report entitled: "Archaeological Investigations in Specified Areas of the Hanalei Wildlife Refuge, Hanalei Valley, Kauai" by A. Rose Schilt (October, 1980).



HAL-1 - Old Hawaiian aquaduct located between existing taro fields at Hanalei NWR. BGB

A Section 7 consultation on the new water delivery system was requested in July, 1979. A biological opinion, issued on October 31, 1979, stated that the new water delivery system and habitat enhancement project would promote the conservation of the endangered Hawaiian water bird.

5. Research and Investigations

a. Aquatic Habitats/Food Sources for Endangered Water Birds

Bob Broshears, a University of Hawaii graduate student in the Cooperative Fisheries Unit, began a ten month study in July, 1978, on the ecology of aquatic invertebrates in the taro fields at the refuge. Results indicate that the benthic fauna involved in the endangered water bird food chain are richest in taro fields from

post harvest to replanting if the fields are not dried out. Drying apparently kills the benthic fauna which must gradually repopulate when fields are reflooded.

Dan Moriarity, then biological technician on Kauai, conducted a study of habitat utilization by endangered water birds concurrently with Broshear's study. Hawaiian stilts and coots feed primarily in open, wet taro fields. Hawaiian gallinules and ducks use these fields too but are often found near more mature taro which provides cover. Stilts apparently eat mostly animals, while coots and gallinules also take plants! Few observations of feeding koloa (Hawaiian duck) have been made.

Their reports entitled: "Aquatic Habitat and Aquatic Food Sources for Endangered Water Birds at Hanalei National Wildlife Refuge" (October, 1978, January, 1979) are on file at the refuge office.

b. Hawaiian Gallinule Nesting Ecology

The nesting ecology of the endangered Hawaiian gallinule was investigated throughout the period by the assistant refuge manager and the temporary biological technician. Flooding of nests was found to be the major cause of mortality. By building water control structures at appropriate places in the irrigation system, this flooding could perhaps be reduced. A paper describing this study was submitted to Western Birds: Byrd, G. V. and C. F. Zeillemaker (in press) "The Ecology of Nesting Hawaiian Common Gallinules at Hanalei NWR, Hawaii".



HAL-2 - Hawaiian gallinule in taro field at Hanalei
NWR. CFZ

E. ADMINISTRATION

3. Safety

No staff injuries occurred during the period, but three minor injuries occurred to YACC enrollees. Weekly safety lectures were given to youth program enrollees.

F. HABITAT MANAGEMENT

1. General

This 917 acre refuge consists of river bottom land, taro farms and wooded slopes in the northern end of Hanalei Valley. The primary wetland habitat is taro fields (120 acres) which are located on both sides of the Hanalei River. The river flows north through the middle of the refuge providing additional wetland habitat. Some of the 298 acres of grassland which surround the taro fields will eventually be converted to taro fields. The forested slopes (458 acres) along most of the refuge perimeter provides an excellent buffer zone for the wetland.

4. Croplands

Hanalei NWR was established for endangered water birds, and the overall plan has been to provide as much wetland habitat as possible. The traditional aquatic taro farming has been retained on a permit basis, because taro provides excellent habitat for water birds. During the period 1978-1980 emphasis was placed on enforcing conditions of special use permits, e.g. use of herbicides limited to those authorized by the Service, taro plants left for cover around gallinule nests found by farmers during harvest, control of pets, etc. In addition, considerable efforts were made to insure that the farmers actively cultivated taro on all of their assigned acreage.

7. Grazing

Since the refuge was created, 3 grazing permits, totalling 163 acres, have been issued to control vegetation in dry areas. Permittees have been told annually that when the development of a new water system is complete, areas that can be used for wetland agriculture and other wetland habitats will be gradually removed from grazing land.

10. Pest Control

A species of Hibiscus called hau, growing in dense stands along the Hanalei River, created additional flooding problems on the refuge. The tree branches extended into the Hanalei River and restricted its flow. This compounded the frequent river flooding into the nearby taro fields, and after flooding occurred the hau tended to act like a dam and keep

flood waters in fields longer than usual. In addition, potential water bird habitat was covered by this tree species. In 1978 and 1979 a D-9 Caterpillar was rented and the YACC enrollees worked with the Caterpillar operator and refuge maintenance worker to clear over 80 acres of dense hau stands.



HAL-3 - D-9 Caterpillar clearing dense hau trees next to Hanalei River. GVB

Other pest control activities involved live-trapping feral dogs and cats which prey on water birds. The YACC enrollees and refuge maintenance worker kept traps set 5 days per week for most of 1978, and after initially capturing 5 cats and 3 dogs, the success rate decreased markedly. Presumably this indicated a significantly reduced population of predators. Only incidental trapping efforts were made in 1979-1980 due to staff time constraints.

G. WILDLIFE

2. Endangered and/or Threatened Species

Population data were gathered weekly for the four endangered species found on the refuge; Hawaiian duck, gallinule, coot, and stilt.

Hawaiian Duck - This species is difficult to count for several reasons. There apparently is diurnal movement, perhaps to mountain streams off the refuge during days, but back to safe roosting areas (like the refuge) during the night. Also birds tend not to form large flocks so scattered individuals near dense cover are difficult to detect. As a result, refuge counts are of questionable accuracy. There was no clear population trend during the period, but refuge populations tended to be higher in winter than in summer. Up to 79 birds were seen on the refuge, but counts averaged 15-40 birds.

Hawaiian Gallinule - Gallinules are relatively secretive and therefore difficult to count. Peak counts were 64, but average counts were 20. Population estimates are 80-100 birds on the refuge. Nesting attempts, also difficult to monitor in the dense taro patches, were estimated to produce 40-50 young per year.

Hawaiian Coot - In wet winters this species apparently moves from Kauai to Niihau Island (30 km to the west) where ephemeral habitats are usually flooded by winter rains. In dry winters the species remains at Hanalei where it spends the summers. The period 1978-1980 included one dry (1978) and two wet winters (1979-1980). The average coot population was 90 birds. No coot nesting attempts have been observed on the refuge.

Hawaiian Stilt - Like the coot, the stilt is believed to migrate to Niihau during wet winters. During the period 1978-1980, summer populations averaged 95 stilts. Nesting at Hanalei was restricted to narrow dikes between taro fields. In 1978 and 1980, 4 or 5 nests were found on the refuge. However in 1979, 12 stilt nests were recorded, most of those were in two fields that had been disced and left dry just prior to the start of the nesting season (April). Experimental artificial nesting structures were put in several taro fields in March, 1978. None of these structures were used for their intended purpose.

3. Waterfowl

In addition to the native Hawaiian duck, incidental sightings of migratory waterfowl have included Northern shovelers (4-10), pintails (5) and a cinnamon teal.

4. Marsh and Water Birds

Black-crowned night herons occurred regularly on the refuge during the period. Counts ranged up to 35, but the average was 20 herons. The heron is known to take chicks and eggs of other birds, and there is a possibility that it preys on endangered gallinules (the only common nester on the refuge of the four endangered species). The clearing of hau (see Pest Control Section) in which herons roost, may reduce their population.

5. Shorebirds, Gulls, Terns and Allied Species

Approximately 80-100 American golden plover winter at Hanalei NWR each year. Migratory shorebirds include wandering tattler (4-10 birds), a greater yellow legs, common snipe (2) and dowitcher.

In late May, 1978, an injured dark-rumped petrel was found on Hanalei NWR. This is one of very few records for Kauai.

11. Fisheries Resources

The aquatic fauna in Hanalei National Wildlife Refuge is found in the taro fields, adjacent wetlands, and the Hanalei River. Many of these fauna are food sources for the endangered water birds. The water birds are attracted to chironomids (midges) and tubificids (worms), which exist in the taro fields. Chironomids are abundant in shallow water, while tubificids can flourish in wet and dry environments. Bird feeding is the most intense during the wet fallow period of the taro agricultural cycle, between harvesting and re-planting of the taro fields. Endemic and exotic gastropod mollusks (snails, slugs, etc.), as well as toads and bullfrogs, inhabit some of the taro fields and ponds (see D. 5a).

In a recent aquatic survey, the Hanalei River was found to have a substantial population of native aquatic species. The Hanalei River not only yielded the greatest number of endemic species in the streams surveyed (based on the number of mountain shrimp per sampling station) but also had the highest percentage of endemic species sampled (74%).

Four species of native o'opu are known to inhabit the streams and ponds of Hanalei Valley. These are o'opu nakea (Awaous stamineus), o'opu nopili (Sicydium stimpsoni), o'opu naniha (Awaous geniuttatus), and o'opu okuhe (Eleotris sandwicensis).

O'opu nakea is the largest goby, and is commercially valuable. The spawning season usually occurs between July and November, corresponding with periods of storm flows in the river. Adult o'opu nakea are washed down to the estuary areas where spawning occurs. The other species of o'opu are believed to spawn year-round at any location of the river.

Opae kala'ole, Atya bisulcata, fresh water mountain shrimp, is endemic to the Hawaiian Islands. It is described as a detritivore, consuming suspended organic particles, and generally inhabits the middle and upper portions of streams. Opae have a diadromous life-cycle, requiring access to seawater to spawn. Couret's paper indicates that spawning takes place year-round, suggesting a multivoltine life cycle known for many other tropical species.

Other aquatic fish inhabiting the refuge include tilapia (Tilapia spp.), mosquito fish (Gambusia affinis), and swordtails (Xiphophorus spp.). Fish species inhabiting or spawning in the estuary and brackish waters

of the Hanalei River include papio (Caranx sp.), mullet (Mugil cephalus), barracuda (Sphyraena barracuda), milkfish (Chanos chanos), and aholehole (Kuhlia sandwicensis). The brackish waters also provide habitat for a number of species of crabs.

15. Animal Control

In winters when Hawaiian coots remained at Hanalei (see Endangered Species Section) the birds apparently changed their diet and began to eat taro leaves and shoots. Damage was particularly severe in fields where taro was in its early stages of growth. To reduce crop damage, the farmers were allowed to erect 2-foot high fences around sensitive fields. Coots could fly over the fences, but they tended to walk between fields, and the short fences frequently excluded many birds. In 1980, depredation was particularly severe and cracked corn was used to concentrate coots in short grass areas near wet fallow fields.

16. Marking and Banding

In 1979 an effort was made to improve the capture techniques for stilts at Hanalei. Mist nets set in taro fields after darkness proved effective when birds were flushed into them. A stilt color-marked at Hanalei in December, 1977, was recaptured at Pearl Harbor NWR on Oahu on March, 1978, documenting for the first time an eastward inter-island movement from Kauai.

In 1980, red plastic neck collars were put on two coots to try to document movement. One of these coots was seen two weeks later in a nearby taro field. No other sightings have been reported.

H. PUBLIC USE

2. Outdoor Classrooms - Students

A regional YMCA camp is situated 10 miles from the refuge. Approximately 100 of these campers per month visited the refuge throughout 1978-1980. The 4 leaders per year, which were trained by the refuge staff, conducted the tours. A taro farmer also donated his time to show the campers how taro is grown, and how the agricultural cycle is timed to benefit water birds.

Kauai Community College students (20) visited the refuge twice a year as part of their biology field trip. Approximately five public school groups (20 students each) per year also visited the refuge during this period.

3. Outdoor Classrooms - Teachers

Four YMCA camp leaders per year were trained by the refuge staff on the

natural history of the Hanalei Valley and taro farming. These teachers in turn conducted outdoor classrooms for their campers (approximately 100/month).

6. Interpretive Exhibits/Demonstrations

An interpretive display was constructed in September, 1980, at the scenic overlook located on a hillside above the refuge. An estimated 400,000 visitors per year view the refuge from this vantage point. The exhibit was part of a BLHP funded project including the interpretive walking tour at Kilauea Point. The three panels in the display explain taro farming, the endangered water birds and the refuge objectives.



HAL-4 - New interpretive display installed in September, 1980 at the scenic overlook above Hanalei NWR. RJS

9. Fishing

The Hanalei River attracts local fishermen searching for mullet, milkfish, barracuda, gobi (o'opu) and shrimp (opae).

An average of 45 visitors per month fish on the Hanalei River for an average of 2 hours each visit. The peak fishing occurs during the fall months, o'opu spawning runs (see G. 11).

11. Wildlife Observation

In addition to the many visitors at the scenic overlook, several birding tours by the National Audubon Society and other private groups visited the refuge each year. Since these groups made observations from the county roadway and the refuge overlook, no permits were required and no documentation was made of such visits.

17. Law Enforcement

A taro farmer was seen firing a shotgun within the refuge on November 21, 1980 by Assistant Manager Brady. Brady gave a verbal warning to the farmer and documented the incident in refuge files.

No other LE activities were noted during the 1978-1980 period.

18. Youth Programs

A YACC program was initiated in 1978, and it continued through 1980. The 3-7 enrollees performed road maintenance, hau clearing, Pangola grass planting, and other jobs. YCC camps of 15 enrollees were also active on the refuge each summer. Although most of their work was at Kilauea Point, the YCC enrollees helped dig an irrigation ditch and assist in roadside plantings.

I. EQUIPMENT AND FACILITIES

1. New Construction

The new water delivery pipe to the taro fields on the east side of Hanalei River, which was constructed in 1977, had to be removed in February, 1978, since it was on an incorrect grade and reinstalled on the proper grade. Unfortunately, the construction of the delivery pipe was nearly complete when John Mack, Regional Office Engineer, inspected the construction and discovered the error. Subsequent delays in construction as a result of the error caused water to be shut off longer than anticipated and caused some damage to taro crops. Although water was flowing through the new tunnel by-pass in March and apparently substantially increasing the amount of water available to taro farmers, the water delivery project for the east-side fields was not finally completed until May. Water control weirs were also completed in 1978.



HAL-5 - Installation of 36" concrete pipe to by-pass (and abandon) historic and decaying irrigation tunnel serving the taro fields on the east side of Hanalei River. GVB

Regional Office personnel Ed Smith and Dick Rodgers met with Refuge personnel on August, 1978, to select a contractor to develop alternative water delivery systems to develop the full wetland potential of Hanalei NWR.

Wilson Okamoto and Associates, Inc. were formally selected in September, 1978. Engineers and planners from this company met with refuge personnel and Hanalei taro farmers throughout 1979 and designed several alternative water delivery systems. After the preferred option was identified, Section 7 consultation and other permits were processed (see D. 4). Bids for this option were solicited in July, 1980, all of which far

exceeded the funds allotted. A minority small business firm, Ron's Construction, was contacted through the Small Business Administration in September, 1980. Open negotiations and changes in the scope of work resulted in a final contract being awarded to Ron's Construction in late December, 1980. This contract included construction of the river inlet structure, the upper river siphon, 1,000' of concrete pipe with two lateral outlets, improvements to the remaining China ditch and the extension of the water delivery system toward the northwestern refuge boundary known as the "Little China Ditch". An improved water delivery system to the taro fields on the east side of Hanalei River was not included in this limited contract. An open ditch (1,800' long) between the river inlet and siphon was constructed in lieu of 48" concrete pipe as a major cost savings measure. However, this open ditch is vulnerable to blockage and siltation and should be replaced with pipe as soon as possible.

HULEIA NATIONAL WILDLIFE REFUGE

Kauai, Hawaii

TRI-ANNUAL NARRATIVE REPORT

Calendar Years 1978 - 1980

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

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G. WILDLIFE

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7.	Other Migratory Birds	NTR
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11.	Fisheries Resources	NTR
12.	Wildlife Propagation and Stocking	NTR
13.	Surplus Animal Disposal	NTR
14.	Scientific Collections	NTR
15.	Animal Control	NTR
16.	Marking and Banding	NTR
17.	Disease Prevention and Control	NTR

H. PUBLIC USE

1.	General	4
2.	Outdoor Classrooms - Students	NTR
3.	Outdoor Classrooms - Teachers	NTR
4.	Interpretive Foot Trails	NTR
5.	Interpretive Tour Routes	NTR
6.	Interpretive Exhibits/Demonstrations	NTR
7.	Other Interpretive Programs	NTR
8.	Hunting	NTR
9.	Fishing	NTR
10.	Trapping	NTR
11.	Wildlife Observation	NTR
12.	Other Wildlife Oriented Recreation	NTR
13.	Camping	NTR
14.	Picnicking	NTR
15.	Off-Road Vehicling	NTR
16.	Other Non-Wildlife Oriented Recreation	NTR
17.	Law Enforcement	NTR
18.	Youth Programs	4
19.	Cooperating Associations	NTR
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1. New Construction	4
2. Rehabilitation	NTR
3. Major Maintenance	NTR
4. Equipment Utilization and Replacement	NTR
5. Communications Systems	NTR
6. Energy Conservation	NTR
7. Other	NTR

J. OTHER ITEMS

1. Cooperative Programs	Complex
2. Items of Interest	Complex
3. Credits	Complex

K. FEEDBACK

NTR

A. HIGHLIGHTS

Since Huleia NWR was established in 1973 no operating funds have been available to create or maintain wetland habitat. In 1978, a newly established YACC crew cleared trees along old drain ditches in the refuge. This action exposed for use the only available permanent wetland habitat on the refuge. Progress continued on purchasing the remaining three parcels needed to consolidate the refuge boundary, and a preliminary master plan was completed. Cattle grazing was permitted throughout the period.



HUL-1 - Aerial view of Huleia NWR (looking east).

EK

The early scene from the motion picture "Raiders of the Lost Ark" when "Indiana Jones" is escaping poisoned darts in an old float plane, was filmed along the Huleia River in September, 1980.

B. CLIMATIC CONDITIONS

The 1977 drought continued through 1978, but during 1979 and 1980 the normal pattern of rainy winters resumed. Increased rainfall in 1979 and 1980 periodically filled ephemeral wetlands on the refuge providing temporary feeding habitat for Hawaiian ducks.

The nearest weather recording station, Lihue Airport, is located

approximately 2 miles northeast of the refuge. The following station summary for the period 1978-1980 reflects the climatic conditions of the refuge:

	<u>Average</u>	<u>1978-1980</u> <u>Extremes</u>
Temperature	75°F	89° (10-7-79) 57° (1-12-78)
Wind Speed	12.0 mph	36 mph (1-8-80)
Rainfall	40"/yr.	-

C. LAND ACQUISITION

1. Fee Title

Purchase of five parcels of land, ranging from .5 to 5.0 acres, was negotiated during the period to consolidate the refuge boundary. Direct purchase was complicated and eventually thwarted by the type of land ownership prevailing in the area. Each parcel, known as a Kuleana, was owned by 10 to 50 individuals each with an undivided, equal interest in the land. For a purchase to be concluded, all owners had to first be located, and then agree to the sale and the price! Office of Realty personnel made a gallant attempt to complete refuge acquisition by direct purchase, but condemnation proceedings finally had to be initiated in 1980.

D. PLANNING

2. Management Plan

Wilson Okamoto and Associates, who designed the new water delivery system for Hanalei NWR, also evaluated potential water sources and conveyance methods at Huleia. Discussions of possible wetland designs with the form and regional office engineers provided information useful in developing a preliminary plan for creation and management of wetlands on the refuge.

F. HABITAT MANAGEMENT

2. Wetlands

The refuge is primarily a river valley which has been used historically for wetland and dryland agriculture. Except for ephemeral habitats flooded after heavy rainfall, the only wetlands in the undeveloped refuge are a single stream and five 1 to 2 foot wide former drainage canals which extend perpendicularly from the river across the valley. The ditches are open to the river and the water level fluctuates with

the tide cycle which affects the river. These canals were completely choked by mangrove and hau trees and unavailable for use by water birds until 1979 when the trees were cleared by YACC personnel. The canals now provide habitat for waterfowl including the endangered Hawaiian duck. In preparation for habitat development, a method was developed for successfully transplanting bulrush, Scirpus californicus, on the refuge. Eventually, this robust emergent may be used as nesting cover in planned coot and gallinule nesting ponds.

7. Grazing

One grazing permit, totaling 158 acres, was active during the 1978-1980 period. Grazing was permitted strictly for vegetation control, and when wetlands are developed, grazing will be eliminated in those areas.

10. Pest Control

In 1979 live traps were used by YACC personnel to reduce the population of feral dogs and cats which prey on water birds at the refuge. Four cats and two dogs were captured and taken to the Humane Society for disposition. A lack of funds required that the project be discontinued, but it is still needed.

G. WILDLIFE

2. Endangered and/or Threatened Species

The refuge was created to provide habitat for the endangered Hawaiian gallinule, coot, stilt, and duck. During the period Huleia NWR provided limited habitat for an average of six Hawaiian ducks, and only one or two Hawaiian coots, gallinules or stilts were observed on the monthly census along Papakolea stream. Active habitat manipulation will be necessary to convert the refuge into an important endangered water bird habitat.

4. Marsh and Water Birds

An average population of 2 black-crowned night herons (native) and 25 cattle egrets (introduced) were observed on the refuge during 1978-1980.

6. Raptors

A short-eared owl, Pue'o, and a barn owl were irregularly seen at the refuge during 1978-1980.

H. PUBLIC USE

1. General

Huleia NWR does not have convenient foot or automobile access because it is isolated from main roads, difficult to locate, and surrounded by private land (some of which is being acquired to extend the refuge boundary to an access road). In addition, there is little of interest to view on the refuge in its undeveloped state. Nevertheless, a Kayak Tour Company ran twice daily trips up the Huleia River along the refuge boundary in 1978 and 1979. The leader explained to each group that the valley was now a refuge and that it would eventually be developed for endangered water birds.

A small scenic overlook area, located just east of the refuge boundary offers an excellent view of the Menehune fishpond (Alakoko Pond) and the refuge lands which surround the far side of this pond. Presently there is no visitor contact point at this location identifying the refuge. Visitation to this area is estimated to be 1,440 hrs./year. This number has diminished in recent years due to poor road conditions and the mangrove overgrowth which now blocks the view of the famous "menehune wall" which separates the pond from Huleia River. An interpretative display constructed at this roadside vantage point may result in an increase visitor use of the overlook and awareness of the refuge and it's objectives.

No environmental education took place on this refuge during the 1978-1980 period. Efforts in this program were directed through the other refuges on this island (Hanalei NWR and Kilauea Point).

18. Youth Programs

YACC enrollees cleared brush along the drainage ditches at the refuge intermittently during the period from April through September, 1978. The open drains provided better habitat for the few endangered water birds residing at the refuge.

I. EQUIPMENT AND FACILITIES

1. New Construction

Approximately \$249,000 of BLHP funds was earmarked for wetland habitat modification in FY79. These funds were reprogrammed to the Hanalei NWR in November, 1980, to offset the projected higher costs of the new water delivery system at that refuge.

JAMES CAMPBELL NWR
Kahuku, Oahu, Hawaii

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J. OTHER ITEMS

1. Cooperative Programs	Complex
2. Items of Interest	Complex
3. Credits	Complex

K. FEEDBACK

A. HIGHLIGHTS

A major wetland habitat development project was begun in the fall of 1980 at the Kii unit of James Campbell NWR. This project, provided through BLHP funds, will triple in size the present wetland habitat used by all four endangered Hawaiian water birds on this refuge.

A three-year intensive study of the reproductive biology of the endangered Hawaiian stilt was begun in 1978. The Kii unit of the James Campbell NWR was the major study area in this investigation.

Salt water effluent from a nearby aquaculture facility significantly increased the ambient salinity of waters within the Kii unit in 1980, killing many fresh-water plants considered to be important for endangered water birds.

B. CLIMATIC CONDITIONS

The nearest weather recording station, BYU-Laie, is located 5 miles SE of the refuge. The following station summary for the period 1978-1980 reflects the climatic conditions at the refuge:

	Average	1978-1980 Extremes (dates)
Temperature	75°F	54° (1-26-80) 93° (8-22-78)
Wind Speed	17 kts.	-
Rainfall	55"/yr.	-

C. LAND ACQUISITION

2. Easements

Water flowage easements were negotiated along the Kii ditch, connecting the Punamano unit with the Kii unit (downstream) during the 1978-1980 period.

In October, 1980, we were informed that the powerline easement serving the old Kii flood control pump would expire in 1983. Our request to tie into this existing powerline was denied by the electric company due to the short tenure of the existing powerline easement. Negotiations began immediately with the landowner, the Estate of James Campbell, to secure a long-term easement commensurate with our 55-year refuge lease.

D. PLANNING

2. Management Plan

Management/Research Plans for all five wetland refuges and Kilauea

Point Administrative Site were drafted in December, 1980, for implementation in FY81. A formatted plan was issued to all field personnel and included in performance standards.

4. Compliance with Environmental Mandates

The Bernice P. Bishop Museum was contracted in August, 1980, to conduct an overview archaeological survey of the refuge. Their one-day reconnaissance of the area failed to uncover any archaeological features. Their final report entitled, "Archaeological Reconnaissance Survey of Ki'i and Punamano Wetland Refuge Units, Kahuku, Oahu Island", by Aki Sinoto, was submitted to the refuge in April, 1981.

5. Research and Investigations

a. Hawaiian Stilt Reproductive Biology

(see Pearl Harbor NWR, D. 5)

b. Cattle Egret/Hawaiian Stilt Interactions

Through cooperation with the Brigham Young University (Hawaii Campus), a one-year study was conducted on the behavioral interactions between Hawaiian stilts and cattle egrets. Suzie Andrews, an undergraduate student at BYU-Hawaii, was the principal investigator of this research. Her study documented a greater intra-specific than inter-specific aggression by Hawaiian stilts during their breeding season. The minimal inter-specific stilt aggression toward cattle egrets was dramatically increased after the stilts' eggs hatched. Andrews' report is on file at the refuge office and at the BYU-Hawaii campus, Laie, Hawaii.

During the stilt/cattle egret behavioral study, Andrews observed an adult black-crowned night heron capture and eat a young Hawaiian stilt chick (ca. 1 week old). This important observation was made at the Kii unit on May 8, 1980, and published in the Elepaio (March, 1981) 41:86.

E. ADMINISTRATION

3. Safety

Only one minor accident occurred during the 1978-1980 period at this refuge. In April, 1979, refuge biologist Coleman stood too close to a barbed wire fence being constructed by a YACC field crew. A strand of barbed wire, being stretched with a come-along, broke loose from the anchor post and lacerated Coleman's right hand. Five stitches in the middle finger of the right hand were necessary to repair the damage inflicted.

F. HABITAT MANAGEMENT

1. General

This 141.5 acre refuge consists of approximately 74 acres of wetlands, 5 acres of grasslands, and 27 acres of scrub forest areas. The wetland habitat development project, begun in November, 1980, will convert 36 acres of grassland into valuable wetlands at the Kii unit.

The 104 acre Kii unit is surrounded by a livestock fence while the 37.5 acre Punamano unit remains unfenced.

2. Wetlands

Wetland habitat management efforts during the 1978-1980 period were limited to a 20-acre impoundment in the Kii unit of the refuge. A 3" portable pump was used during the stilt nesting season (March-July) to attempt to maintain an adequate water level in this pond. The lack of water level control structures and an inoperable flood control pump hampered efforts to insure a steady water level in the impoundment. A heavy rainfall in May, 1978, resulted in extensive flooding of stilt nests in this pond. In contrast, a long dry Spring in 1979 and 1980 resulted in a draw-down of the pond, exposing over 50% of the pond bottom and constricting the available food supply for the water birds and their young. Portable pumps used to mitigate this lowered water table had little effect on the situation. Eutrophication was severe in restricted pond water.



JMC-1 - Aerial view of "Pond A", a 20-acre shallow water impoundment at the Kii unit of James Campbell NWR. The small islands provided good nesting habitat for the endangered Hawaiian stilts. RJS

The extensive wetland habitat development project, designed to resolve the problems experienced in the 1978-1980 breeding season, was begun in November, 1980. Water control structures, permanent electric pumps, and extensive grading work will create two additional impoundments, totaling 33 acres, and provide water level control for the existing 38 acres of impounded water. Flood control for the entire refuge will be possible with the installation of a 40 hp electric pump.

Nesting islands created in the 20-acre impoundment in 1977 were used extensively by the Hawaiian stilts. YACC enrollees and refuge personnel attempted to control the vegetation on these islands in 1979 and 1980 prior to the onset of stilt nesting (March). These efforts were rewarded almost immediately by stilts selecting recently cleared areas to construct nests. Wintering migratory waterfowl also aided in this vegetation control in 1978 and 1979. Extensive growth of an introduced succulent plant, pickleweed (Batis maritima) was out of hand by May, 1980. Small clumps of Batis over water have been used as nest sites by the Hawaiian coot; however, this dense growth over the small islands precludes stilt nesting attempts. Batis control measures with a long-term effect need to be developed.

7. Grazing

Cattle grazing, existing on the Kii unit prior to the refuge acquisition, was allowed to continue until the perimeter fence was completed in 1980. The free-roaming cattle were documented destroying two viable stilt nests prior to their total exclusion from the refuge. Approximately 40 head of cattle were maintained on the Kii unit during the 1978-1980 period.

10. Pest Control

Limited live-trapping of mongooses and cats was conducted during the stilt nesting season at the Kii unit. Trapping efforts were concentrated around the 20-acre impoundment.

Feral dogs, in packs of 3-10, were frequently seen in the refuge. Efforts to live-trap these dogs failed. Control by other means had some effect and the completion of the perimeter livestock fence greatly reduced the problem.

Vegetation control on the numerous nesting islands was conducted by manual and mechanical means. Approved herbicides, "Roundup" and "Banvel" were used with some success. A trial application of "Banvel" in August, 1980, appeared to be the most effective control of the succulent pickleweed, Batis maritima.

No pest control measures were undertaken at the Punamano unit during the 1978-1980 period.

11. Water Rights

The Punamano unit and Kii unit of this refuge are connected by a 1 mile-long ditch easement, known as the Kii ditch. Mid-way along the Kii ditch a 15-acre saltwater aquaculture facility was constructed in 1979. This facility, subleased from a freshwater aquaculture farm (Lowe Aquafarm), is run by a Japanese-based company, Ikko Hawaii, Inc.

As this saltwater shrimp farm developed, refuge personnel became aware that they were dumping their effluent into the Kii ditch. Salinity levels within the Kii unit rose dramatically from less than 5 ppt to 15-18 ppt in June, 1980. Negotiations began in July, 1980, between refuge personnel, the aquaculture companies, and the Estate of James Campbell to resolve the effluent pollution problem. An injection well, designed to take all the effluent from the Ikko facility was completed in November, 1980. Problems with the injection well, solution to the effluent problem, persisted at the end of 1980.

G. WILDLIFE

1. Wildlife Diversity

Although the wetland management efforts made during this period were directed at improving the nesting and feeding habitats of the endangered Hawaiian water birds, particularly the stilt, numerous other migratory bird species utilized these same improved areas. This immediate wildlife response clearly indicates the great potential for wildlife diversity at the Kii unit when it approaches full development in the next few years.

2. Endangered and/or Threatened Species

All four endangered Hawaiian water birds, the Hawaiian stilt, Hawaiian coot, Hawaiian gallinule, and Hawaiian duck, nest and maintain populations on both units of James Campbell NWR.

An increase in the Hawaiian stilt population and stilt nesting attempts at the Kii unit is well documented during the 1978-1980 period. This increase from an average of 20-30 stilts in 1978 to 80-100 stilts in 1980 may be due in large part to an increased available food supply as the adjacent 110-acre aquaculture farm (Lowe Farms, Inc.) was constructed. Flight paths between the Kii unit and these freshwater one acre ponds (100 total) clearly established the link between the protected nesting habitat available at the Kii unit and the abundant food supply provided at the aquafarm. Available nest sites did not appear to be limited at the Kii unit. Future expansion of stilt nesting and feeding areas within the Kii unit will further increase the resident stilt population to perhaps the largest in the state.

Resident populations of the Hawaiian coot, Hawaiian gallinule, and

Hawaiian duck also slowly increased during the 1978-1980 period. These birds were also observed at the adjacent Lowe Aquafarm. No comparable nesting data for these birds was obtained at either unit of the refuge. Incidental nest sightings were recorded and served to document clutch size and nesting chronology. Nesting attempts by both the Hawaiian coot and gallinule were regularly observed at both units of the refuge on a year-round basis.

No Hawaiian duck nests were located at the refuge; however, one hybrid nest (male Hawaiian duck X female mallard) was found, containing seven eggs, at the Kii unit in 1979. These eggs were collected and five hatched at the Honolulu Zoo. The brood consisted of four drakes, which resembled mallard stock and one hen which resembled a Hawaiian duck.

3. Waterfowl

Wintering waterfowl populations at the refuge fluctuated from year to year, perhaps due to irregular water level conditions in the fall of each year. During dry autumn months, less wetland habitat was available at the Kii unit and many waterfowl may have continued past the area.

The deeper natural pond at the Punamano unit continued to support the greatest statewide concentration (30-40) of scaup each winter. Pintails and Northern shovelers, the most common migratory waterfowl in the state, averaged approximately 50 and 100 respectively at the refuge. American wigeon was also commonly seen each winter. Other waterfowl seen less frequently at the refuge included: green-winged teal, blue-winged teal, Garganey teal, European wigeon, hooded merganser and bufflehead. A single Canada goose was seen at the Kii in 1979. A pair of black brants were also seen at this unit during January through March, 1980.

With the development of the 110 acre aquafarm adjacent to the refuge and the increase of stable wetland areas within the refuge, future waterfowl use at the refuge is likely to increase.

4. Marsh and Water Birds

The black-crowned night heron population at the refuge increased from approximately 10 birds in 1978 to more than 30 birds in 1980. A heron rookery, shared with cattle egrets was adjacent to the northwest corner of the Kii unit during 1978 and 1979. This rookery was mostly abandoned in 1980 and a new rookery was established 300 yards northeast of the Punamano unit. Cattle egret populations on the refuge fluctuated with the change in the rookery location and in response to grass mowing activity on the Kii unit. Counts ranged from 10 to 300 egrets during the 1978-1980 period. It is uncertain what impact cattle egrets may have on endangered water birds as predators or vectors of avian disease. Their unchecked exponential population growth in the state is alarming! A pied-billed grebe was seen at the Kii unit in January, 1979.

5. Shorebirds, Gulls, Terns and Allied Species

The Kii unit of the refuge became known as a "hot spot" for migratory shorebirds during the 1978-1980 period. Habitat manipulations designed for improved Hawaiian stilt use were equally attractive to most migratory shorebirds. The most common shorebird species included American golden plover, wandering tattler, sanderling, and ruddy turnstone. Several bristle-thighed curlews were commonly seen at the unit in the winters of 1978 and 1979, although none were observed in 1980. Other incidental shorebirds recorded were black-bellied plover, lesser-yellowlegs, long-billed dowitcher, sharp-tailed sandpiper, pectoral sandpiper, western sandpiper, northern phalarope, and common snipe. A buff-breasted sandpiper was recorded during an Audubon Society tour in September, 1978. This was the first sight record in the state for this species.

An immature laughing gull was regularly seen at the Kii unit during the early part of 1979. During March and April, 1979, this gull was discovered preying on Hawaiian stilt eggs. A majority of the stilt nests on islands within the 20-acre impoundment lost eggs during March and early April. Frequent aggressive attacks by nesting stilts on this gull and gull footprints next to stolen decoy eggs, provided conclusive evidence of laughing gull's predatory role. This gull was collected on April 10, 1979, and donated to the Bernice P. Bishop Museum. A pair of Franklin's gulls were seen once at the Kii unit in May, 1979.

Sooty terns and sometimes gray-backed terns were often seen flying over the Kii unit, cutting across the northernmost tip of the island. Red-tailed tropicbirds were also seen flying over the unit, perhaps attracted by the cattle egret rookery. A Laysan albatross also flew around the unit one morning in the spring of 1978.

6. Raptors

The short-eared owl and barn owl were often seen over the grassy areas of the Kii unit. The short-eared owl, or Pueo, probably nested on the refuge, although no nests were actually located.

12. Wildlife Propagation and Stocking

(see Pearl Harbor, Section D. 5)

16. Marking and Banding

A total of 53 adult Hawaiian stilts was banded and auxiliary marked at this refuge during 1979 and 1980. A total of 26 young stilt chicks was also banded, measured, and released and later recaptured to determine chick growth rates in the wild. (see Pearl Harbor, G. 16)

17. Disease Prevention and Control

The necropsy of an adult black-crowned night heron found dead at the

Kii unit in May, 1980, revealed that the bird contained Salmonella typhimurium. This is a very contagious form of Salmonella and raises concern over possible disease related mortality of young water birds and the role of herons and cattle egrets as vectors of this disease.

H. PUBLIC USE

1. General

Public use of James Campbell NWR during the 1978-1980 period was limited to specific requests by school groups, scout clubs, or local bird groups to visit the refuges. Service efforts to increase public use during this period were not initiated due to limited staff time, a lack of suitable access routes, and concern over the possible impact on the resident endangered species on the small units.

2. Outdoor Classrooms - Students

No formal environmental education program was developed during this period. Most of the school groups visiting the refuge were escorted by refuge personnel. A brief introduction of Hawaii's endangered water birds was the focus of the Service talk presented.

7. Other Interpretive Programs

Off-refuge talks by Service personnel at the local chapter of the Audubon Society, church groups, school groups, and business clubs often discussed the wetland NWR program in Hawaii. James Campbell NWR was highlighted in these presentations as a refuge soon to be intensively managed for the protection and preservation of Hawaii's four endangered water birds.

11. Wildlife Observation

Each winter the local chapter of the Audubon Society took at least one field trip to both units of the refuge. The group, usually 15-20 persons, enjoyed several hours of bird watching and wildlife photography. Five individual bird watchers have obtained special use permits to visit the refuge on a year-round basis with prior verbal approval from the refuge manager.

17. Law Enforcement

The only law enforcement problem at this refuge was an occasional trespass by weekend pheasant hunters using the area. Three individuals were cited for trespass and hunting on the refuge on November 17, 1980. The apprehension was made after several days of stakeouts in the vicinity of the refuge. This was the first refuge wildlife case brought before the U.S. Magistrate in Hawaii. The three men were fined \$50.00 each for

the trespass and for possession of a firearm and one was fined an additional \$100.00 for destroying a "No Vehicles" refuge sign and shooting a pheasant on the refuge.

18. Youth Programs

A field crew of 3-8 Young Adult Conservation Corps enrollees worked at the Kii unit throughout the 1978-1980 period. Major work projects included perimeter fencing, dike maintenance, nesting island modifications and vegetation control. They also assisted with the construction of an Aeromotor windmill, predator control, and general area clean up.

I. EQUIPMENT AND FACILITIES

1. New Construction

A 12' Aeromotor windmill was installed atop a 30' tower at the Kii unit in May, 1980. The 6" diameter pump (11" stroke) pumped only 450 gph into the 20-acre impoundment. Improvements to the system were necessary to realize its full pumping capacity. Hog wire/barbed wire fencing was constructed around 90% of the refuge in 1979-1980 by the YACC field crew.



JMC-2 - Twelve foot Aeromotor windmill, installed in May, 1980, supplies water to impoundment at a rate of 450 gph almost continuously. DHW

Haitsuka Brothers Limited was contracted in October, 1980, to provide for heavy equipment rental (with operator). Work began on December 2, 1980. A D-8 Cat and Can was used to level and lower the substrate of the 17-acre Pond B in the Kii unit by one foot and the excess dirt was used to raise the main roadway in the center of the unit. This D-8 ended up in the adjacent canal for 2 days when the operator "looked back" once too often and drove off the main roadway. Another D-8 and a D-9 were used to pull it out. A JD 450 dozer was also used to construct small nesting islands in Ponds B and C of the unit and to remove the dense grass from the southern-most quarter of Pond C. A Pettibone backhoe (4A19) was used to install culverts and water control structures provided by the other contractor, R. N. Thomas and Sons.



JMC-3 - D-9 Caterpillar in canal after contract operator "looked back" once too often. DHW

R. N. Thomas and Sons Construction was contracted in October, 1980, to build a new pump structure at the Kii unit and to supply culverts and water-control structures for use at the unit. A 40 hp flood control pump and a 5 hp pump to supply water to Ponds B, C and D would be located on the pump structure. Although start-up work began in November, 1980, the contractor did not begin on-site work before the end of 1980.

A 6" portable pump was rented in December, 1980, to help control the

high flood water levels in the Kii area as a result of several heavy rains that month.

2. Rehabilitation

Rehabilitation of the existing flood control pump at the Kii unit was investigated in 1980. The pump was considered to be beyond repair and its replacement became part of the FY81 BLHP habitat development project for the unit.

4. Equipment Utilization and Replacement

A Ford tractor (25 hp, 4-wheel drive) was purchased in 1980. This tractor, equipped with high flotation front tires and puddling wheels, proved very useful in controlling the vegetation on the nesting islands within the impoundment. It operated effectively even in water 18-24" deep.



JMC-4 - Puddling wheels and high flotation front tires (not shown) enable this Ford tractor to work in shallow flooded areas without getting stuck (at this writing). DHW

6. Energy Conservation

(see Section I. 1)

K. FEEDBACK

The 55-year lease agreement with the Estate of James Campbell, which established this refuge, contains many conditions binding on the Service which have proven to be unworkable. The one-sided nature of the agreement, in favor of the Estate, clearly indicates the poor bargaining position of the Service during the final negotiations of this lease. The implications of this agreement on construction and O&M funding, required to meet the Service commitment, has been overlooked for years. The most oppressive of these commitments is the requirement to maintain and operate two flood control pumps (at Service cost) for a large watershed, only a small percentage of which is refuge land. This requirement was ignored since the refuge was established until the start of the FY81 BLHP construction project in November, 1980. Completion of this project will enable the Service to operate the most important flood control pump, the Kii pump. The necessary renovation of the other pump, No. 19, which is also required in the lease agreement, has not been considered by this BLHP project. O&M funds required to operate the Kii pump will have to be absorbed entirely by the Service unless a cost-sharing arrangement can be worked out with other lessees and the landowner. Increasing electrical costs will make this required pump operation more demanding on station funds.

Future lease agreements to acquire refuge lands should carefully consider requirements involving future energy costs absorbed by the Service. These hidden costs in any lease may seriously jeopardize the Service's ability to retain the lease and manage the habitat. The major problem with refuge lands acquired under a non-perpetual lease agreement is that the inherent Service value of the land will continue to increase as wildlife becomes more dependent on this refuge land. What happens to this wildlife after the lease is terminated?

PEARL HARBOR NWR

Honolulu, Hawaii

TRI-ANNUAL NARRATIVE REPORT

Calendar Years 1978 - 1980

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

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J. OTHER ITEMS

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K. FEEDBACK

NTR

A. HIGHLIGHTS

Major wetland habitat improvements at both units of Pearl Harbor NWR were accomplished in 1979 and 1980 by means of BLHP funds (FY79). Refuge personnel directed heavy rental equipment (with operators) in the construction of a perimeter moat, additional nesting islands, and a perimeter service road at the Waiawa unit. A new four-acre shallow-water impoundment was also constructed at the Honouliuli unit.

B. CLIMATIC CONDITIONS

The nearest weather recording station, the Honolulu International Airport, is located approximately 3 miles southeast of the refuge. The following station summary for the period 1978-1980 reflects the climatic conditions at the refuge:

	Average	1978-1980 Extremes (dates)
Temperature	76°F	93° (10-11-79) 56° (1-26-80)
Wind Speed	11.7 mph	35 mph (1-8-80)
Rainfall	21"	-

C. LAND ACQUISITION

3. Other

Both units of the refuge, Waiawa unit (24.5 acres) and Honouliuli unit (36.5 acres), are perpetual easements from the U.S. Department of the Navy. These easements were obtained in 1976. An additional unit to this refuge; hereafter, called the Waiawa Annex unit, was offered to the Service by the Navy in 1979. The Service was reluctant to immediately accept the 14 acre parcel, approximately one-half mile south of the Waiawa unit on the same peninsula. This unit is a deep coastal fish pond overgrown with a dense stand of mangrove trees. High initial development costs for this area, with a low potential as a viable habitat for endangered water birds, was determined. The City and County of Honolulu expressed an interest in a portion of the Waiawa Annex land as part of a municipal golf course. Cooperative development plans, initiated in 1980, were postponed after the November election of a new mayor.

D. PLANNING

2. Management Plan

Habitat improvement plans to maximize Hawaiian stilt nesting on the

refuge were drafted in November, 1979. The plans called for increased shoreline-feeding areas by subdividing larger islands, increased shallow feeding areas by placing excess fill material in deep water areas, better predator protection by digging perimeter moats and improved pond circulation by increasing the connections between ponds. These ideas directed the subsequent BLHP construction project utilizing the rental of heavy equipment.

5. Research and Investigations

a. Hawaiian Stilt Reproductive Biology

A three-year study of the reproductive biology of the endangered Hawaiian stilt, Himantopus mexicanus knudseni, was begun in 1978 by Richard Coleman, then Refuge Biologist. The study areas included both units of Pearl Harbor NWR and the Kii unit of James Campbell NWR.

As outlined in the Hawaiian Waterbird Recovery Plan, this investigation was designed to determine the overall reproductive success of the Hawaiian stilt and identify components of the nest site selection and chronology which have a significant impact on the hatching success. Improved habitat management recommendations would be drawn from these results.

Table 1 summarizes the reproductive success of the Hawaiian stilts at the Pearl Harbor NWR for the period 1978-1980.

F. HABITAT MANAGEMENT

1. General

This 61 acre refuge consists primarily of shallow man-made impoundments at two units (40 acres) surrounded by service roads (one-lane, gravel) and a partial scrub forest buffer zone 30-50 feet wide. A 7 foot high chainlink fence surrounds each refuge unit on three sides. A livestock fence isolates the refuge units from the adjacent harbor.

2. Wetlands

Wetland habitat management efforts at both units of the refuge were funded by FY79 BLHP funds. Habitat improvements at the Waiawa unit included the creation of additional nesting islands by digging a perimeter moat around most of the ponds and subdividing half of the service road between the two ponds. Large rocks and driftwood were placed on these islands in 1980 to provide stilt nesting cover which would not grow and become a maintenance problem. A perimeter service road along the southeast side of this unit was also constructed.

The remaining funds for this project were used to expand an existing shallow impoundment at the Honouliuli unit from 1 acre to 5 acres and

creating twelve small nesting islands within this pond.

The intensive habitat management efforts at both units of the Pearl Harbor NWR have been reasonably successful. Due to the small size of these man-made habitats, disturbance by man and predators such as feral dogs, cats, and mongooses appears to be the major limiting factor in achieving the maximum use by the endangered water birds.

Water quality is a major concern at both units of this refuge which depend entirely on well water to maintain wetland habitat. The water source for the Waiawa unit's sump well is the adjacent Waiawa stream. The diminished flow of this stream has enabled the salt water of Pearl Harbor to move upstream contaminating the water source used for the Waiawa unit. Pumping brackish water into the shallow impoundments of the unit creates a saltpan effect. Hyper-saline conditions at this unit have restricted the water bird use to only the Hawaiian stilt. A fresh water source needs to be located and maintained for this unit, before this unit can be viable for the other three endangered water birds in the vicinity.

The Honouliuli unit water source is presently good and the use by all four endangered water birds reflects its fresh quality. However, increasing human demands for the same water source may reduce the available ground water and enable the nearby salt water to contaminate this source as well.

3. Forests

A small business operator, Scott Mathews, received a SUP to remove Kiawe trees along the boundary at the Honouliuli unit in 1980. This hardwood is a nuisance to refuge maintenance yet is a valuable wood for the manufacture of charcoal. During 1980, approximately 95 chords of wood were harvested from the unit. No fees were collected, as the operator promised to assist with the fence line brush clearing.

10. Pest Control

Limited trapping efforts were made during the stilt nesting season to control feral cats and mongooses on both units of the refuge. In general, trapping success was good; however, the use of live traps was too time consuming for this effort to continue on a regular basis.

A livestock fence along the harbor side of each unit was built in 1980. The completed perimeter fencing around the refuge secured the units from feral dogs.

The herbicide, "Roundup", was used on a one-time basis in 1980 to control the noxious roadside weeds and succulent vegetation on the nesting islands. Future applications of this herbicide and "Banvel" are necessary to provide optimum nesting habitat for the Hawaiian stilt and reduce the cover for predators.

G. WILDLIFE

1. Wildlife Diversity

This refuge was established as mitigation for the loss of stilt feeding habitat when Keehi Lagoon reef runway was built in 1976. As a result, the man-made wetland habitats of this refuge were designed to provide ideal feeding and nesting areas for stilts. The other endangered water birds, shorebirds and waterfowl have also benefited from these habitat modifications. The high salinity conditions at the Waiawa unit have restricted the diversity of avifauna compared with the fresh water conditions at the Honouliuli unit. Efforts to decrease the salinity at this unit were begun in 1980.

2. Endangered and/or Threatened Species

The fresh-water habitat at the Honouliuli unit was utilized by all four of Hawaii's endangered water birds; the Hawaiian stilt, Hawaiian coot, Hawaiian gallinule, and Hawaiian duck. The Waiawa unit supported only the endangered Hawaiian stilt, due to its hyper-saline waters, ranging from 70 to 110 ppt (sea water is 35 ppt), during the 1978-1980 period. Daily stilt movements between the refuge units and the settling basins at nearby Waipio Peninsula was observed. Nesting attempts by the stilt at both units were well documented for 1978-1980 (Table 1). Limited nesting attempts each year by Hawaiian coots and gallinules at the Honouliuli unit produced only a few young. Modifications to the nesting islands at the Honouliuli unit in 1978 better isolated these areas from the pond perimeter and reduced excessive vegetative growth not conducive to stilt nesting. Similar vegetative control was conducted on a limited basis at the Waiawa unit in 1980.

3. Waterfowl

A few feral mallards were sometimes seen at the Honouliuli unit during the 1978-1980 period. Their large size and often white mottled appearance clearly distinguished these ducks from the Koloa, the endangered Hawaiian duck. Hybridization of the Koloa by these feral ducks is a major concern of biologists in Hawaii. One duck nest containing seven eggs was found at the Honouliuli unit in May, 1979. This viable nest, believed to be from a mallard pair, was destroyed by dogs just prior to hatching.

4. Marsh and Water Birds

The native black-crowned night heron was commonly seen in both units of the refuge. The average heron population numbered less than ten per unit. These birds were believed to be associated with a small rookery less than one mile away on the north side of Pearl Harbor's west loch.

An immature white-faced ibis was observed at irregular intervals at the Honouliuli unit during 1979-1980. This ibis was also seen on the Waipio Peninsula, located between both units of the refuge.

Table 1

Hawaiian Stilt Reproductive Success
Pearl Harbor NWR

Number of Active Stilt Nests Located (containing at least 1 egg)

	<u>Waiawa Unit</u>	<u>Honouliuli Unit</u>
1978	32	32
1979	23	14
1980	20	20

Average Number of Eggs Laid Per Nest (n)

	<u>Waiawa Unit</u>	<u>Honouliuli Unit</u>
1978	3.9(32)	3.6(32)
1979	3.8(22)	3.6(14)
1980	3.7(20)	3.8(20)

Average Number of Eggs Hatched Per Nest (n)

	<u>Waiawa Unit</u>	<u>Honouliuli Unit</u>
1978	2.6(32)	1.7(32)
1979	3.0(22)	2.5(14)
1980	2.6(20)	2.6(20)

Fecundity = $\frac{\text{Number of Eggs Hatched/Nest}}{\text{Number of Eggs Laid/Nest}}$ (n)

	<u>Waiawa Unit</u>	<u>Honouliuli Unit</u>
1978	0.6(32)	0.4(32)
1979	0.8(22)	0.6(14)
1980	0.6(20)	0.6(20)

Fledgling Rate - Fledglings Per Nest (n)

	<u>Waiawa Unit</u>	<u>Honouliuli Unit</u>
1978	0.69(32)	0.23(30)
1979	0.83(23)	0.36(14)
1980	0.25(20)	0.25(20)

5. Shorebirds, Gulls, Terns and Allied Species

A least tern was seen several times at the Honouliuli unit in February, 1979. Other incidental sightings of migratory shorebirds at the refuge during 1978-1980 include black-bellied plover, semi palmated plover, sharp-tailed sandpiper, dunlin, Northern phalarope and lesser yellowlegs (6 seen in two groups). The more common migratory shorebirds at the refuge were ruddy turnstone (20-50), American golden plover (40-80), wandering tattler (5-10) and sanderling (10-20).

6. Raptors

An osprey was irregularly seen at the Waiawa unit between February, 1979 and April, 1980. This raptor was believed to be the same bird frequently observed at the Nuupia ponds, (ca. 8 miles NE of Pearl Harbor) during 1978.

11. Fisheries Resources

A large population of immature milkfish, Chanos chanos, (ca. 3 years old, 12-16" long) was noted in the Waiawa unit ponds in 1980. These fish apparently entered the refuge as juveniles through the outlet into the harbor. Management plans to drain the pond provided an opportunity for these fish to be harvested for research purposes. In September, 1980, approximately 2,000 live milkfish were collected by the Oceanic Institute for research in captive breeding for fish pond stocking and a potential live bait resource for the local tuna fisheries. Approximately 300 of these live fish were donated to a newly constructed Mokuleia fishing village pond, a cooperative program by the University of Hawaii.

A large population of milkfish still remains at the Waiawa unit and other research groups have expressed an interest in obtaining this convenient potential breeding stock for additional baitfisheries development. A controlled harvest of this fishery resource during the stilt's non-breeding season is under study.

16. Marking and Banding

A total of 24 stilts were banded and auxiliary marked with 3 plastic colored leg bands at the refuge units during 1978-1979. The stilts were captured at night by driving them into mist nets using spotlights and steady noise. Standard morphological measurements were taken of each bird prior to banding and release. One of the stilts captured at the Waiawa unit in April, 1978, was originally banded at the Hanalei NWR, on the island of Kauai, in December, 1977. This was the first documented record of a stilt flying from Kauai to Oahu, across 95 miles of ocean. These auxiliary marked birds were subsequently observed at other wetland areas on the island, and aided in the three-year study of the reproductive biology of the Hawaiian stilt.



PHB-1 - Live milkfish were harvested for research purposes (aquaculture and tuna bait-fisheries) from the Waiawa unit of Pearl Harbor NWR in Sept., 1980. RJS

H. PUBLIC USE

1. General

The urban, yet hidden, location of this refuge affords a great potential for environmental education at this unique (man-made) wetland habitat. The small area of each unit would restrict the size of school groups and season of visits to minimize disturbance to the endangered birds. Special teacher-training sessions could be easily accommodated and lesson plans should be designed to maximize the learning during the subsequent brief visits by their respective school group. Budget and staff reductions will deter such activity in the immediate future.

11. Wildlife Observation

Each winter the local chapter of the Audubon Society (10-20 persons) visited the refuge for several hours. Individual bird watchers received permits to infrequently visit the refuge throughout the year, totaling less than 25 hours per year.

17. Law Enforcement

Incidental trespass by fishermen seeking access to and from the adjacent

Pearl Harbor was the only law enforcement related concern during the 1978-1980 period. One fisherman cut the chainlink fence at the Waiawa unit several times in 1978. This individual was later identified and confronted by a USFWS special agent. No subsequent trespass was observed at this unit.

18. Youth Programs

A field crew of 2-7 enrollees in the Young Adult Conservation Corps participated in various habitat improvement projects at the refuge. These projects included vegetation control on the nesting islands and pond perimeter predator trapping, construction of livestock fencing along the harbor side of both units, drainage ditch maintenance, and boundary posting.

I. EQUIPMENT AND FACILITIES

1. New Construction

(see Section F. 2)

4. Equipment Utilization and Replacement

The 5 hp electric pump (Peabody Barnes) at the Waiawa unit had to be replaced in 1980. The original pump apparently burned up due to an excessive voltage supply and a transformer malfunction. The replacement pump (Jacuzzi), similar to the original pump, encountered the same trouble immediately. Arrangements were made to trade this new pump for a 3" submersible pump placed in the adjacent sump well. The original 3 hp pump (Crane) at the Honouliuli unit operated with little trouble throughout the 1978-1980 period.

6. Energy Conservation

Energy consumption is limited to the small electric pumps at each unit which operate only to maintain constant water levels in the vital man-made wetland habitat. Alternative energy sources such as wind or solar does not appear to be feasible at this refuge.

KAKAHAIA NWR

Molokai, Hawaii

TRI-ANNUAL NARRATIVE REPORT

Calendar Years 1978 - 1980

U.S. Department of the Interior
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K. FEEDBACK

A. HIGHLIGHTS

Kakahāia NWR supported the highest recorded nesting density of the endangered Hawaiian coots during the 1978-1980 period. An average of one active nest/acre of open water were noted on monthly surveys.

The thin strip of refuge land (1.8 acres) on the ocean side of the highway was converted to a picnic area in 1978. Six picnic tables, grills, and wind breaks were constructed and maintained by the County of Maui under a special use permit.

YCC non-residential camps were held at the refuge in 1978, 1979, and 1980. The 8-week camps of 15 local enrollees each, were supervised by a staff of three local residents. Major projects accomplished were perimeter livestock fencing and the control of encroaching bulrush in the pond.

A Stevens water level recorder was installed at the refuge, adjacent to the open water area, on November 5, 1980. Baseline water level data will be essential in determining the impact of future well drilling activities in the immediate vicinity.

B. CLIMATIC CONDITIONS

The nearest weather recording station, Molokai Airport, is located 10 miles west of the refuge. Temperature and rainfall data from this station, at a higher elevation than the refuge, would not accurately reflect the conditions at the refuge. No wind speed data is available for the island of Molokai. General weather conditions are similar to that reported for Honolulu International Airport (see Pearl Harbor, B).

C. LAND ACQUISITION

1. Fee Title

One Kuleana, totaling 0.35 acres along the northern side of the refuge was purchased in fee during 1978. Two other Kuleanas (0.43 and 0.17 acres) directly north of the pond were not purchased due to reluctant sellers. A Kuleana is an extended family of heirs who own land in common, which requires all members of the Kuleana to agree to the sale of a parcel of land. This system makes fee purchases very difficult.

A total of 44.6 acres, acquired in fee, now make up this refuge.

F. HABITAT MANAGEMENT

1. General

This 44.6 acre refuge consists of a centrally located 15 acre spring-fed

wetland area which was formerly used for rice and taro cultivation. The wetland area is bordered by a two-lane highway to the south and surrounded by a scrub forest (22 acres) on the remaining three sides. A strip of land (1.8 acres) on the ocean-side of the highway is developed as a picnic area and operated as a County Park under a special use permit.

Historic aerial photographs of this area were used to inventory major habitat types. Current aerial photographs are needed to update this habitat evaluation.



KKA-1 - Aerial photo of Kakahaia NWR looking SW taken 10/78. Note dense algal mat within open water area. GV

2. Wetlands

A total of 15 acres of wetland habitat on this refuge consists of 11 acres of a dense bulrush stand surrounding 4 acres of open water. A thick algal mat covers 50-80% of the open water area. Water bird use of this spring-fed wetland habitat is restricted, for the most part, to the open water pond (avg. depth ca. 50-70 cm.) and the bulrush border surrounding the open pond. During the summers of 1979 and 1980, YCC enrollees removed bulrush (5 m. wide strip) along the north and west sides of the open water. Regrowth of this bulrush was not apparent during the subsequent six months.

An open flat area, approximately 5 acres, along the west side of the refuge is interspersed with a low succulent plant, Batis maritima. This area, periodically flooded after heavy rains, has a potential for development into a shallow wetland habitat for the endangered Hawaiian stilt and other shorebirds.

3. Forests

A buffer zone of 22 acres of forest land surrounds the centrally located refuge wetland. Kiawe and Koa haole are the dominant species in this stand. No stand improvements have been conducted or planned for this refuge.

10. Pest Control

Mongoose trapping was conducted during the summers of 1978-1980 by YCC enrollees. Over 100 mongooses were removed from the pond area each summer.

No pesticides were used on this refuge during the three-year period.

11. Water Rights

Development of an agriculture subdivision, Kawela Plantations, which borders the refuge to the north and west, was begun in 1980. Three wells were drilled within 1600-2000 feet of the refuge boundary. The potential impact of these wells on the spring flow within the refuge wetland area was discussed in several meetings with the developers and refuge staff. A Stevens water level recorder was installed along the west side of the open water area in the refuge on November 5, 1980. This recorder will document baseline water level data prior to the active use of the Kawela Plantation wells.

G. WILDLIFE

1. Wildlife Diversity

No management activities were aimed at increasing the wildlife diversity on the refuge.

2. Endangered and/or Threatened Species

The Hawaiian coot was the only endangered species observed on the refuge during the three-year period. Monthly census of this coot population indicated a steady increase of the refuge population until February, 1978, when it peaked at 65 adult coots. This high population of 50-60 coots began to decline in June, 1978. An average population of 35-40 adult coots was maintained at the refuge in 1979-1980. This decline may be associated with the removal of the algal mat by YCC enrollees during the summers of 1978-1980. A reduced algal mat may have limited the nesting efforts and removed an important substrate for coot feeding. Year-round coot nesting attempts averaged approximately 15 nests per year during 1978-1980 period.



KKA-2 - Stevens water level recorder
installed in November, 1980 at
the edge of open water, Kakahaia
NWR. RJS

3. Waterfowl

Limited waterfowl use of the refuge has been noted during the winter months. An average of 4 scaup, 15 pintails, 10 Northern shovelers and 4 American wigeon were seen wintering on the refuge. An unusual sighting was made at Kakahaia on April 13, 1978, of two drake Gargany teal.

4. Marsh and Water Birds

Less than a dozen indigenous black-crowned night herons are regularly observed around the edge of the open water area. No heron nesting was observed on the refuge during the period.

H. PUBLIC USE

1. General

Kakahaia Pond is located immediately adjacent to the southern coastal highway and only 5 miles east of Kaunakakai, the largest town on the island. Traffic on this road is very light and most travelers pass by the refuge without seeing this important wetland. A tall, dense stand of bulrush shields any view of the open pond from the highway. If such a view was afforded to the local residents and the limited number of tourists, there could be increased disturbance and/or poaching of the endangered coot. With no FWS staff or State Forestry and Wildlife personnel on the island, this problem would be difficult to control.

14. Picnicking

A day-use only picnic area was constructed and maintained by the County on the ocean-side of the highway intersecting the refuge. These concrete tables, constructed by the YCC, and metal barbeque grills are used on a limited basis by local residents and tourists. No view of the wetland area is presently available from the picnic area.



KKA-3 - Kakahaia Park sign and picnic area constructed by YCC enrollees in 1978. JBG

18. Youth Programs

Non-resident YCC camps were held at the refuge for 8 weeks during the summers of 1978-1980. Fifteen enrollees and three staff members provided an important field crew, completing projects including perimeter fencing, bulrush control, predator control, and access trail clearing. The crews also cleared several miles of trails/fire breaks on State Forest lands near the refuge. The 1978 crew constructed six picnic tables, windbreaks and a refuge sign at the picnic area on the refuge. Environmental education for these enrollees concentrated on Hawaii's wetland habitats and endangered water birds.



KKA-4 - YCC enrollees constructing a perimeter fence at Kakahaia NWR. JBG

I. EQUIPMENT AND FACILITIES

3. Major Maintenance

Approximately \$59,000 of BLHP funds was earmarked for wetland habitat modification in FY79. Preliminary cost estimates to contract heavy equipment for the removal of encroaching bulrush far exceeded the funds allocated. These funds were carried over into FY80 and were reprogrammed to the Hanalei NWR in November, 1980, to offset the projected higher costs of the new water delivery system at that refuge.

K. FEEDBACK

The high density, year-round nesting attempts by the endangered Hawaiian coot at Kakahaia, clearly indicates the great value of this small refuge. Only 20% of the potential wetland habitat on this refuge is currently viable for coot reproduction or maintenance. Development plans for these other wetland areas must consider the subsequent impact on the existing open water area that appears to be working so well. Research efforts should be undertaken to clearly describe the existing wetland ecology of this open pond and its perimeter and to better assess the potential impacts of habitat development adjacent to this area. Water quality and quantity should be specifically addressed in this investigation.

HAWAIIAN ISLANDS NATIONAL WILDLIFE REFUGE

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K. FEEDBACK

NTR

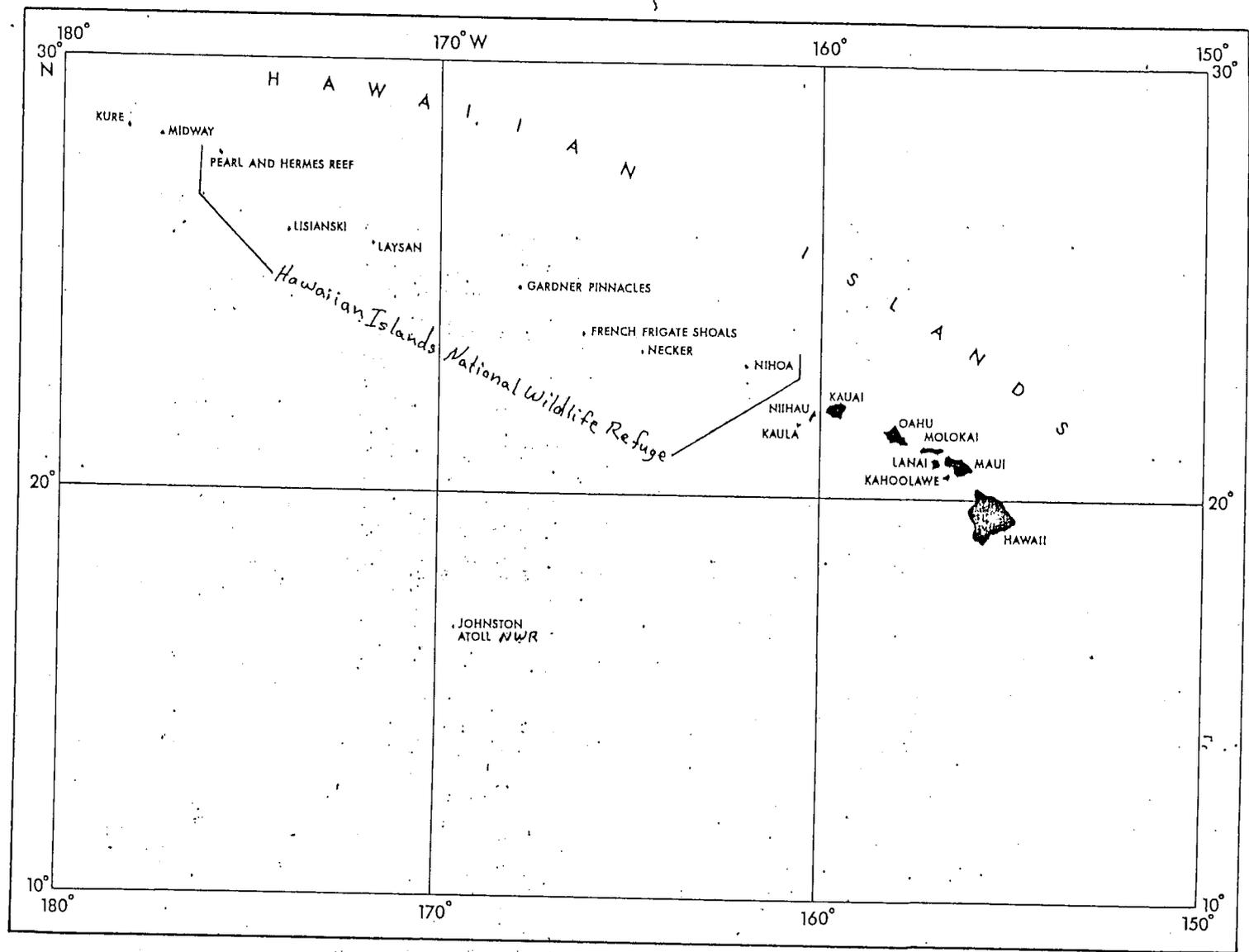


Figure 1. The Hawaiian Islands.

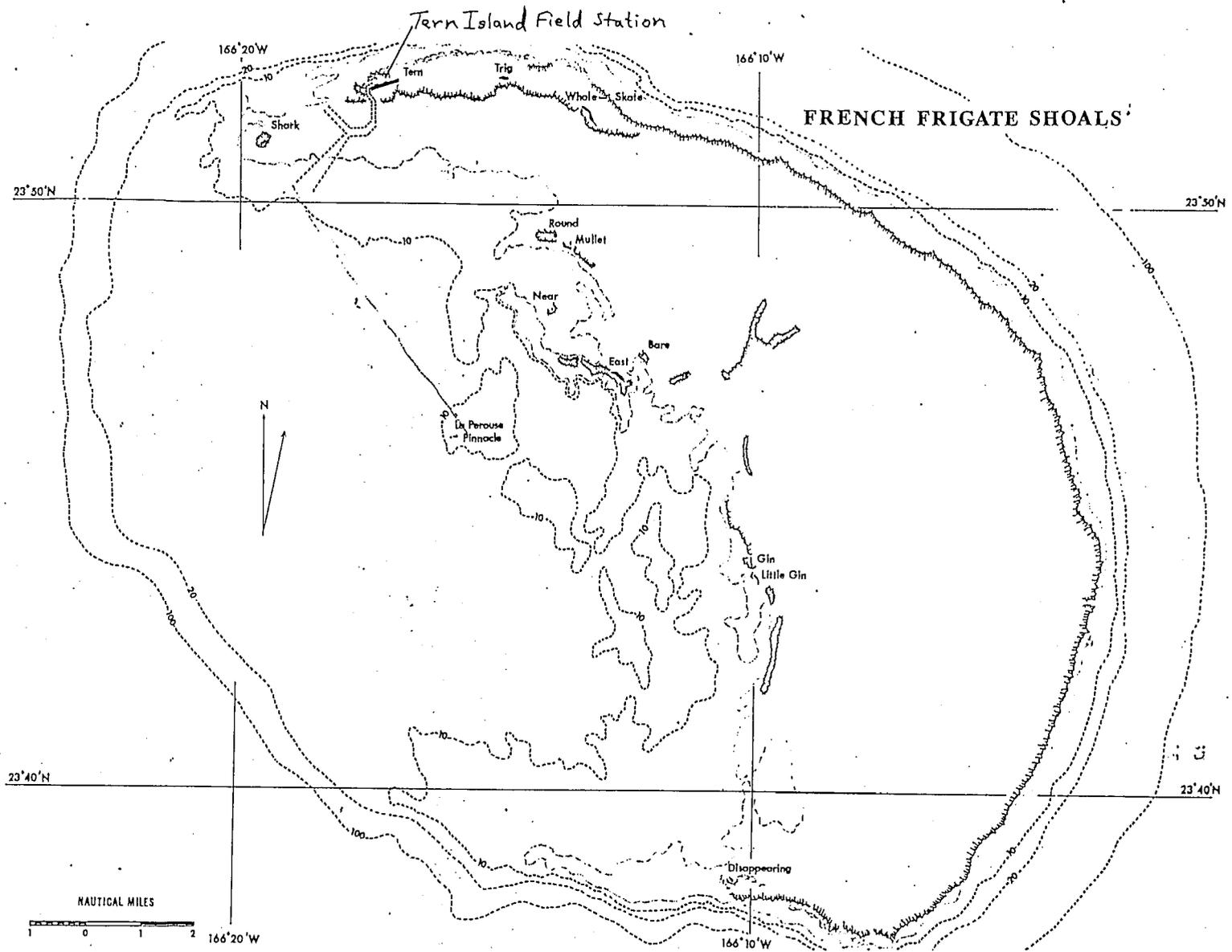


Figure 2. Map of French Frigate Shoals. Redrawn from USCGS Chart No. 4172.

A. HIGHLIGHTS

The Hawaiian Islands National Wildlife Refuge became the site of a major cooperative research effort with the signing of a Tripartite Agreement between the U.S. Fish and Wildlife Service, the National Marine Fishery Service, and State of Hawaii Department of Lands and Natural Resources. This study is designed to assess the major biotic stocks in and around the Northwestern Hawaiian Islands in order to determine the magnitude of fishery resources and to assess the potential effects of commercial fishery harvest on refuge resources. The Service's primary research role focused on seabird resources. The Sea Grant Program of the University of Hawaii became greatly involved in Tripartite research programs after the original Agreement was signed.

In July, 1979, the U.S. Coast Guard decommissioned the LORAN station that was situated on Tern Island at French Frigate Shoals. Personnel from the refuge have manned and maintained the facilities since that date and have followed through on the Secretary of the Interior's commitment to the Governor of Hawaii to maintain the station in a manner that does not preclude future uses.



HWN-1 - Tern Island, French Frigate Shoals.

GML

French Frigate Shoals was the location of two vessel groundings during 1980. The fishing boat, Santa Inez, grounded on March 10, 1980. The Greek freighter, Anangel Liberty, ran aground on the south edge of the atoll reef on April 25, 1980. In order to lighten the vessel to pull it

off the reef, 2,200 tons of alumina silicate cargo was dumped into the ocean. The vessel was successfully salvaged.



HWN-2 - Anangel Liberty, aground at French Frigate Shoals. Plume of dumped kaolin drifting away from ship. JA

B. CLIMATIC CONDITIONS

The portion of the Hawaiian archipelago included in this refuge extends from Nihoa Island (23°03'N., 161°55'W) to Pearl and Hermes Reef (27°47'N., 175°49'W). Weather conditions are variable because of the change in latitude but generally are tropical in nature with a fairly constant northeast tradewind blowing. A storm that caused major damage to the main Hawaiian Islands in January, 1980, also destroyed the solar water heater and some other equipment at Tern Island.

Temperature and precipitation records for French Frigate Shoals Weather Station are available for 1978 only because of the deactivation of the manned weather station in early 1979. A satellite monitored weather station was installed at Tern Island in August, 1980, but summary reports have not been available to date.

French Frigate Shoals Temperature and Precipitation Averages

	<u>1978</u>
<u>Temperature</u>	
Annual mean temperature	72.3°F(11 months)
Highest temperature	90.0°F(Sept.)
Lowest temperature	59.0°F(Oct.)
Departure from mean annual temperature	unknown
<u>Precipitation</u>	
Total annual precipitation	26.4 in.(11 months)
Wettest month	6.8 in.(May)
Driest month	.3 in.(April)
Departure from mean annual precipitation	unknown

D. PLANNING

2. Management Plan

MANTA Corporation was contracted in March, 1979, to conduct an extensive review of the history, natural resources and other relevant facts pertinent to the development and evaluation of various options for the future use of the Coast Guard LORAN station at Tern Island. This study included a series of interviews with legislators, fishermen, researchers, conservation group representatives and agency officials. The report of the Tern Island Study was distributed in March, 1980.

A variety of other management plans that have direct and indirect affects on the refuge were reviewed or partially developed by refuge personnel. The Western Pacific Regional Fisheries Management Council published draft management plans for a number of fishery resources that are within and/or adjacent to the refuge. These included programs for the management of precious corals, lobsters, billfish, snappers and other bottom fish.

The State of Hawaii, Dept. of Land and Natural Resources published the "Hawaii Fisheries Development Plan" in 1979 which stated that there are extensive fishery resources in or around the refuge. The plan also proposed that the Tern Island facilities be utilized as a fisheries support station.

Supervisory Wildlife Biologist Shallenberger also participated as a member of the Monk Seal Recovery Team. Team meetings were held during the period in Honolulu and San Diego.

4. Compliance with Environmental Mandates

An "Authorization to Discharge Under the National Pollutant Discharge Elimination System" was issued to the refuge for the discharge of treated domestic sewage from the Tern Island facility in February, 1980. This permit was no longer needed after the sewage system was converted to a cess pool operation during the summer of 1980.

The Tern Island Study was the initial scoping phase of a planning process anticipated to lead to an environmental impact statement at a later date.

5. Research and Investigations

A Tripartite Cooperative Agreement was signed by the Acting Assistant Administrator for Fisheries of the National Marine Fisheries Service (March 9, 1978), Lynn Greenwalt, Director of the U.S. Fish and Wildlife Service (April 19, 1978), William Thompson, Chairman of the Board of Land and Natural Resources, State of Hawaii (May 23, 1978) and Roland Higashi, Member of the Board of Land and Natural Resources, State of Hawaii (May 23, 1978).

This Agreement has provided the impetus for a tremendous amount of research with the objectives of determining the population levels of major terrestrial and marine vertebrates, selected marine invertebrates and distributions of these populations. In addition, the interaction between the terrestrial (including endangered monk seals and threatened sea turtles) resources and those marine resources that are of potential commercial value is to be determined. Particular emphasis is being put on the possible effect that commercial or recreational fishing may have on the wildlife resources of the refuge.

Research has been conducted by parties from the signing agencies and from the University of Hawaii Sea Grant Program. In April, 1980, an interim status symposium was held in which all researchers presented status reports on their projects. The "Proceedings of the Symposium on Status of Resource Investigations in the Northwestern Hawaiian Islands" was published in August, 1980. Twenty-six papers were presented under the major categories of Onshore research, Nearshore research, Offshore research and Management. The following papers were presented at the symposium:

ONSHORE RESEARCH

The Status of Seabird Research in
the Northwestern Hawaiian
Islands

Craig S. Harrison, USFWS
Thomas S. Hida, NMFS

An Investigation into Unusual
Mortality in the Hawaiian Monk
Seal, Monachus schauinslandi

William G. Gilmartin
Robert L. DeLong
Alvin W. Smith
Lynn A. Griner
Murray D. Dailey, NMFS

A Review of Basic Biological Data
on the Green Turtle in the
Northwestern Hawaiian Islands

George H. Balazs, UH

NEARSHORE RESEARCH

The Structure of Reef Fish
Communities in the Hawaiian
Archipelago: Interim Status
Report

Edmund S. Hobson, NMFS

Progress Report on the Nearshore
Fishery Resource Assessment of
the Northwestern Hawaiian
Islands: 1977 to 1979

Henry Okamoto
Paul Kawamoto, HDLNR

Results of Ciguatera Analysis of
Fishes in the Northwestern
Hawaiian Islands

Bernard M. Ito
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Preliminary Notes on Growth and
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Biology, Distribution, and Esti-
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Distribution in Relation to
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Darryl T. Tagami, NMFS

- Biology, Distribution, and Estimates of Apparent Abundance of the Spiny Lobster, Panulirus marginatus (Quoy and Gaimard), in Waters of the Northwestern Hawaiian Islands: Part II. Size Distribution, Legal to Sublegal Ratio, Sex Ratio, Reproductive Cycle, and Morphometric Characteristics
- Richard N. Uchida
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Darryl T. Tagami
Paul M. Shiota, NMFS
- Preliminary Results of Studies on Fecundity of the Spiny Lobster, Panulirus marginatus, in the Northwestern Hawaiian Islands
- Victor A. Honda, UH
- Population Estimates and Yield-Per-Recruit Analysis for the Spiny Lobster, Panulirus marginatus, at Necker Island
- Jeffrey J. Polovina
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- Population Biology of Spiny Lobsters in the Lagoon at Kure Atoll - Preliminary Findings and Progress to Date
- Craig D. MacDonald
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- Trophic Studies of Shallow-Water Fish Communities in the Northwestern Hawaiian Islands
- James Parrish
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Steven Feldkamp
Laurie Sanderson
Carol Sorden, USFWS/UH
- OFFSHORE RESEARCH
- Distributions of Plankton Stocks, Productivity, and Potential Fishery Yield in Hawaiian Waters
- J. Hirota
S. Taguchi
R. F. Shuman
A. E. Jahn, UH
- An Analysis of the Hawaiian Offshore Handline Fishery: A Progress Report
- Stephen Ralston, NMFS
- A Preliminary Report on Bottom-fishing in the Northwestern Hawaiian Islands
- Robert B. Moffitt, NMFS

- Preliminary Study on the Spawning Season of the Opakapaka, Pristipomoides filamentosus Bert S. Kikkawa, NMFS
- Feeding Habits of the Kahala, Seriola dumerili, in the Hawaiian Archipelago Robert L. Humphreys, Jr., NMFS
- Exploratory Fishing on the Hancock Seamounts by the Townsend Cromwell, 1976-79 Reginald M. Gooding, NMFS
- Survey of the Pelagic Fishes of the Northwestern Hawaiian Islands James H. Uchiyama, NMFS
- Genetic Aspects of Population Structure of Four Species in the Northwestern Hawaiian Islands James B. Shaklee
Paul B. Samollow, UH

MANAGEMENT

- Status of the Hawaiian Islands National Wildlife Refuge Robert J. Shallenberger, USFWS
- Preliminary Results from Ecosystem Modeling at French Frigate Shoals Jeffrey J. Polovina
Darryl T. Tagami, NMFS
- Economics of Fisheries Development for the Hawaiian Archipelago Salvatore Comitini
Jack R. Davidson, UH
- The Hawaii Fisheries Development Plan Stanley N. Swardloff, HDLNR

Additional papers on monk seals resulting from work on the refuge and published during the period covered by this report include:

Fiscus, C. H., A. M. Johnson, and K. W. Kenyon, 1978. Hawaiian monk seal (Monachus schauinslandi) survey of the Northwestern (Leeward) Hawaiian Islands. NW and Alaska Fish. Cent. Process. Rept. 27 p.

Johnson, B. W. and P. A. Johnson: The Hawaiian monk seal on Laysan Island: 1977. U.S. Marine Mammal Commission. Rept. No. MMC-77/05.

The principal involvement in the Tripartite Agreement by refuge personnel involved planning and implementation of studies on the life histories and ecology of the 18 species of seabirds that breed in the refuge. A particular emphasis is placed on the feeding relationships because of the direct and indirect relation of their food (fish and squid) to the fishery resources. Monitoring of monk seals and green sea turtles has also been ongoing, particularly at French Frigate Shoals. Additional avian research has been directed toward the four endangered terrestrial birds that are endemic to the refuge islands. Most of these studies are continuing beyond the years covered by this narrative report.



HWN-3 - Weighing red-tailed tropicbird chick. MN



HWN-4 - Craig Harrison, Refuge Biologist,
taking food sample from white
tern. GML

A brief listing of research projects underway within the refuge during the CY78-80 period is as follows:

Dr. Sheila Conant of the University of Hawaii conducted population, behavior and habitat utilization studies on endangered Nihoa finches and millerbirds. She was assisted by Mark Collins of the U.S. Forest Service while doing field work on Nihoa Island from June to August, 1980. Partial objectives of the study are to evaluate the feasibility of transplanting a population of millerbirds to Necker Island. Additional studies will continue in subsequent years. Dr. Conant also collected insects, molluscs and water samples for microbe analysis during her stay on Nihoa.

Dr. Daniel Moulten conducted field work to analyze the population status and breeding biology of the endangered Laysan teal on Laysan Island in the summers of 1979 and 1980. An estimated 500 Laysan teal were found. Data on habitat usage and survival of some broods was also obtained.

Endangered Hawaiian monk seal research included summer field studies in 1978, 1979 and 1980 on the life history, haul out and other behavior patterns on Laysan Island by Brian and Patricia Johnson. They experimented with different methods of population analysis. Final results of this work have not been reported. The Johnsons assisted members of the refuge staff at Tern Island in determining sex and estimating age of monk seals as part of a continuing study of population levels and demography at French Frigate Shoals. Most of this work is being conducted by refuge volunteers Susan Schulmeister and Ruth Ittner.



HWN-5 - Endangered Hawaiian monk seal with injuries from rope flotsam. GML

Dr. William Gilmartin, Eric Knudtsen, Dr. Jerry Kooyman, Thomas Loughlin and Robert DeLong analyzed diving depths for monk seals at Lisianski Island during the summer of 1980. Of over 500 dives recorded, 60% were deeper than 20 fathoms and 40% were between 20 and 100 fathoms. Diving depths were determined by recording bathymeters attached to the animals's hind flippers.

George Balazs of the University of Hawaii and Dr. Andrew Dizon (NMFS) analyzed green sea turtle movements at French Frigate Shoals with the help of radio tracking methodology during the summer of 1980 and found that most turtles tend to restrict their activities to areas surrounding islands where they had been tagged in previous years. Balazs and his assistant Alan Kam have also continued to tag turtles and monitor food habits and nesting activities throughout the Hawaiian chain. Particular emphasis in turtle studies has been placed on French Frigate Shoals because it has been found to be the major nesting area in Hawaii.



HWN-6 - Threatened green sea turtle with Laysan albatross and juvenile blue-faced booby. GML

Elizabeth Flint, Ph.D. candidate from UCLA, initiated an analysis of the breeding biology of sooty terns at Tern Island during 1980 and assisted refuge managers with seabird data collection there.

An estimated 30 Laysan finches were collected by refuge staff from Laysan Island in 1979 for a determination of their susceptibility to avian malaria by Dr. Charles Van Riper. All were found to be susceptible to the disease. This study was part of an attempt to understand factors contributing to the decline of endemic and endangered birds in the Hawaiian Islands.

Dr. Milton Friend of the USFWS National Wildlife Health Lab analyzed dead Laysan albatross from Midway Island in 1978 and determined the

cause of the deaths to be avian pox. Pox has been noted by researchers visiting this and other islands in the refuge but has not been fully quantified. It is not believed to be a major problem for albatross in the refuge.

Heavy metal presence in seabird feathers were analyzed from 18 species from 6 islands in the refuge by Dr. Ohlendorf of UC-Davis and Refuge Biologist Craig Harrison in May, 1979. No indication of abnormal levels of metals was detected although there was significant differences between locations.

A radio telemetry study of the flight patterns of seabirds from Manana Island off Oahu was conducted to determine the feasibility of initiating a larger study within the refuge. The pilot study was done in the summer of 1979 by Dr. Daniel Stonebrunner (National Park Service) and Craig Harrison. Students from the University of Hawaii Marine Options Program assisted in the research. Daily flight patterns from Manana Island suggested that the monitored birds flew to suspected feeding grounds at Penguin Banks which is southeast of Oahu.



HWN-7 - Sooty tern with radio transmitter.

RJS

E. ADMINISTRATION

3. Safety

A safety and health contingency plan was developed for Tern Island in 1980. Emergency contingency plans have also been developed for field camps.

Assistant Refuge Manager Ludwig was appointed to the Area Office Safety Committee and is also a fire warden within the Federal Office Building in Honolulu.

Two events that occurred at French Frigate Shoals were potentially dangerous. The fishing vessel Santa Inez, with a crew of four, went aground near Disappearing Island at the south end of the Shoals in March, 1980. The vessel was towed off the reef by a second fishing vessel, the Easy Rider, but the Santa Inez sank later while it was being towed to Honolulu. Refuge personnel gave assistance to the crew at Tern Island.

A second vessel grounding occurred in April, 1980, when the large freighter, Anangel Liberty, ran onto the southern side of French Frigate Shoals. Two thousand two hundred tons of kaolin were dumped into the sea before the vessel was freed by large U.S. Coast Guard vessels. Tern Island Refuge Managers, Robert Schulmeister, Jon Gravning and John Andre provided assistance to the crew of the grounded vessel and recorded observations of the salvage operation. Schulmeister received back injuries from a small boat accident that occurred during the salvage procedures.

A study done after the ship was pulled from the reef indicated that damage to the coral reef was much less significant than was suspected at first. This surprising result probably happened because the fine clay particles were rapidly flushed from the Shoals by strong currents.

4. Technical Assistance

Frequent assistance was given to the Western Pacific Regional Fisheries Management Council in the form of critiques of their proposed fishery management plans for waters adjacent to the refuge. Fishery management plans from Guam and Commonwealth of the Northern Marianas Islands were also reviewed.

Additional technical assistance included assistance in the construction of a remote weather station on Tern Island by NOAA. Continued assistance in keeping the station operational has been given. The University of Hawaii maintains a tide station at Tern Island also. Tern Island refuge personnel have given frequent assistance to the University in the form of maintaining the station and collecting data for them.

F. HABITAT MANAGEMENT

1. General

There are two geological types of islands within this refuge. Nihoa and Necker Islands, La Perouse and Gardner Pinnacles are remnants of volcanos that have eroded, steep sides that are very difficult to land on from

boats, particularly when high seas prevail. Nihoa and Necker have substantial amounts of vegetation including endemic species, but the other two islands have virtually no vascular plant life.

The second type of island is the low, sandy islets that either form part of the atoll formation at Pearl and Hermes Reef and French Frigate Shoals or are in the center of fringing reefs. Laysan and Lisianski Islands belong in the latter category.

All of the islands except Necker and Nihoa are surrounded by extensive areas of coral reef. The entire refuge is at the northern extreme of coral reef development in the Pacific Ocean. The total emergent land area within the refuge is 1,768.1 acres, while 302,435.3 acres of submerged lands are also included. Most of the submerged lands are contained within atoll lagoons at Pearl and Hermes Reef and French Frigate Shoals.

The islands and wildlife resources of the Hawaiian Islands NWR were subjected to considerable human disturbance prior to designation of the Hawaiian Islands Reservation by Executive Order in 1909. The documented fragility of these insular ecosystems has been the stimulus behind policy of "hands off" habitat management. Efforts are directed at preventative programs relating to pollution and the introduction of exotic pest species. This is done by careful control over research activities, the prohibition of entry into the refuge without authorization, and coordination with the public and governmental agencies and individuals such as fishermen, the Coast Guard and the Navy.

2. Wetlands

The only inland wetland within this refuge is a hypersaline pond on Laysan Island. No active management of this pond has taken place although a tide gauge was installed to determine the influence of oceanic tides on the water level in the pond.

There are a few freshwater seeps on Nihoa Island. Bottom scrapings from these seeps were sent to Dr. Norman Grim of Northern Arizona University for determining the presence of selected microbes in 1980. Results have not been reported.

6. Other Habitats

Land management practices at Tern Island have included maintaining the landing strip free of nesting birds and of repairing damage to the island that was caused by heavy rain or wave erosion. Filling in of erosion-caused holes has helped prevent endangered monk seals from becoming injured or trapped when they wander about the island.

In December, 1980, George Balazs, Allan Kam, William Gilmartin, Douglas DeMaster (NMFS), and Refuge Managers Ludwig, Schulmeister and Andre destroyed

a large cement slab that had been left on East Island, French Frigate Shoals from a former U.S. Coast Guard Station. This was done in order to provide additional nesting habitat for green sea turtles.



HWN-8 - John Andre, Assistant Refuge Manager, removing cement slab for green sea turtle nesting habitat improvement. GML

12. Wilderness and Special Areas

All areas within the Hawaiian Islands NWR, with the exception of the dredged area around Tern Island and highly modified areas of Tern Island, have been declared a Research Natural Area. Most Tripartite Studies that were ongoing during the period of this report fall within the realm of activities sanctioned by this designation. Most of these studies are also geared to determining the effects of a commercial activity (fishing) on the natural resources within the refuge/research natural area.

G. WILDLIFE

1. Wildlife Diversity

No active management has occurred to increase wildlife diversity, however, the basic philosophy of allowing this refuge to maintain itself in as natural a state as possible facilitates the maintenance of a high degree of species diversity. Future studies are planned to assess the natural diversity of terrestrial ecosystems in the refuge, including primarily molluscs, insects and plants.

2. Endangered and/or Threatened Species

The Hawaiian Islands NWR provides habitat for the threatened green sea turtle, and the following endangered species: Hawaiian monk seal, Laysan teal, Laysan finch, Nihoa millerbird and Nihoa finch. The endangered short-tailed albatross is also occasionally sighted within the refuge.

A variety of management studies during the 1978-1980 period involved these species. Most of the emphasis of the field work was to obtain a basic understanding of their life histories and ecology. The rationale for conducting this research was to obtain information from which recovery plans can be developed and to provide an information base from which management decisions can be made, particularly those that relate to the development of fishery resources in the refuge area. Research studies done during the period of this report are described under "Planning, Research and Investigations".

A significant die-off of Hawaiian monk seals occurred in 1978, particularly at Laysan Island and Pearl and Hermes Reef. The die-off was detected during field work being conducted by Brian and Patty Johnson on Laysan Island. They observed 20 dead seals and estimated that at least 50 had died on Laysan Island.

The cause of the monk seal die-off was not determined, although ciguatera poisoning was suspected. William Gilmartin fed moray eel meat to two elephant seals and found that it was toxic to those animals. This experiment was somewhat inconclusive since elephant seals have not evolved in an environment that harbors ciguatera whereas monk seals have. The endangered status of the monk seals precludes similar experiments with them. Gilmartin also reported that autopsied monk seals had heavy nematode infestations but it could not be determined whether this was a cause of death or an effect of the seals being in a weakened condition. No healthy monk seals could be used as a control for the determination.

Monitoring of monk seal populations at French Frigate Shoals by refuge staff members and volunteers Sue Schulmeister and Ruth Ittner indicate that the highest population of these animals in the world are at this

atoll. They have also recorded a very significant increase in the use of Tern Island by the seals since the station has been manned by U.S. Fish and Wildlife personnel. Strict enforcement of restrictions on activities that may adversely affect the animals probably accounts for the increased daily sightings of seals on the island from 0-3 in 1979 to over 30 by the end of 1980.

Laysan ducks were collected from Laysan Island in 1978 for the Pohakuloa Propagation Station that the State of Hawaii operates on the Island of Hawaii. Dan Moulton, University of Minnesota, studied Laysan ducks on Laysan Island in 1979 and 1980. His study produced population estimates of around 500 ducks. He also determined habitat usage, food utilization, movement patterns and estimates on production and survival.

Dr. Moulton and refuge personnel estimated Laysan finch population levels at about 5,000 during two field camp seasons. Laysan finches were also collected in 1978 for a research project by Dr. Charles Van Riper.

Dr. Sheila Conant, University of Hawaii, studied ecology and life history of Nihoa millerbirds and Nihoa finches during the summer of 1980. She estimated populations of millerbirds at 300 and finches at 1,750. Part of the reason for the millerbird study was to determine the feasibility of transplanting a population of these birds to Necker Island.

George Balazs continued studies of movement, feeding and nesting activities of green turtles with particular emphasis on those that utilize the nesting areas at French Frigate Shoals. His work has established that the Shoals are the most important nesting area within the Hawaiian Islands. Practically all turtles within the island chain that breed migrate to that area for that purpose. Balazs and Dr. Andrew Dizon, NMFS, conducted a radio tracking study at French Frigate Shoals in 1980 and detected little inter-island movement of the turtles.

3. Waterfowl

The general lack of suitable habitat for waterfowl and the location away from major waterfowl migratory routes accounts for the rarity of these species within this refuge. The following species were observed on Tern Island however:

<u>Species</u>	<u>Sightings</u>		<u>Season Observed</u>
	<u>1979</u>	<u>1980</u>	
Greater Scaup		2	Fall
Green-winged Teal	3	1	Fall
Mallard	1	4	Fall
Pintail		1	Fall

4. Marsh and Water Birds

The cattle egret, which was introduced to Hawaii, is occasionally observed on Tern Island. Three of these birds were seen during all seasons of the year.

5. Shorebirds, Gulls, Terns and Allied Species

The major emphasis on management in the NWHI is in the area of migratory seabirds. During the time period of this report our principal program has involved the collection of basic research data on the life histories and ecology of the 18 species of seabirds that utilize these islands for breeding and nesting. The rationale behind the studies is to increase our understanding of the relationship of the bird populations to the availability of resources in the surrounding waters. The determination of base level information on population levels, diets, growth rates, reproductive success and other aspects of the lives of these birds will hopefully allow us to make proper assessments of the effects of resource development within the waters surrounding the refuge. Long-term studies will also enable us to obtain information on the natural variability of the life history and population parameters and to continually monitor the health of the various populations.

Collection of data has been done on a year-round basis as much as conditions will allow. All islands of the refuge have been included in the sampling effort; however, Tern, Laysan and Nihoa in the refuge and Midway and Kure Islands outside the refuge have received more emphasis than the other islands because of the ease of getting to them or the presence of long-term field camps. Cooperation from the National Marine Fisheries Service Honolulu Lab has been extensive. The NOAA ship Townsend Cromwell has provided logistical support to field camps and to field survey crews doing work on all of the islands.

A major emphasis during 1978, 1979 and 1980 has been on the determination of food habits of the seabird populations. Nearly all species of seabirds have been sampled and many of them have been sampled on all islands where they are present. Some have been sampled throughout the year. Regurgitant samples were collected by Refuge Biologist Craig Harrison and other refuge staff members. The identification of the stomach contents is being done by Tom Hida and Michael Seki of the National Marine Fisheries Service Lab in Honolulu. All of the birds have been found to rely on fish and/or squid for the major part of their diets, although unusual items such as marine insects and plastic toys frequently show up in some species.

In addition to the food studies, the breeding biology has been studied and estimates of the breeding populations of a variety of seabird species have been made at field camps on Nihoa, Tern, Laysan and Lisianski Islands. Participants in these field camps have included Maura Naughton, Audrey Newman, Eric Knudtsen and Mark Rauzon from the refuge. Dr. Sheila Conant and Mark Collins of the University of Hawaii and Dr. Dan Moulton of the

University of Minnesota assisted in the collection of data for our studies in addition to their work on endangered birds.

The establishment of full-time occupancy of Tern Island by refuge staff in 1979 has also increased our ability to initiate long-term breeding biology studies and work on the development of more accurate population enumeration techniques. Bob Schulmeister, John Andre and Jon Gravning did most of the data collection on that island with the able assistance of Susan Schulmeister and Ruth Ittner, refuge volunteers. Elizabeth Flint, a graduate student from UC-Los Angeles, conducted work on the behavioral biology and energetics of sooty terns on Tern Island during the summer of 1980.



HWN-9 - Robert Schulmeister, Assistant Refuge Manager, collecting data on black noddies on Tern Island. RJS

Participants in field trips that have collected samples and made observations on all of the islands included Craig Harrison, Elizabeth Cummings, Gerald Ludwig, Rick Coleman and Demi Black from the refuge staff. We have also received assistance from Nelson Santos and Ralph Saito of HDLNR, Mike Seki of YACC and Ernie Kosaka of the Office of Endangered Species USFWS.

Collections for joint studies with outside researchers have been conducted during some of the field trips. Bird eggs were collected for pesticide analysis in conjunction with work done by Dr. Harold Ohlendorf of UC-Davis. Feathers were also collected from a number of birds for heavy

metal analysis. A telemetry study to determine feeding flight patterns of brown noddies, wedge-tailed shearwaters and red-footed boobies on Oahu was done with Dan Stonebrunner of the National Park Service.

Seabird population and distribution data that were collected during the 1978-1980 period will be analyzed and used to update earlier data developed by Smithsonian biologists in the mid-60's and by refuge staff since that time. The following table provides a summary of population estimates based on a preliminary review of historic data.

Population Estimates of Seabirds in the Northwestern Hawaiian Islands

	<u>Nihoa</u>	<u>Necker</u>	<u>FFS</u>	<u>Gardner P:</u>	<u>Laysan</u>	<u>Lisianski</u>	<u>P & H</u>	<u>Midway++</u>	<u>Kure++</u>	<u>Totals</u>
* Black-footed Albatross	100	350	4,700	0	67,000	3,500	14,000	30,000	600	120,250
** Laysan Albatross	tr	1,800	1,600	tr	550,000	8,000	45,000	500,000	2,400	1,108,800
* Bonin Petrel	0	0	750	0	40,000	1,000,000	1,000	10,000	2,500	1,054,250
Bulwer's Petrel	250,000	200	500	tr	20,000	tr	tr	0	0	270,700
Wedge-tailed Shearwater	25,000	4,500	13,000	tr	1,000,000	500,000	26,500	20,000	1,500	1,590,500
+ Christmas Shearwater	800	0	tr	0	10,000	2,000	tr	100	tr	12,900
* Sooty Storm-Petrel	tr	0	tr	0	2,500	0	7,500	0	0	10,000
Red-tailed Tropicbird	500	200	450	100	4,000	4,500	200	3,000	2,000	14,950
Masked Booby	350	500	1,200	800	2,000	1,200	600	20	100	6,770
Red-footed Booby	3,500	1,400	750	tr	2,500	3,000	200	1,000	600	12,950
Brown Booby	225	50	135	20	250	200	200	tr	100	1,180
Great Frigatebird	10,000	2,000	1,400	250	8,000	2,500	900	200	500	25,750
Sooty Tern	100,000	50,000	250,000	750	2,000,000	1,700,000	80,000	50,000	12,000	4,242,750
+ Gray-backed Tern	10,000	7,500	1,750	4,000	40,000	15,000	1,900	50	100	80,300
+ Blue-gray Noddy	2,500	2,500	tr	tr	tr	0	0	0	0	5,000
Brown Noddy	20,000	50,000	10,000	5,000	30,000	15,000	8,400	3,000	1,200	142,600
Black Noddy	2,000	1,000	11,000	400	5,000	5,000	4,300	5,000	2,000	35,700
White Tern	3,000	600	3,700	400	1,500	500	tr	6,000	tr	15,700
										<u>19,418,750</u>

** breed in NWHI only

* breed in NWHI and Bonin Island/Volcano Island only

+ large portion of world population in NWHI

++ Midway and Kure Atolls are not part of the Hawaiian Islands NWR

Other birds of this category that were observed at Tern Island during 1979 and 1980 include the following:

<u>Species</u>	<u>Sightings</u>		<u>Season Observed</u>
	<u>1979</u>	<u>1980</u>	
White-tailed tropicbird		2	summer
American golden plover	1-83	3-84	all year, winter high
Semi-palmated plover	1		summer
Bristle-thighed curlew	2	3	summer
Wandering tattler	7	7	all year
Ruddy turnstone	up to 225	10-252	all year, winter high
Dunlin		2	fall
Ruff/reeve	2		summer
Spotted sandpiper	1	1	summer, fall, winter
Sharp-tailed sandpiper	1		fall
Pectoral sandpiper	1	1	fall
Sanderling	2-4	2-7	fall
Wilson's phalarope	1		summer
Glaucous gull		1	winter
Franklin's gull		1	summer
Least tern	1	1	summer
Greater yellowlegs (Greenshank ?)		1	fall

6. Raptors

Raptors are seldom seen within the Hawaiian Islands NWR except for occasional sightings of shorteared owls. Shorteared owl individuals were reported from Tern Island during the fall and winters of 1979 and 1980.

7. Other Migratory Birds

Other migratory birds that have been reported from Tern Island include mockingbirds (1-3 were seen in the fall of 1979), a snow bunting seen in the fall of 1979 and a Savannah sparrow (little bunting ?) spotted in the fall of 1980.

9. Marine Mammals

Although a number of marine mammals such as whales and porpoises are occasionally found within or near the refuge they have not been the subject of research or management activities. The endangered Hawaiian monk seal is covered in the "Endangered Species" section of the report.

11. Fisheries Resources

Fishing is prohibited within the refuge although there have been requests to conduct commercial fishing for certain inshore species and for baitfish for offshore tuna fishing. The "Management: Research and Investigations" section of this report lists the titles of some of the ongoing or completed fisheries resources investigations that have occurred within or adjacent to the refuge.

Refuge staff have assisted in the appraisal of fisheries management proposals that may have an effect on the resources within the refuge. The staff has also assisted the work of a number of researchers by providing logistical assistance and quarters at the Tern Island Field Station on many occasions. In addition, Tern Island and Honolulu staff members have helped in data and specimen collection for lobster and fish studies at French Frigate Shoals.

The Tern Island Field Station at French Frigate Shoals has provided logistical support and lodging for a number of Tripartite related fishery studies. Dr. James Parrish of the Hawaiian Cooperative Fisheries Research Station (USFWS) is doing extensive studies there on the trophic dynamics of inshore reef fish. The State of Hawaii (HDLNR) has conducted population studies of inshore fishery resources at the Shoals and at all other islands within the Refuge. Besides reef fish they have also assessed population levels of opihi (an edible limpet), lobster and other crustaceans. Lobster and offshore fisheries resources around the Shoals and other island areas have been surveyed by NMFS from the NOAA ship Townsend Cromwell. Population levels of mackerel scad and assessment of primary production has been conducted by Dr. Jed Hirota of the University of Hawaii. Genetic differentiation between islands for opihi and damselfish has been determined by Dr. James Shaklee of UH also. Dr. Edmund Hobson of the National Marine Fisheries Service has done extensive work on the distribution of reef fish throughout the NWHI. Dr. Leighton Taylor and Timothy Tricas of UH in cooperation with Gary Naftel, captain of the Easy Rider, have done a study of feeding and daily movements in tiger sharks at French Frigate Shoals.

14. Scientific Collections

Collecting of scientific specimens has been conducted in conjunction of most of the previously mentioned studies. A brief listing of the types and magnitude of collections includes the following: 20 Laysan finches from Laysan Island, 472 feather samples from 18 seabirds in 10 locations for heavy metal analysis; 4,315 regurgitant samples from 18 seabirds from all islands in the Northwestern Hawaiian Islands for stomach analysis; assorted inshore fish from French Frigate Shoals for stomach analysis; assorted corals and coralline algae for identification and ageing; fish and limpets from La Parouse pinnacle, French Frigate Shoals and Necker Island for electrophoretic analysis; monk seal scat and spewing samples

for analysis of feeding and parasites; limpet samples to determine population structure; one dead monk seal salvaged from French Frigate Shoals and 15 dead monk seals from Laysan Island for autopsies, 300 hatchling green sea turtles for marking and recapture experiments.

16. Marking and Banding

An extensive banding program has been carried out within the refuge in order to determine ages and inter-island movement of sea and other birds. The following list includes banding that occurred on the refuge and also at Kilauea Point, Kauai, Midway Island and Kure Island.

<u>Species</u>	<u>Number of Birds Banded</u>		
	<u>1978</u>	<u>1979</u>	<u>1980</u>
Sooty tern		306	7
Gray-backed tern		206	97
Noddy tern			87
Fairy tern		37	31
Black noddy		63	316
Black-footed albatross	51	117	325
Hybrid albatross			1
Short-tailed albatross		2	
Laysan albatross	3,997	653	765
Black-brown albatross		5	
Wedge-tailed shearwater	454	1,116	595
Christmas shearwater		6	91
Dark-rumped petrel	1		
Bonin Island petrel		47	66
Bulwer's petrel		29	152
Sooty storm petrel		11	
Red-tailed tropicbird		105	26
Blue-faced booby		6	82
Brown booby		5	128
Red-footed booby	13	285	23
Laysan teal		448	50
American golden plover			18
Ruddy turnstone			116
Laysan-Nihoa finch			3
Total	<u>4,516</u>	<u>3,466</u>	<u>2,979</u>

Approximately 450 green sea turtles were tagged by George Balazs from 1978 through 1980.

17. Disease Prevention and Control

Assistance has been given to the National Marine Fisheries Service in the way of collecting dead monk seals in an attempt to determine the causes of death. Logistical and on-site observational assistance was also given during the monk seal die-off of 1978. Results of autopsies performed on seals have been inconclusive. The cause of deaths in 1978 is thought to have been ciguatera because of symptoms associated with the deaths. Heavy nematode infestations were detected by the autopsies.

Bird diseases have not been a major problem on the refuge, however, refuge biologists have provided advice and assistance in the form of advice to wardens and collecting specimens and having the material analyzed in USFWS labs during a die-off of Laysan albatross on Midway. Milton Friend, USFWS Avian Disease Laboratory, determined that bird pox was the cause of death.

H. PUBLIC USE

1. General

Because of the potential danger to endangered species and to nesting seabird populations, visitation to the islands in the Hawaiian Islands NWR is restricted to researchers and other personnel engaged in management related projects. Previous introductions of rabbits to Laysan Island resulted in the extinction of three endemic bird species. Potential introduction of other exotic animals, plants or diseases may cause irreversible damage to these fragile ecosystems.

In order that the public may be aware of the resources present there an interpretive display has been opened at the Kilauea Point Wildlife Administrative Site on Kauai Island. A number of the bird species that breed in the HINWR can be observed there including red-footed boobies, wedge-tailed shearwaters, white-tailed tropicbirds and great frigatebirds. Many public lectures and newspaper interviews are also given by refuge staff.

Articles on the refuge are frequent in the local newspapers. National Geographic, May, 1978, featured the refuge in the article "Hawaii's Far-flung Wildlife Paradise". National Wildlife, April-May, 1979, published a photograph by Mark Rauzon of a nesting red-footed booby on Tern Island. The refuge was also featured on a popular local tide calendar for 1978 and 1980. Monthly photographs of wildlife or of the islands taken by George Balazs were utilized in these calendars.

17. Law Enforcement

No arrests for law violations occurred during the period of this report, however, several incidents were investigated.

Trespass on Laysan Island and Pearl and Hermes Atoll by helicopters in 1978 was stopped after helicopters were removed from Midway Island by the Navy and the Navy issued orders to aircraft carriers to cease the activity.

Mitigating circumstances were felt to be of sufficient magnitude to stop additional investigation into an incident where a researcher left a net unattended overnight in 1980 in violation of provisions of his Special Use Permit. The net had become tangled in coral as it was being removed and nighfall prevented the safe removal of the net.

Investigation of alleged trespassing and harassment of monk seals on Laysan Island by a researcher in 1980 was ceased when insufficient evidence was found to continue the case.

The alleged use of unauthorized fish collecting methods (rotenone) within the refuge in 1978 and 1979 was stopped after provisions of the researcher's Special Use Permit were clarified.

Threats by two commercial fishermen to illegally fish within the boundaries of the refuge in 1978 and 1979 were investigated but no action was taken after Law Enforcement Special Agent James Bartee and Refuge Manager Geizentanner apprised the fishermen of the boundaries and the legal consequences of trespassing. No illegal fishing was found.

Alleged trespass by a fishermen who had run aground at French Frigate Shoals in 1980 was investigated. No charges were pressed because the grounding was outside the refuge, according to witnesses on the vessel that towed the grounded fishing boat away from the reef.

21. Volunteers Program

Susan Schulmeister and Ruth Ittner have provided considerable amounts of their time in assembling data on Hawaiian monk seals and in assisting in every aspect of the Tern Island Field Station. A number of Marine Options students assisted in the seabird telemetry work, with Dylan Balesco providing many hours of his time to this effort. Beth Flint has been extremely helpful to the Tern Island staff during her research activities at Tern Island.

James Cook of the fishing boat Kaimi and Gary Naftel of the Easy Rider have provided invaluable help in bringing supplies to the Tern Island Field Station.



HWN-10 - Volunteer Beth Sheekey measuring red-footed booby eggs on Tern Island. GV

I. EQUIPMENT AND FACILITIES

1. New Construction

The Tern Island Field Station was a U.S. Coast Guard LORAN station until the U.S. Fish and Wildlife Service took over operations of the station in 1979 after the LORAN facilities were no longer needed. The USFWS was committed to keeping the station in a condition that "does not preclude other uses". This commitment was made by the Secretary of the Interior to the Governor of the State of Hawaii at the time the Coast Guard abandoned the station. The commitment was made in order that the station not deteriorate to a point that it could not be utilized as a fisheries support station by Hawaiian fishermen should a decision be made in the future to do so. The LORAN station supported about 22 personnel while the station is now staffed by two refuge assistant managers and two volunteers. Because of the reduction in people at the station it was determined that the size of the operating systems could be reduced. Principally this took the form of deactivation of the sewage treatment facility and changing it to a septic system, reduction in the power utilization resulted in the installation of a 15 kw and a 17.5 kw generating system also. The three 250 kw generators that the Coast Guard used are now run periodically in order to maintain their operating capability but they are only utilized for power when the smaller generators are being repaired.

A solar water heating unit was installed in order to conserve power but it was later destroyed in a storm. Since that time (1980) the small generators have been converted to a system that will produce sufficient hot water for the station. This conversion involved substantial amounts of personnel time in digging ditches for water lines and assisting the contractor in the installation of the system.

New construction of a safer boat launching facility was completed in the summer of 1980.

2. Rehabilitation

Major rehabilitation efforts at Tern Island included the conversion of a sewage system to a septic tank system, major repairs to the fresh and salt water holding and distribution system, repairs to the large refrigeration system and major improvements to the boat launching facility including reinforcement of the boat hoist. A tractor-frontend-loader-backhoe was completely overhauled as was a small pickup truck. An automatic oiling mechanism was installed on the engines for the generator system.

3. Major Maintenance

Major maintenance procedures include constant grooming of the gravel runway at Tern Island, repair and overhaul of the generating system, repair of a truck and repair and overhaul of a tractor with front-end loading and backhoe accessories. Numerous repairs and maintenance processes are required to keep ahead of the corrosion caused by exposure of all equipment on Tern Island to the salty environment. This involves constant lubrication, derusting and painting of all metal equipment and frequent painting of cement and wood surfaces.



HWN-11 - Grooming the Tern Island runway.

RJS

Erosion control is required after every major storm that passes Tern Island. This is necessary to keep the runway clear and to fill holes that are a danger to wandering turtles and monk seals. Three large generator systems are kept operational but are not currently required for power. A salt water distillation unit is kept operational but is not used either.

All buildings, water, sewage and electrical systems and all equipment are kept in working order as per the Secretarial commitment to the State of Hawaii.

4. Equipment Utilization and Replacement

The heavy usage of the Tern Island facility by USFWS and visiting researchers has resulted in high utilization of all of the station's equipment. Because much of the research that is conducted there requires the use of small boats, the resident managers are frequently repairing or tuning up outboard motors and maintaining the boats in working condition.

This includes housing, kitchen facilities, the airfield, boats and storage areas, hand and power tools, the radio and other communications equipment and some recreational facilities including a tennis court and pool table. The use of the boats increases the rate of deterioration of the boats and engines. A 16 foot utility boat, two 55 hp outboard engines and a 25 hp outboard engine have recently been added.

5. Communications Systems

The Tern Island staff maintains two single side band radios for communication with the Kilauea Administrative Site and with Honolulu. During the time when field camps are in operation on other islands, communication is also maintained through Tern Island.

A non-directional beacon was installed at Tern Island in 1980 to aid the supply plane in finding the island during its monthly (or more frequent) flight to the island.

On-site communication with researchers in the lagoon or on islands at French Frigate Shoals is maintained on a scheduled basis with the resident managers through hand held radios. A radio system that monitors marine band broadcasts is kept operating also.

6. Energy Conservation

A solar water heater was installed in 1979 but it was destroyed during a severe storm in January, 1980. In September, 1980, a heat exchanger unit was installed on the diesel engines that operate the generators. This unit provides hot water for the station. The water that is needed at the station is collected from rain run-off instead of using the distillation units that were left by the Coast Guard. The Coast Guard

delivered 20,000 gallons of fuel oil to Tern Island in the summer of 1980. Future fuel deliveries will require other arrangements because of the reduced Coast Guard budget.

J. OTHER ITEMS

1. Cooperative Programs

The Tripartite Agreement that has been signed with the State of Hawaii and the National Marine Fisheries Service is the principal cooperative program the refuge has been engaged in during the term of this report. The scope of the Agreement is discussed in greater detail under "Highlights" and "Planning" sections of this report.

An informal cooperative program in which fishermen and the personnel of the refuge help each other has developed during the time that the Service has been at Tern Island on a full time basis. We frequently help the fishermen by relaying messages to individuals that are outside the range of their radios, have brought up spare parts for their boats and have provided refuge from storms in some cases. The fishermen have brought gasoline drums and other items that are too heavy or bulky to fit on the supply plane to the Tern Island Field Station.

JOHNSTON ISLAND NWR

TRI-ANNUAL NARRATIVE REPORT

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Fish and Wildlife Service
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K. FEEDBACK

NTR

A. HIGHLIGHTS

Johnston Atoll was established as a National Wildlife Refuge by Executive Order in June, 1926. Subsequent events in the Pacific resulted in the establishment of the atoll as a strategic military installation by Executive Order in 1934. The joint administration of the atoll by the Department of the Interior and the Department of Defense precipitated the formulation of a Memorandum of Understanding that was signed in 1976. This Memorandum of Understanding states that the Department of the Interior, through the U.S. Fish and Wildlife Service, has primary responsibility and jurisdiction for the protection and preservation of the atoll's natural resources, fish and wildlife. The Department of Defense through the Defense Nuclear Agency has jurisdiction over the atoll in matters pertaining to military operations, human residents and visitors to the atoll.



JHN-1 - Johnston Island and Sand Island, Johnston Atoll
NWR. GML

Johnston Atoll has been utilized by the Department of Defense as a base during World War II, for atmospheric testing of nuclear devices, for the storage of nerve and mustard gas and their projectiles and for the temporary storage of the defoliant Agent Orange.



JHN-2 - Warning signs for toxic gas storage area on Johnston Island. GML

Two visits by refuge personnel were made during the period of this report.

B. CLIMATIC CONDITIONS

The National Oceanic and Atmospheric Administration maintains a manned weather station on Johnston Island. The following table summarizes temperature and precipitation data for 1978, 1979 and 1980.

	<u>1978</u>	<u>1979</u>	<u>1980</u>
<u>Temperature</u>			
Annual mean temperature	79.4°F	19.2°F	80.5°F
Highest temperature	86.0° (Oct.)	88.0° (Oct.)	89.0° (Oct.)
Lowest temperature	69.0° (Mar.)	67.0° (Jan.)	69.0° (Jan.)
Departure from mean annual temperature	+0.5°	+0.3°	+1.6°
<u>Precipitation</u>			
Total annual precipitation	24.1 in.	36.8 in.	17.4 in.
Wettest month	5.4 in. (Dec.)	13.8 in. (Nov.)	4.3 in. (Nov.)
Driest month	.1 in. (June)	.2 in. (June)	.1 in. (Apr.)
Departure from mean annual precipitation	-4.0 in.	+2.7 in.	-10.7 in.

D. PLANNING

2. Management Plan

The Memorandum of Understanding was reviewed with the commanding officer of Johnston Atoll in June, 1980. Although no changes were made in the MOU it was stated that limited on-site experience by new refuge staff would necessitate reevaluation of the MOU in the near future.

During a visit by Assistant Refuge Manager, Gerald Ludwig, in September, 1980, a variety of subjects were discussed with the commanding officer, LTCOL Klein, and the base engineer, MAJ Gage. These discussions covered the need for the posting of refuge regulations, the possible assistance by the Defense Nuclear Agency in the development of habitat improvements on some parts of each of the islands and the need for enforcement of refuge regulations pertaining to visitation to North and East Islands, particularly during the seabird nesting seasons. Additional subjects of discussion related to the preservation of vegetation on each of the islands, particularly Johnston Island, and the need to regulate the removal of coral and fish from Johnston Atoll.

Greater coordination of military planning and activities that may affect wildlife resources was agreed upon in these meetings. In addition, the Defense Nuclear Agency agreed to and did construct a sign at the airport entrance to the atoll that identified the atoll as a National Wildlife Refuge. They also agreed to pay greater attention to briefing incoming personnel on the refuge status of the atoll and to regulate the taking of fish and coral to the limits outlined within the MOU.

These meetings have resulted in greatly improved communication occurring between the Defense Nuclear Agency and the Refuge staff.

5. Research and Investigations

Surveys of bird populations on each of the islands and of the condition of the coral reefs and the dredged areas of the lagoon were conducted during two visits by refuge staff during 1979 and 1980 (see Wildlife).

The Defense Nuclear Agency also conducted surveys of the amount of residual radiation present on the island from the explosion of two nuclear warhead carrying rockets. They also continued monitoring of effects of the leakage of Agent Orange that occurred while it was stored on Johnston Island during the mid-1970's. Details of these investigations are not fully known except that a number of radioactive pieces of scrap metal were found during the radiation survey. Three areas of Johnston Island were also placed off-limits to personnel because of the presumed presence of unacceptable levels of radioactive plutonium. The area of Johnston Island where the Agent Orange was stored is also off-limits to all personnel, presumably because of the presence of dioxin. LTCOL Charles Thalken is conducting or coordinating the investigation of the dioxin residual. He is stationed at Brooks Air Force Base, Brooks, Texas.

F. HABITAT MANAGEMENT

1. General

Johnston Atoll originally consisted of two low sandy islands surrounded by a coral reef. The coral reef forms a barrier that reaches sea level at low tide on the north side of the atoll. The original surveys of these islands during the mid-1980's to the 1930's indicated that there were only two species of plants present. The abundance of seabirds on the islands provided the resources for a guano harvest during the 1890's.



JHN-3 - Achilles tangs and table top coral in Johnston Lagoon. GML

Since the occupation of the atoll by the military there has been tremendous changes in both the terrestrial and marine habitats. Johnston Island and Sand Island were enlarged a number of times and also covered with structures related to the military operations.

Dredging operations to facilitate sea plane landings occurred in the late 1930's. Subsequent dredging has occurred to allow for the entrance of military vessels to the atoll, to increase the size of Johnston and Sand Islands and to construct North and East Islands. Johnston Island was increased in size from 60 acres in 1942 to 625 acres in 1964 through the utilization of dredge spoil. North Island is 25 acres and East Island is 18 acres of dredge spoil. The depth of the dredged areas reaches 55 feet in some areas. No additional dredging occurred during the 1978-1980 period.

North Island is now utilized only for occasional small arms training and East Island is not used by the military. Sand Island is the site of a U.S. Coast Guard LORAN station. Johnston Island is now a storage site for poisonous gases, radioactive materials and dioxin contaminated items. It is also the site of a 5,000 foot runway, and active harbor and the facilities necessary to operate the base and house its human occupants.

As might be expected from the drastic changes that have occurred during the history of this Refuge there have been many fluctuations in the fish and wildlife resources. Much of the coral reef has been destroyed by the dredging and the resultant siltation. Trash is very common in some areas of the reef and pollution from sewage has enriched or destroyed portions of the reef as well.

Although there have been major damages to the environment, some of the activities in the past are now providing additional habitat for some of the natural inhabitants of the atoll. The near abandonment of activities on East Island has resulted in the establishment of a sooty tern and a red-footed booby colony. White terns, gray-backed terns, brown noddies and red-tailed tropicbirds are colonizing North Island. The succession of vegetation into the dredge spoil areas of Johnston Island is providing habitat for moderate numbers of red-tailed tropicbirds. In addition, the great increase in the variety of introduced plants on Johnston Island has probably resulted in an increase in the number of white terns and black noddies that nest at the atoll.

No active habitat management occurred during the 1978-1980 period. Future activities will probably include habitat enrichment of North and East Islands which are now only gradually increasing in vegetative complexity. Greater coordination with the Defense Nuclear Agency to maintain and improve existing habitat on all islands will hopefully also improve the terrestrial habitat. Coordination of activities will also hopefully prevent further deterioration of the marine environment. cursory surveys of the dredged areas of the lagoon in 1980 indicated that considerable colonization of coral and other organisms has occurred in some areas.



JHN-4 - Sooty tern colony on East Island.

GML

G. WILDLIFE

2. Endangered and/or Threatened Species

Interviews with longtime residents of Johnston Island (Holmes and Narver, Inc. personnel) in 1980 indicated that a Hawaiian monk seal, observed at the atoll over an extended period, was accidentally killed when a boat ran over it in 1977. No seals have been observed since that time. The threatened green sea turtle is a frequent visitor or resident of the atoll. Many residents reported to Ludwig in 1980 that they enjoy spending time along the south side of Johnston Island watching green sea turtles forage on the marine algae that is abundant there. It is quite possible that the algae is being enriched by the sewage outfall that is on that side of the island. The water in this area is considerably more turbid than in other areas of the lagoon and marine algae cover is greater. Ludwig sighted 20-30 turtles near the south shore during his September, 1980 visit.

5. Shorebirds, Gulls, Terns and Allied Species

The four islands in Johnston Atoll provide breeding habitat for at least 11 species of seabirds. During the surveys conducted by refuge personnel in 1979 and 1980 the following populations were estimated:

Species	April, 1979		Sept., 1980	
	Count	Breeding* Status	Count	Breeding* Status
Wedge-tailed shearwater	low 1,000's	a	burrows present	not noted
Christmas Shearwater	present	?		
Red-tailed Tropicbird	60	b	5	c
Brown Booby	101	a-d (60)	219	a-c
Red-footed Booby	190	c	152	a-c
Great Frigatebird	300	a	152	a-d (4)
Sooty Tern	150,000	b-d	30	e (10)
Gray-backed Tern	75	b-c		
Brown Noddy	5,050	b	658	a-e (40)
Black Noddy	15	b (3)	40	a-b
White Tern	10	c (1)	60	a-b
Golden Plover			100+	a
Ruddy Turnstone			100+	a

*a no nesting

b eggs present

c small chicks present

d large chicks present

e fledglings present

() numbers in parentheses are the number of eggs, chicks reported

11. Fisheries Resources

The Memorandum of Understanding with the Defense Nuclear Agency allows for the taking of fish and limited amounts of coral for recreational purposes. Although no accurate estimates of the amount of fish taken by island personnel are available, it is known that recreational fishing is a favorite pastime of many people there. Types of fishing include cast netting from the shores of Sand, East and North Island, spearfishing and hook and line fishing from boats and shore. In addition to fishing in the lagoon, Johnston Island personnel also fish for pelagic species on the outside of the lagoon (outside refuge boundaries).

Refuge personnel have advised the command at Johnston Island that the eating of fish from within the lagoon may be risky because of past problems of fish poisoning that have occurred in the mid-60's. Testing of fish during that time indicated a fairly high percentage of species were ciguatoxic.

H. PUBLIC USE

1. General

Approximately 145 military and 200 civilian contractors were stationed on Johnston Atoll during this period. Many are particularly interested in fishing and recreational diving among the coral reefs. Shell collecting, underwater and terrestrial photography and bird, fish and turtle watching are favorite pastimes for many people there. Observing sharks at a point where garbage is discarded is a highlight for many resident and visiting personnel. For purposes of reporting, these activities by stationed personnel are not considered "public" use as no unauthorized visitors are allowed at the station.

6. Interpretive Exhibits/Demonstrations

Preliminary conferences to jointly develop an interpretive display at the Johnston Island airport were held with the commanding officer and the base engineer during Ludwig's 1980 visit.

Assistant Refuge Manager Ludwig presented several slide programs on reef and shore habitats and fauna during 1980.

I. EQUIPMENT AND FACILITIES

1. New Construction

The Defense Nuclear Agency through their contracting agency, Holmes and Narver, Inc. constructed a sign at the airport that indicates Johnston Atoll is a National Wildlife Refuge.

BAKER/HOWLAND/JARVIS NWR'S

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7. Grazing	NTR
8. Haying	NTR
9. Fire Management	NTR
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11. Water Rights	NTR
12. Wilderness and Special Areas	NTR
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G. WILDLIFE

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3. Waterfowl	NTR
4. Marsh and Water Birds	NTR
5. Shorebirds, Gulls, Terns and Allied Species	5
6. Raptors	NTR
7. Other Migratory Birds	NTR
8. Game Mammals	NTR
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10. Other Resident Wildlife	9
11. Fisheries Resources	NTR
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8. Hunting	NTR
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11. Wildlife Observation	NTR
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I. EQUIPMENT AND FACILITIES

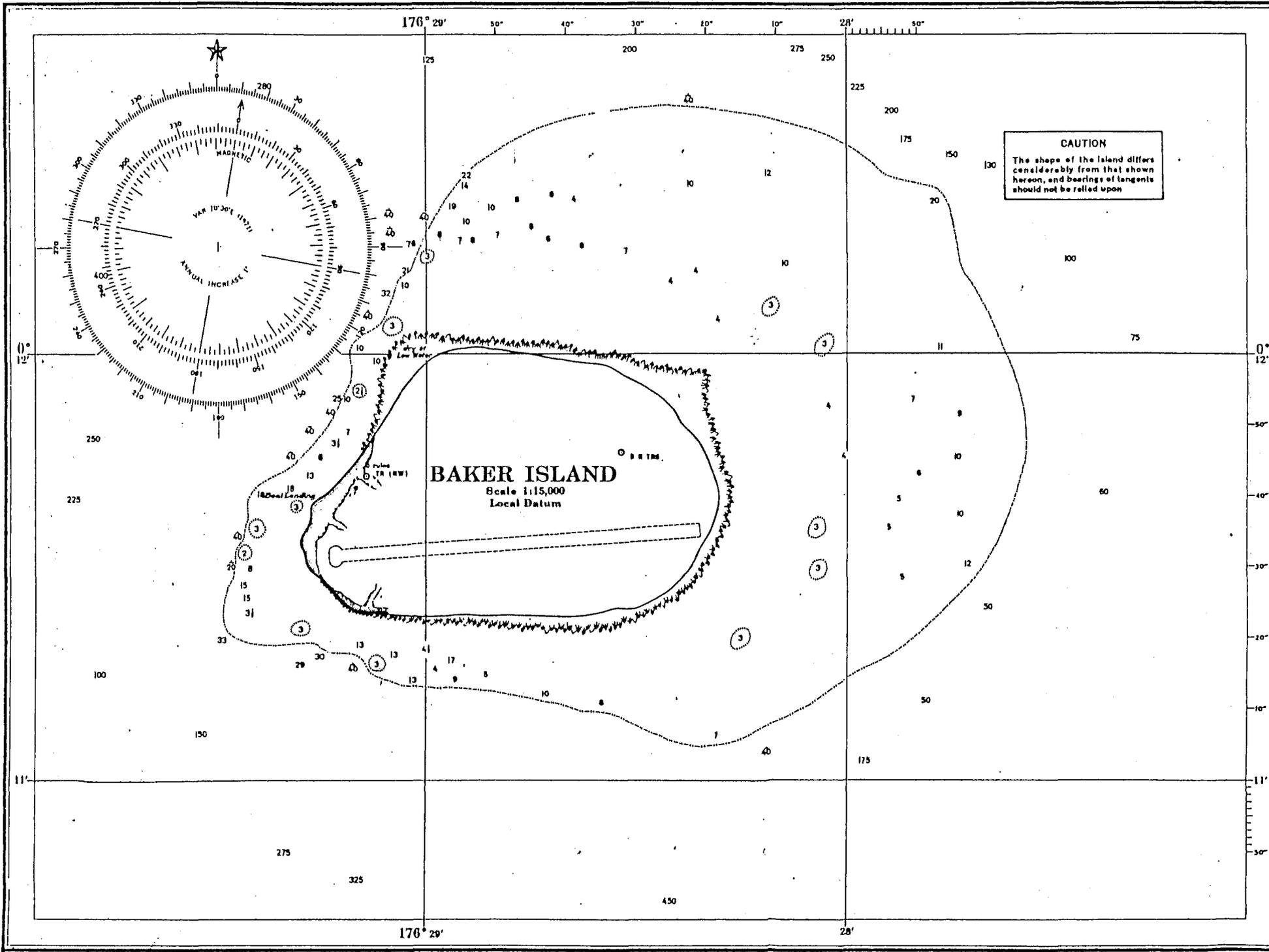
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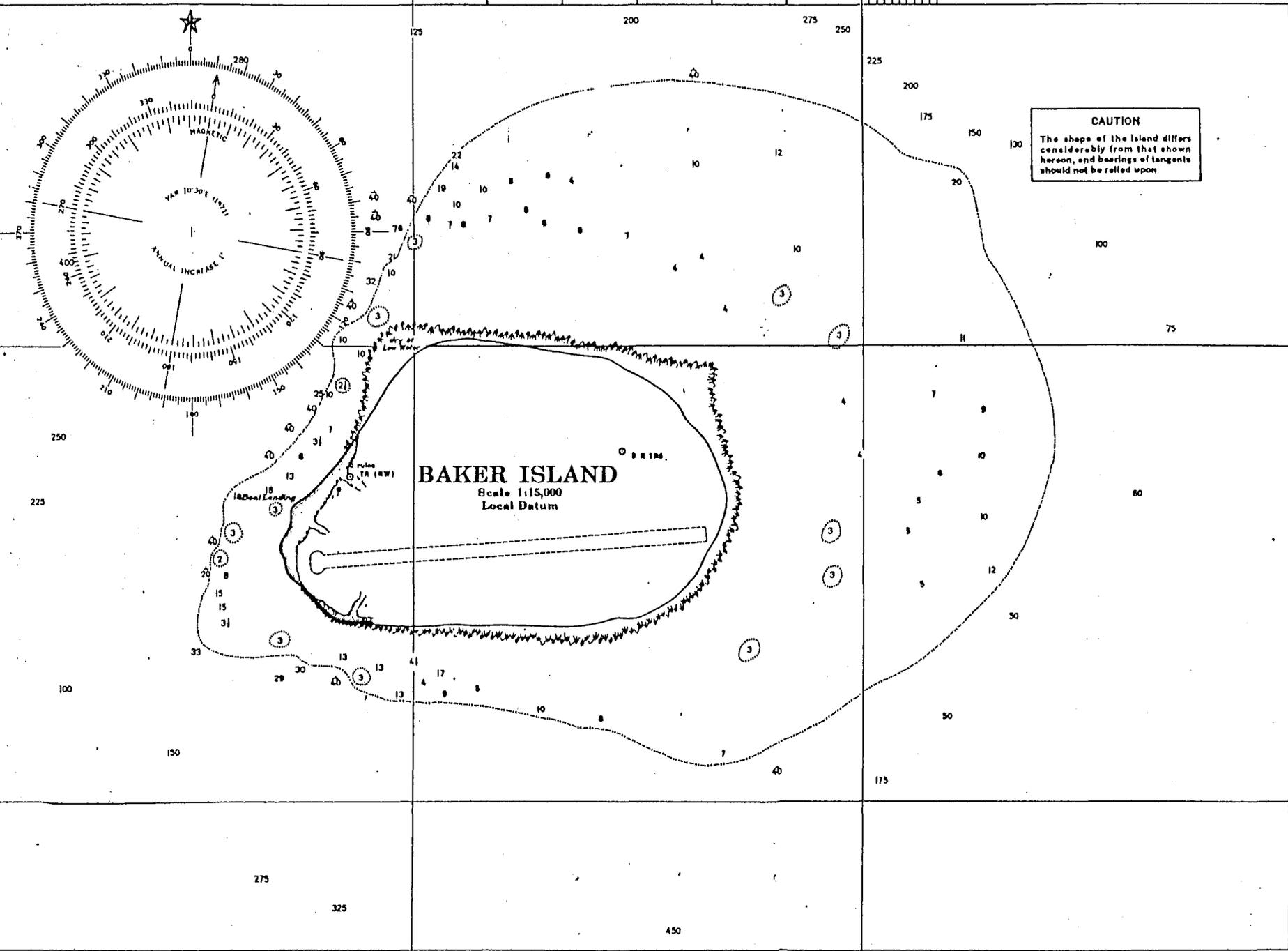
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K. FEEDBACK

NTR



176° 20' 30" 40" 50" 10" 20" 28'



CAUTION
 The shape of the island differs considerably from that shown hereon, and bearings of tangents should not be relied upon

BAKER ISLAND
 Scale 1:15,000
 Local Datum

176° 20' 28'

12'

12'

11'

11'

50'

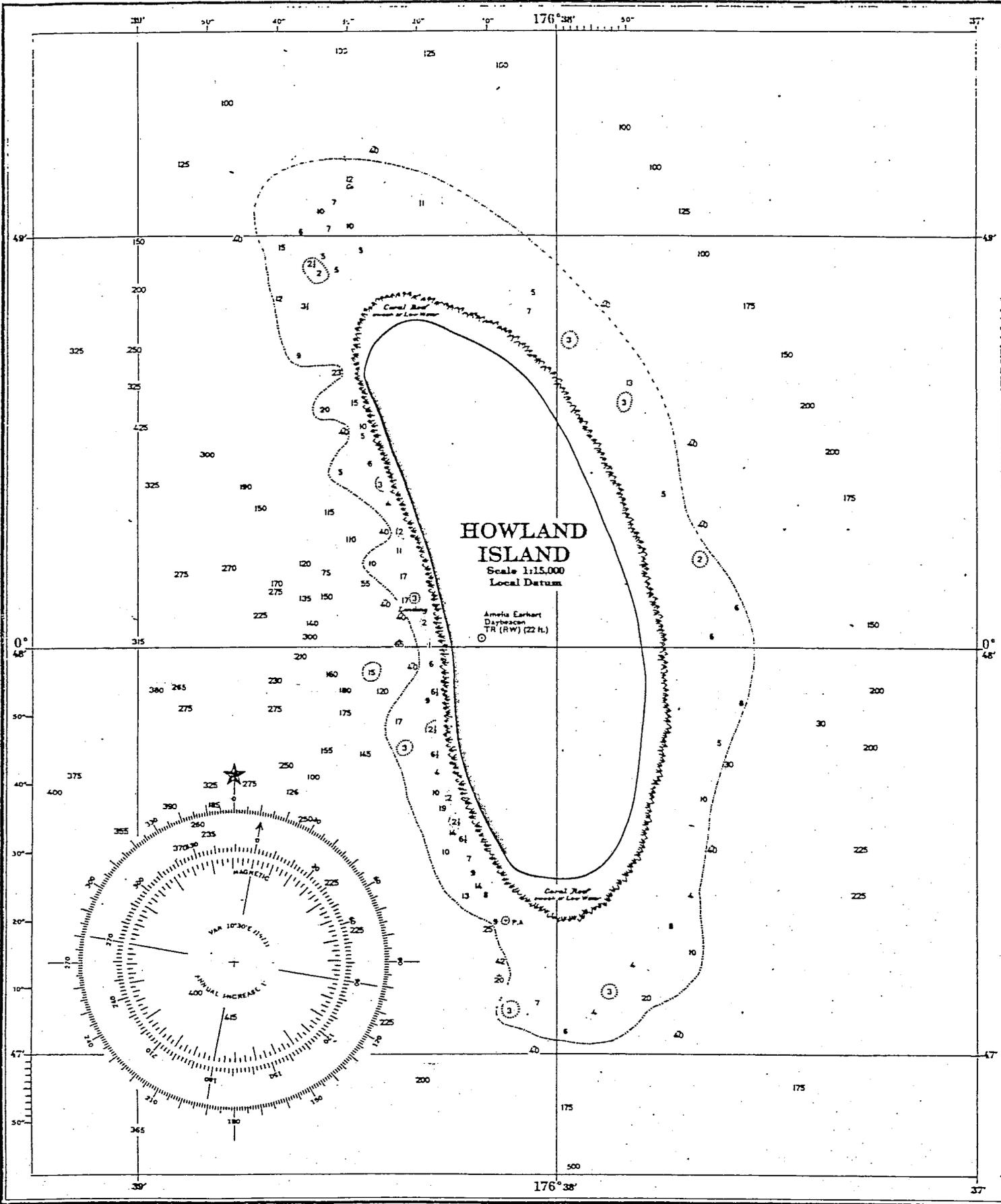
40'

30'

20'

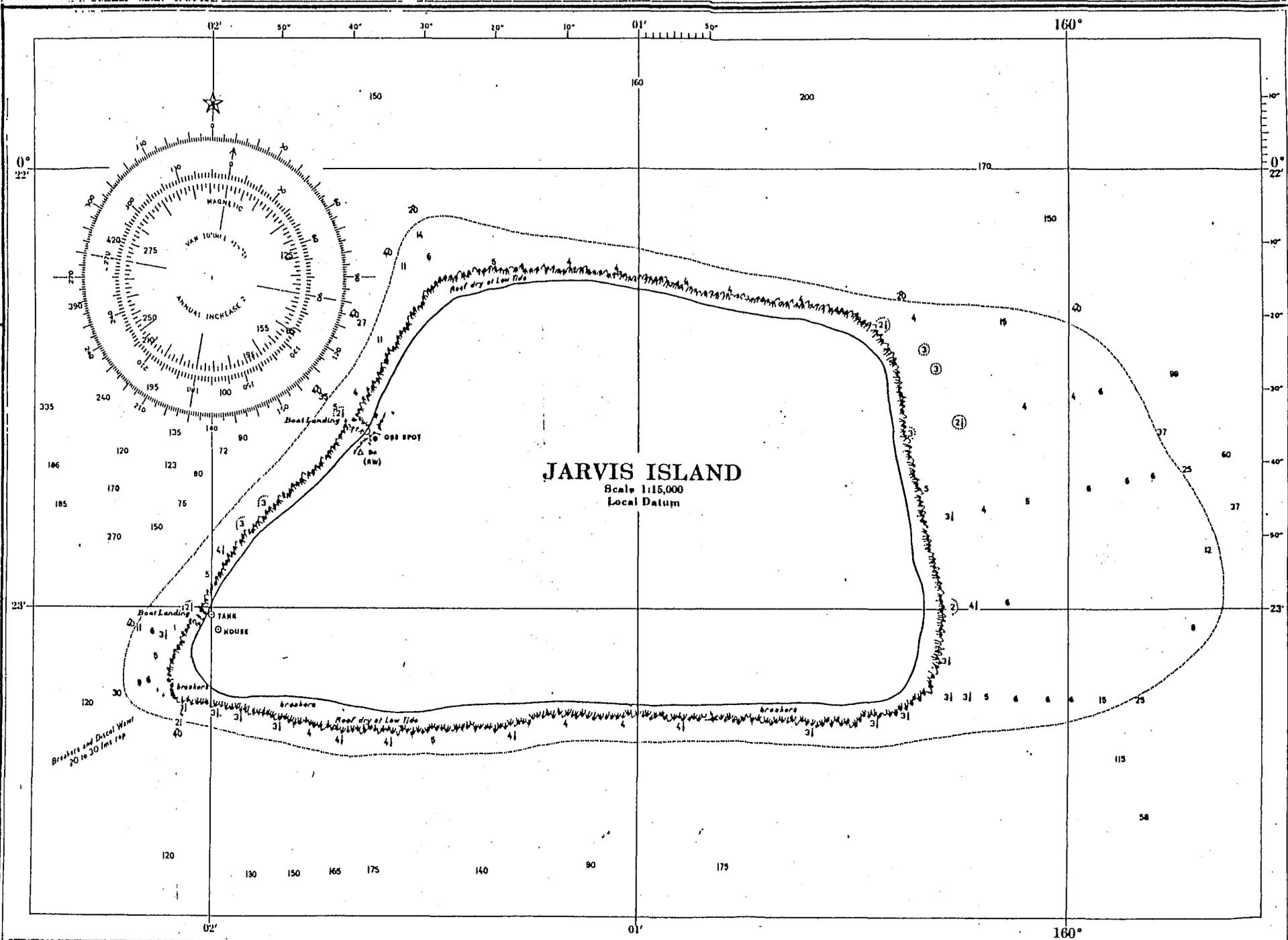
10'

50'



170° 29'

28'



A. HIGHLIGHTS

The extreme isolation of Howland, Baker and Jarvis Islands and the difficulty in obtaining transportation to them makes any visit a highlight. Baker and Howland Islands were visited by refuge employees in November, 1978, May, 1979, and January, 1980. Jarvis Island was visited in October, 1978, May, 1979, and February, 1980. These remote islands support nesting seabirds, but predation by feral cats has limited populations of certain bird populations. The purpose of the visits was to census and determine phenology of seabirds and to reduce the feral cat populations as much as possible in the limited time available.

Wedge-tailed shearwaters were reported nesting on Jarvis Island for the first time by Barry Brady in 1979.

B. CLIMATIC CONDITIONS

The closest weather station to this refuge is at Canton Island. The similarity in topography and in distance from the equator indicates that the climate is similar. Weather records are incomplete for the years covered by this report because the weather station became inoperable in mid-1979 and was removed in 1980. Mean temperature in 1978 was 83.7°F with a maximum temperature of 92°F and a minimum of 68°F. Total precipitation was 24.8 inches in 1978 with monthly variation from 0.1 inches in November to 6.7 inches in January. The 1978 mean monthly temperature and rainfall are about 5°F and 5 inches below the mean annual values respectively for Canton Island. The incomplete 1979 record indicates that precipitation was considerably higher than the previous year. Precipitation reached 69.9 inches during the six months that records were kept that year.

Climatic and sea conditions on Jarvis Island are being recorded by Dr. Martin Vitousek of the University of Hawaii. Unfortunately the intermittent operation of the recording instruments during the period of this report prevented summarization of the data. The intermittent records are presented in: Vitousek, M. J., B. Kilousky and W. G. Leslie, 1980. Meteorological observations in the Line Islands, 1972-1980. Hawaii Inst. Geophysics. Data Rept. 38, HIG-80-7. 74 pp.



BHJ-1 - Baker Island NWR.

PF

D. PLANNING

5. Research and Investigations

During the 1978-1980 period, Dr. Martin Vitousek (University of Hawaii) continued investigation of the ocean-atmosphere interaction in the equatorial Pacific through the use of six unmanned observatories as part of the North Pacific Experiment (NORPAX). As part of this program, an observatory was installed on Jarvis Island in 1974. Although the observatory has only provided intermittent data, the observations have helped involved scientists predict the onset of the El Nino, an unusual warming of the ocean off the coast of Peru. This oceanic event has profound effects on the productivity of the coastal waters and severe repercussions on the fisheries and seabird populations along the western South American coast.

Douglas Forsell, USFWS wildlife biologist, visited Howland, Baker and Jarvis Islands during an October 12-November 17, 1978 cruise conducted by the U.S. Coast Guard vessel Buttonwood. The Coast Guard, at that time, visited these islands to maintain the former lighthouses as daytime location beacons and to maintain United States sovereignty over the islands. Forsell spent approximately one day on Jarvis Island (Oct. 18, 1978) during which he surveyed bird populations and attempted to reduce the feral cat population. In addition, he helped improve seabird habitat by removing debris and participated in the sovereignty ceremony.

On November 10, 1978, Forsell visited Baker Island for four hours and conducted bird surveys and participated in the sovereignty ceremony. He also reached Howland Island that day and conducted additional seabird surveys, hunted cats and banded birds. Forsell was assisted by Coast Guard personnel during the 15 hours that he was able to stay on the island.

Assistant Refuge Manager Barry Brady and maintenance worker Demi Black visited Jarvis, Howland and Baker Islands during May, 1979. They were accompanied by Dr. Ralph Kirkpatrick of Ball State University, Indiana. The motor sailer Machias was chartered for the visit. Brady and Black met the boat in Tarawa, Kiribati on April 25, 1979, and proceeded to Howland Island where they spent four days surveying bird populations and exterminating cats. One day was spent on Baker Island to survey birds and eight days were spent on Jarvis Island for bird surveys and cat control activities.

Dr. Kirkpatrick collected osteological and other materials from the cats that were destroyed in order to determine the demographic structure of the population. In addition, he obtained food samples from the cats and assisted in the bird surveys. Publications on the results of Kirkpatrick's study are in preparation. Proposed publication titles are "Foods of Feral House Cats, Felis catus, on Howland and Jarvis Islands, Central Pacific Ocean" and "Cranio-metric Studies of Feral House Cats, Felis catus, Collected on Howland and Jarvis Islands, Central Pacific Ocean". This expedition returned to Honolulu on June 6, 1979.

Daniel Moriarty (maintenance worker, Hanalei NWR) accompanied the USCG Buttonwood to Howland and Baker Islands during their 1980 sovereignty visits to these islands. Moriarty was able to go ashore at Howland Island with four Coast Guard personnel on January 21, 1980 and was able to conduct limited bird surveys during an overnight stay. Although one of the objectives of the visit was to reduce the cat population, they were unable to do so because heavy surf prevented the launch that carried their weapons from landing.

Research Biologists Dave Fellows and Cameron Kepler (USFWS) met the Buttonwood in Pago Pago when Moriarty disembarked. They were able to visit Jarvis Island on February 18-19, 1980, but due to high surf were unable to land on the island. They made observations on the birds that were on or over the island during the time that the Buttonwood circled the island.

Dr. Kepler formulated a plan for future surveys of the bird populations on Jarvis Island that will be used during future visits.

F. HABITAT MANAGEMENT

1. General

Habitat management on each of these islands is based on the philosophy that the resident populations of seabirds and other wildlife will return

to a natural state if environmentally destructive conditions resulting from former habitation of the islands is removed or controlled. Control has taken two forms: control of introduced cats and destruction of debris. These two items are objectives included in all visits to the islands. In addition to restoring the islands to their former state, (without destroying historically important artifacts or structures) the natural state of these islands is maintained by a restrictive policy of allowing only activities that would be beneficial to the wildlife populations to occur on the islands.

10. Pest Control

All visits to Howland, Baker and Jarvis Islands include the objectives of assessing cat populations or attempting to remove the cats. Due to the short time that personnel could be on the islands during most trips, total eradication of feral cat populations has been unsuccessful except on Baker Island. Forsell found cats preying on nearly all seabird species present on Jarvis Island during his 1978 visit. He recommended a broad-spectrum approach to extermination of the cats.

There are substantial differences in the number of cats that have been able to survive on each of the three islands. Although the reason for this is not fully understood, it is most likely related to differences in the vegetative cover, timing in the return of breeding seabird populations and the amount of debris available for hiding places. Forsell felt that the cats on Jarvis rapidly return to maximum carrying capacity if the breeding population is not eliminated.

No cats were noted on Baker Island by any of the personnel involved in the visits described above. Forsell hypothesized that young birds from Howland may be colonizing Baker since cats were removed in 1964. Howland Island appears to have only a few cats while Jarvis Island has hundreds. Control activities have only included shooting and physical dispatchment of the cats up to now. A trip report by Dave Fellows (USFWS Animal Damage Control) recommends that future control activities include as many different methods as possible.

The results of previous cat control activities are summarized as follows:

Jarvis Island	Oct. 18, 1978	160 cats killed (50% less than 6 months old)
	May 20-27, 1979	115 cats killed (est. 200+ more seen)
Howland Island	Nov. 10-11, 1978	5 cats killed (3 more seen)
	May 9-16, 1979	9 cats killed (no others seen)
	Jan. 21, 1980	0 cats killed (10 seen)
Baker Island	May 17, 1979	0 cats seen during 3 hours observation



BHJ-2 - Remains of blue-faced boobies killed by cats on
Jarvis Island. BGB

G. WILDLIFE

5. Shorebirds, Gulls, Terns and Allied Species

Howland, Baker and Jarvis Islands provide habitat for a variety of resident and migratory sea and shore birds. Previous visits have recorded 28 species of birds on Baker and Howland Islands and 20 species from Jarvis Island. There are 11 species of seabirds found at Baker Island (four nest there) and 17 species of seabirds have been reported from Howland Island (eight nest there). Eight of the 14 species of seabirds reported from Jarvis Island nest there.

Nesting of wedge-tailed shearwaters on Jarvis Island was first recorded during the 1979 visit to that island. It is expected that greater control of the predatory cat populations will result in an increase in the number of species nesting on Jarvis and Howland Islands.

The following table summarizes the observations reported from Howland, Baker and Jarvis Islands during 1978, 1979 and 1980.

Jarvis Island	Oct. 18, 1978		May 20-27, 1979		Feb. 19, 1980*	
	Count	Breeding Status**	Count	Breeding Status**	Count	Breeding Status**
-Red-tailed Tropicbird	20	b-e (10)	1,500	a-e (1,500)		c
-Unidentified Frigatebird	40+	a				
-Lesser Frigatebird			2,000	a	1	a
-Blue-faced Booby	3,365+	b-c	8,000	c (6,000)	3,000+	
-Brown Booby	30	a	300	c (60)		
-Red-footed Booby	1	a	1,000	a		
-Sooty Tern	5,500+	a	500,000	b (100,000)	1,000,000	b-?
-White Tern	1	a				
-Brown Noddy			2	b		
-Wedge-tailed Shearwater			2	b (2)		
-Wandering Tattler	2					
-Bristle-thighed Curlew	1					
-Golden Plover	2					

Howland Island	Nov. 10-11, 1978		May 9, 1979		Jan. 21, 1980	
	Count	Breeding Status	Count	Breeding Status	Count	Breeding Status
-Unidentified Frigatebird	2					
-Lesser Frigatebird			20	a		
-Blue-faced Booby	2,125	c-e (61)	3,500	d (100)	3,763	b-c (22)
-Brown Booby	117+	c-e (3)	500	d (60)	54	b-c (9)
-Red-footed Booby	3	e (1)	5	a	37	b-c (11)
-Sooty Tern	8,000++		30,000	a	7,000	a
-Wandering Tattler			25			

<u>Baker Island</u>	<u>Nov. 10, 1978</u>	<u>Breeding</u>
	<u>Count</u>	<u>Status</u>
-Lesser Frigatebird	13,000	a-d (4,328)
-Greater Frigatebird	50	b-? (10)
-Blue-faced Booby	595	b-e (53)
-Brown Booby	88	b-d (4)
-Red-footed Booby	226	c-e (16)
-Sooty Tern	9,570+	b (300+)
-Gray-backed Tern	32+	a
-Brown Noddy	1,046	e (4)
-Wandering Tattler	3	
-Bristle-thighed Curlew	5+	
-Golden Plover	19+	
-Ruddy Turnstone	144+	

* Survey done from boat

** a = no nesting

b = eggs present

c = small chicks present

d = large chicks present

e = fledglings present

() = numbers reported



BHJ-3 - Frigatebird nesting colony.

DF

Forsell reported that Baker Island has had a remarkable increase in the number of lesser frigatebirds. Although he does not provide enough details to determine if the data are directly comparable, he indicates that the number of young birds increased from 2,250 in 1967 to 4,328 in 1978. Forsell's additional report, that he had found 920 dead frigatebird chicks during his 1978 visit, may indicate that these birds are beginning to exceed the carrying capacity for frigatebirds on the island or that a disease had caused problems in the colony. Forsell attributed the increase in lesser frigatebirds to the eradication of cats that took place on this island in 1964.

Forsell also compared the percentages of blue-faced boobies that were found on each island and concluded from the low number present on Baker Island that the increase in population there is probably resulting from an influx of young (unbanded) birds. An alternative hypothesis that Forsell offered was that the higher percentage of banded blue-faced boobies on Howland and Jarvis Islands may be a reflection of the cat predation that is occurring on those islands.

9. Marine Mammals

Forsell noted the presence of Pacific bottlenose porpoise (100 seen) off Howland Island on November 11, 1978.

10. Other Resident Wildlife

Forsell and Moriarty noted the abundant populations of hermit crabs on each of the islands that they visited in 1978 and 1980. Moriarty also stated that he had observed two unidentified skinks during his visit to Howland Island in 1978.

14. Scientific Collections

Dr. Ralph Kirkpatrick of Ball State University, Indiana, collected skulls and other parts of cats that were shot during the 1979 effort to eliminate cats on Howland and Jarvis Islands. The purpose of the collections was to ascertain the sex ratio, population structure and possible genetic differentiation of the feral cat populations on these islands. Results of Dr. Kirkpatrick's studies have not been published yet.

16. Marking and Banding

Forsell and Moriarty reported that they had read the bands on blue-faced boobies on each of the islands that they visited. Forsell read and reported to the Banding Laboratory 45, 48 and 3 bands from Jarvis, Howland and Baker Islands respectively. This represented 7.8, 13.6 and 1.6 percent of the blue-faced boobies reported by Forsell from these islands.

Moriarty read and reported to the Banding Laboratory 77 bands from blue-faced boobies on Howland Island in 1980. This represents 2.0 percent of the blue-faced boobies that Moriarty reported censusing on that island.

J. OTHER ITEMS

2. Items of Interest

Howland Island was the destination of aviatrix Amelia Earhart during the last flight that she flew in her attempt to fly around the world in 1938. Because of this, the refuge receives occasional inquiries about information on her. Requests to visit the island and even to attempt to duplicate her intended mission were also received.

The refuge also received one somewhat unorthodox request to adopt orphans from these uninhabited islands and another proposal to settle "Boat People" escaping from South Vietnam. The complete lack of facilities, potable water and the isolation of the islands make them very unsuitable for these types of activities even if they had been compatible with wildlife management objectives.

ROSE ATOLL NWR

American Samoa

TRI-ANNUAL NARRATIVE REPORT

Calendar Years 1978 - 1980

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

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G. WILDLIFE

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J. OTHER ITEMS

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K. FEEDBACK

NTR

A. HIGHLIGHTS

Rose Atoll National Wildlife Refuge is approximately 150 miles east-southeast of Pago Pago, American Samoa. Because of this extreme isolation, any visit by refuge personnel or other people may be considered a highlight. Refuge personnel visited the atoll March 28-30, 1978 and November 10-13, 1980. The tour ship Lindblad Explorer visited the refuge on October 29, 1978. Office of Marine Resources (OMR) (American Samoa Government) personnel visited the refuge on June 7, 1978.

Rose Atoll, one of the smallest atolls in the world, is administered by the U.S. Fish and Wildlife Service under a Cooperative Agreement with the American Samoa Government. This agreement established the atoll as a refuge and provided for the management of the refuge through periodic aerial surveys and through the deputization of Samoan officials to enforce national wildlife rules and regulations.



ROS-1 - Rose Atoll NWR.

GW

B. CLIMATIC CONDITIONS

The nearest weather station to Rose Atoll is located 150 miles away at Pago Pago on Tutuila Island. There is a very distinct difference between the topography of Rose and Tutuila Islands so comparisons must be viewed with much caution. Rose Atoll has two low islands while Tutuila is mountainous and as a result has a considerable amount of rainfall.

However, average daily temperatures at Tutuila range from 78° to 81°F with extremes of 70° to 95°F. Precipitation at Rose Atoll is estimated to be about 20 inches per year.

D. PLANNING

2. Management Plan

The original Cooperative Agreement for the management of this refuge was signed in 1973. Because of the expense of observational flights that the Service agreed to pay for in that agreement and because of differences in opinion as to what species are protected by the refuge, there have been discussions with representatives of the American Samoa Government related to changes in the Agreement. Most of the discussion has involved a desire on the part of the Samoans to harvest giant clams, Tridacna maxima, from the lagoon waters. Present members of the Office of Marine Resources in American Samoa interpret the Agreement to mean that seabirds and turtles are to be protected by the refuge but that fishery and other marine resources within the atoll should be open for public harvest. The Office of Marine Resources involvement has been a result of requests by private fishermen. Mr. Henry Sesepasara, Director of the Office of Marine Resources and Richard Wass, Fishery Biologist with that office have taken part in the interchange of ideas along with Refuge Managers Brent Geizentanner, Liz Cummings, Robert Shallenberger and Daniel Moriarity.

Additional discussions with the American Samoan Government have included requests that they help inform representatives of the foreign fishing fleets that enter Samoan waters that they should enter the waters in or near the refuge. A plan for periodic surface visits to the atoll, during which terrestrial and marine resources would be surveyed, was proposed to be included in the Cooperative Agreement during Shallenberger's 1980 visit to American Samoa.

The members of the Office of Marine Resources in American Samoa have been very cooperative in assisting our efforts there. Interchange of ideas and information is often very difficult because of the long distance involved, the turnover of personnel in both offices and the infrequency of personal contact.



ROS-2 - Rose Island, one of two islands on tiny Rose Atoll
NWR. RJS

5. Research and Investigations

Research at Rose Atoll has consisted principally of surveys of terrestrial and marine flora and fauna during the brief visits to the atoll.

The March 28-30, 1978 visit included Richard Coleman, Refuge Biologist, USFWS and Pat Bryan, Fishery Biologist, OMR. They reached the island on a chartered fishing boat, J-ANN from Pago Pago. They conducted seabird counts, obtained evidence of sea turtle nesting and inspected the area for evidence of human trespass. In addition they noted the condition of plant cover and the magnitude of the rat population. Maintenance of refuge signs was also conducted.

David Swan, OMR, and Rick Stober and Bert Morris, U.S. Coast Guard, visited the atoll on June 7, 1978. They noted evidence of turtle nesting activity, the presence of many birds and no evidence of trespass. Because their stay was only for less than an hour, detailed data on populations were not obtained.

The M. S. Lindblad Explorer visited the atoll on October 29, 1978. The purpose of the visit was to show the passengers on the ship the seabird nesting areas and to familiarize them with the marine resources of the refuge. During their stay, Thomas Ritchie, Chief naturalist on the ship, conducted a short survey of the bird populations on the island,

counted turtles in the lagoon and listed fish species that were seen during dives in the lagoon and on the outside of the atoll.

The November 10-13, 1980 trip to Rose Atoll included Robert Shallenberger (Supervisory Wildlife Biologist - RWR), Ernest Kosaka (Endangered Species Coordinator), Derral Herbst (Endangered Species Botanist), George Balazs (Research Biologist, NMFS), Richard Wass (Fishery Biologist, OMR) and William Pedro (Biologist, OMR). The Leilani, skippered by W. Thompson and a crew of 3 was chartered for the trip.



ROS-3 - Banding brown boobies.

RJS

The purpose of this trip was to assess the condition of fish and wildlife resources in the refuge and to do a preliminary evaluation of the potential for harvesting Tridacnid clams from the refuge waters. Surveys of birds, turtles, fish, clams and plants were conducted during the trip.



ROS-4 - Tridacnid clam and damselfish
in Rose Atoll lagoon. GML

F. HABITAT MANAGEMENT

1. General

Rose Atoll, one of the smallest atolls in the world, is composed of a coralline algae reef that encloses a 50 foot deep lagoon. There is one opening from the lagoon to the sea and this is only deep enough for small boats to enter at high tide.

Two islands are found on the atoll, Rose Island and Sand Island. The vegetation on Rose Island is dominated by 50-70 ft. Pisonia trees and 10-20 ft. Tournefortia bushes. Sand Island has no vascular vegetation. Distribution of debris indicates that both of these islands are occasionally swept over by waves. The basic management philosophy for this atoll has been to leave it in as natural a state as possible. Because of the

possibility of introduction of exotic organisms and of pollution by visitors, access to the refuge is limited to persons having valid research objectives. The extreme isolation of the refuge from inhabited islands facilitates maintaining this policy although it also inhibits enforcement activities.

3. Forests

Rose Island is dominated by a Pisonia forest on the south side of the island and groves of Tournefortia bushes on the east and north sides of the island. In addition there is a small grove of coconut palms in the center of the island. The palms have been introduced during visits of American Samoan officials during the first half of this century. A die-off of Pisonia trees that was reported by visitors to the island in the mid-1970's was found to be rapidly recovering during the 1978 visit by Richard Coleman, USFWS.

The Tournefortia forest appears to have increased in size between each visit that occurred during the time covered by this report.

Derral Herbst collected plants during the 1980 visit to the atoll and also marked Pisonia trees. The marked trees were measured with the intention that future visitors would obtain additional measurements in order to ascertain the amount of growth that occurs.

6. Other Habitats

The principal type of marine habitat at Rose Atoll is the coralline algae dominated reef crest that forms an approximate square with a single opening to the sea. The outside of the reef descends to great oceanic depths and is composed of an extremely diverse coral reef complex. The inside of the reef crest at first descends gradually into a rubble dominated reef flat that contains numerous patch reefs composed of coralline algae, coral and a diversity of other sessile invertebrates including the small giant clam, Tridacna maxima. The rubble reef flat descends abruptly to about 50 feet and forms the bottom of a one kilometer wide lagoon. The bottom of the lagoon is principally composed of rubble, silt and small coral patches. Occasional coral patch reefs reach the surface. A high diversity of reef fishes are present within the lagoon. The diversity of fishes and invertebrates is greater on the outside of the atoll.



ROS-5 - Assorted hard and soft corals at
Rose Atoll lagoon. GML

The Office of Marine Resources in American Samoa has proposed that the Tridacnid clams within the atoll be harvested. They sell for about one dollar in the Pago Pago markets. One of the objectives of the 1980 visit to the atoll was to do preliminary surveys of the clam geographical and size distribution in order to develop a proposal for a fishery of this resource. Richard Wass and William Pedro did population distribution surveys and estimated size frequency abundances and later developed a preliminary proposal for managed harvest. Future trips to the refuge will be utilized to evaluate and modify the proposal by determining the size of sexual maturity and growth rates of the clams.

The preliminary proposal assumes that clams could be harvested from three sides of the lagoon and that there would be a size limitation to protect immature clams. No estimate of the potential value of the fishery was determined.

10. Pest Control

All visitors to the atoll report the presence of Polynesian rats on Rose Island. No attempts to control the animal have been instituted although it is possible that the presence of the rats may relate to the absence of subterranean nesting birds. Although the rat population is very high, as indicated to the ease with which they can be sighted by visitors, the actual density has not been determined. A program to determine rat density and to determine what they are feeding on was instituted during the visit by Shallenberger during the Nov., 1980 visit.

G. WILDLIFE

1. Wildlife Diversity

Wildlife resources at the atoll include nesting and resident seabirds, nesting endangered or threatened sea turtles, rats and a low diversity of terrestrial invertebrates including several species of hermit crabs and insects. Diversity of species varies during the year because of the seasonal nature of the use of the atoll by nesting seabirds.

2. Endangered and/or Threatened Species

Rose Atoll contains a resident and possibly a visiting population of nesting endangered Hawksbill turtles and threatened green sea turtles. All visitors to the island have reported the presence of green sea turtles and in most cases have reported seeing actual or evidence of nesting activities on Rose and Sand Islands. Coleman reported seeing one green sea turtle in the entrance channel in 1978 and one set of tracks on Rose Island. He also reported evidence of one recent nest on Rose Island and the presence of several older nests along the east side of that island and in the center of Sand Island.

George Balazs, turtle biologist of the Hawaiian Institute of Marine Biology, was present during the November, 1980 visit. Numerous recent turtle nests were reported along the beach and beneath the Pisonia and Tournefortia trees on Rose Island and throughout the barren Sand Island. All six turtles that were observed on land during the 1980 visit were tagged and released. It was concluded by observers on this visit that, because of the firmness of the substrate on both islands, aerial surveys of turtle nesting would not be accurate. There would be no way of determining how long the nests that would be observed by that method had been present.

A naturalist on the Lindblad Explorer reported seeing a single Hawksbill turtle in the lagoon on October 29, 1978.

Derral Herbst surveyed Rose Island during the 1980 visit for the presence of previously undiscovered plant species that may qualify for endangered status. They did not find species that fulfilled the criteria for listing under the endangered or threatened categories.

4. Marsh and Water Birds

The reef heron is a common breeding bird in the South Pacific. One reef heron was observed on Rose Island in March, 1978, and three more were seen there in November, 1980. Nesting on the island was confirmed by the observation of three nest sites during the 1980 visit. A single snowy egret, rare in the Central and South Pacific, was seen during the March, 1978 and the November, 1980 field trips. A cattle egret was also observed during the 1980 visit.

5. Shorebirds, Gulls, Terns and Allied Species

Eleven breeding species of seabirds comprise the most prominent group of wildlife within this refuge. Counts of birds were made during three of the trips to Rose Atoll during the reporting period. A summary of the results of these counts is given in the following table. One of the objectives of the 1980 trip was to develop a more standardized method of making counts through the utilization of predetermined transects.

Seabirds censused on Rose Atoll field trips.

Species	March 28-30, 1978		Oct. 29, 1978		Nov. 10-13, 1980	
	Adults	Breeding* Status	Adults	Breeding* Status	Adults	Breeding* Status
-Red-tailed Tropicbird	3	c	-	-	present	d(6)
-White-tailed Tropicbird	-	a	12	a	2	a
-Blue-faced Booby	6	a	1	a	100	b,c
-Brown Booby	500	a	1,000	c (200-300)	150-200	a,b
-Red-footed Booby	200	a	500	a	200	d
-Great Frigatebird		200	a	70	a	100+
-Lesser Frigatebird		200	a	30	a	50+
-Sooty Tern	7,000	d (5,000)	200,000- 300,000	b	2,000	b
-Gray-backed Tern	-	a	-	a	12	a
-Brown Noddy	5,200	c (10)	3,000	c	150 (nests)	b-e
-Black Noddy	5,000	b	3,000	c	235 (nests)	b-d
-White Tern	200	a	1,000	b	120 (nests)	b,c

- *a. no nesting observed
- b. eggs present
- c. small chicks present
- d. large chicks present
- e. fledglings present

() indicates estimates of eggs or chicks present

American golden plover, ruddy turnstones, wandering tattlers, sanderlings and bristle-thighed curlew are the most common wintering shorebirds in the Central and South Pacific Islands. The following populations were recorded during trips to Rose Atoll:

<u>Species</u>	<u>Mar. 28-30, 1978</u>	<u>Oct. 29, 1978</u>	<u>Nov. 10-13, 1980</u>
American Golden Plover	10	2	12
Ruddy Turnstone	15	8	8+
Wandering Tattler			6
Sanderling			2
Bristle-thighed Curlew			2

In addition to these birds, 20 whimbrels were recorded on Oct. 29, 1978. It is possible that these were actually bristle-thighed curlews, however.

7. Other Migratory Birds

During the November, 1980 trip two very interesting species of birds were recorded: a long-tailed New Zealand cockoo and possibly a wattled honeyeater. Both of these species are known from other islands in American Samoa.

11. Fisheries Resources

The lagoon and surrounding waters of Rose Atoll contain a multitude of tropical coral reef species and many resident and migratory palagic species as well. Naturalists from the Lindblad Explorer recorded 76 species of marine fish in the lagoon or just outside the entrance to the lagoon on October 29, 1978. They suspected that they had found a new species of butterflyfish but their description matches that of a melanistic phase of the long-nose butterflyfish, Forcipiger longirostris.

Richard Wass (Fishery Biologist, Office of Marine Resources, American Samoa Government) surveyed the fish of the lagoon and just outside the lagoon entrance in November, 1980. He concentrated on four habitat types: coral blocks, rubble flats, lagoon floor and pinnacles in the lagoon. He observed 120 species of fish in these habitats and concluded that there was a higher abundance of larger piscivorous fish at the atoll than is usually found in other areas of the Samoan Islands. This was attributed to the low level of fishing that occurs at the atoll. In addition, he found far fewer damelfish species and individuals than he expected and attributed this to the lack of strong plankton-carrying currents within the lagoon. Herbivorous fish were also lower in abundance than he expected within the lagoon. This may be the result of the inedible coralline algae out-competing edible species. Dr. Wass also found three species that he had previously not recorded from other islands in American Samoa: Naso vlamingii (a surgeonfish), Scarus caudofaciatus(?)--(a parrotfish), and a Girrhilabrus sp. (an undescribed wrasse).

Dr. Wass also conducted surveys of the geographical and size frequency distribution of the small giant clam, Tridacna maxima, during the 1980 field trip. From the results of the trip he proposed a tentative fisheries management plan for harvesting the clams. They are eaten in Samoa and

are worth approximately one dollar in the shell. Dr. Wass, however, also concluded that additional work must be done to determine the age at sexual maturity and to refine the estimate the abundance of the clams of the atoll. Clam growth rates may also be necessary in order to estimate a sustainable yield that might be taken from Rose Atoll lagoon. The question of the role of these clams within the ecosystem should also be further determined before a commercial enterprise of this nature be allowed also.

14. Scientific Collections

Derral Herbst, Botanist, Honolulu Office of Endangered Species, USFWS, collected plants from Rose Atoll during the Nov., 1980 visit. Specimens have been sent to specialists for confirmation of identification but results have not been received.

16. Marking and Banding

Robert Shallenberger banded 33 adult and 39 juvenile brown boobies and 27 adult and 15 juvenile blue-faced boobies during the Nov., 1980 visit.

H. PUBLIC USE

1. General

The Lindblad Explorer visited Rose Atoll on October 29, 1979 with 80 passengers. The naturalists aboard led a brief shore survey and a dive in the lagoon. This visit was not authorized by the USFWS but instead the Governor of American Samoa allowed the visit. An apparent lack of understanding of the jurisdiction of the American Samoan Government in relation to the administration of the Refuge perhaps led to this unauthorized visit.

Requests from a group of researchers from the Walla Walla University to film birds on Rose Atoll were approved but their boat charter did not materialize.

7. Other Interpretive Programs

Robert Shallenberger appeared on television in American Samoa in Nov., 1980, along with turtle biologist George Balazs and Henry Sesepasara to explain the importance of the atoll and the wide variety of fish and wildlife species that inhabit the atoll.

Meetings were also held with Taiwanese and Korean fishery agents in Pago Pago to emphasize the significance of refuge status at Rose Atoll and to insure that foreign tuna fishermen do not illegally enter the refuge.

KILAUEA POINT WILDLIFE ADMINISTRATIVE SITE

Kilauea, Hawaii

TRI-ANNUAL NARRATIVE REPORT

Calendar Years 1978 - 1980

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

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K. FEEDBACK

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A. HIGHLIGHTS

Kilauea Point is a U.S. Coast Guard Lighthouse site which has been managed as a seabird refuge by the Service since 1975. The property is in the process of being transferred to the Service, but in the interim it is managed as the Kilauea Point Wildlife Administrative Site under permit from the Coast Guard. The period 1978-1980 was a very active one on the site. Kauai refuge staff, based at Kilauea Point, increased from two to four, a YACC program was initiated and YCC camps were active each summer. Research projects were conducted on the wedge-tailed shearwater and the Newell's Manx shearwater. Major landscaping was accomplished, several buildings were constructed or remodeled, and an interpretive tour route and visitor contact point were designed.



KPW-1 - Kilauea Point Wildlife Administrative Site and
Mokuaeae Island. RJS

B. CLIMATIC CONDITIONS

Heavy rains on Kauai in November, 1978, caused the death of shearwater chicks when burrows collapsed or flooded and forced chicks out into the rain. Mortality was less than if the flooding had occurred earlier in the nesting season.

Kilauea Point is an official weather recording station for the National

Weather Service. Volunteers, living at the Point, reported weather observations during 1978. An automatic reporting station was constructed at the Point in April, 1978, and was operational in July, 1978. The following station summary for the 1978-1980 period reflects the climatic conditions of the refuge:

	<u>Average</u>
Temperature	75°F
Wind Speed	10-15 kts (NE)
Rainfall	40"/yr.

D. PLANNING

2. Management Plan

Management/Research Plans for all five wetland refuges and Kilauea Point Administrative Site were drafted in December, 1980, for implementation in FY81. A formatted plan was issued to all field personnel and included in performance standards.

5. Research and Investigations

a. Cross-fostering of Newell's Manx Shearwaters

As part of the recovery effort for the threatened Newell's Manx shearwater, a project was undertaken to evaluate the feasibility of establishing a colony of Newell's shearwaters in a location where they might be protected from introduced mammalian predators. Kilauea Point was one of the sites chosen for the experiment (a cooperative effort with the state of Hawaii and the Service's endangered species research station on Kauai). Eggs taken from Newell's shearwater nests in remote mountain locations were transported to Kilauea Point and substituted for wedge-tailed shearwater eggs under incubating birds. Of 65 Newell's shearwater eggs taken to Kilauea Point 1978-1980, 57 (88%) hatched and 54 (95%) of the chicks fledged. Young Newell's shearwaters are 3 to 5 years old before they return to the breeding colonies so the success of the project cannot be determined for several years. Preliminary results of the cross-foster project have been presented orally at a Pacific Seabird Group meeting and at a Hawaii Forestry and Wildlife Conference.

b. Breeding Biology of Wedge-tailed Shearwater

To provide a scientific basis for management of the Kilauea Point refuge, a study was begun to assess the characteristics of this species, one of the major nesters at the refuge. The purpose was to: 1) describe nest sites, 2) estimate the size of the breeding population, 3) determine nesting phenology, 4) determine nesting and fledging success and 5) determine mortality factors.

As part of the study, the use of artificial burrows was evaluated and methods of reducing egg predation (which was discovered early in the study) were tested. Results of several parts of the study have been published:

- Byrd, G. V. 1979. Common myna predation on wedge-tailed shearwater eggs. 'Elepaio 39:69-70.
- Byrd, G. V. 1979. The distribution and status of wedge-tailed shearwaters on Kauai. 'Elepaio 39:129-131.
- Byrd, G. V. 1979. Artificial nest structures used by wedge-tailed shearwaters. 'Elepaio 40:10-12.
- Byrd, G. V. and D. Moriarty 1980. Treated chicken eggs reduce predation on shearwater eggs. 'Elepaio 41:13-15.

A paper on the overall project is being prepared.



KPW-2 - Banding a wedge-tailed shearwater as part of a long term comprehension study of this species which nests at Kilauea Point. BGB

c. Laysan Albatross Colony Establishment

A unique situation occurred at the edge of the refuge in 1977. A few pairs and a single nest of the Laysan albatross was discovered. The species has rarely been recorded in the main Hawaiian Islands, and the establishment of a colony had never been observed in this species which is known to home to its breeding site. Careful observation was made of the colony 1978 to 1980 and results are given in the table below and were published:

The status of the albatross populations at Kilauea Point, Kauai.

Season	Peak No.	No. Taken By Dogs	Eggs Laid	Fate of Eggs			Fate of Chicks		
				Abandoned	Predated	Vandalized	Hatched	Died	Fledged
1974-75	7		0						
1975-76	6		0						
1976-77	6	2	1				1	1	
1977-78	22	3	3	1	1	1			
1978-79	23	5	6	2	1		3		3
1979-80	20	6	3	1	1	1			1
Total		16	13	4	3	2	4	1	4

Byrd, G. V. and T. C. Telfer 1979. Laysan albatross is attempting to establish breeding colonies on Kauai. 'Elepaio 38:81-83.

Byrd, G. V. and T. C. Telfer 1980. The Laysan albatross on Kauai. 'Elepaio 41:1-3.

d. Seabirds of Kilauea Point

Observations of all species of seabirds at Kilauea Point were compiled in 1980 and submitted for publication:

Byrd, G. V. and C. F. Zeillemaker 1981. Seabirds of Kilauea Point, Kauai Island, Hawaii. 'Elepaio 41:67-70.

e. Expansion of Cattle Egrets

The cattle egret was introduced in Hawaii in 1958 and it has rapidly expanded. The largest known roost is adjacent to the Kilauea Point Refuge boundary, and the staff was concerned that egrets might compete with red-footed boobies for nest sites. During the period 1978 to 1980 the roost along with others on Kauai was monitored and the results were submitted for publication:

Byrd, G. V., C. F. Zeillemaker and T. C. Telfer 1980. Population increases of cattle egrets on Kauai. 'Elepaio 41:25-28.

E. ADMINISTRATION

1. Personnel

Kilauea Point is the headquarters for the three refuges on the island of Kauai (Hanalei, Huleia and Kilauea Point). The personnel stationed at Kilauea Point are responsible for management and maintenance of all three areas. At the beginning of 1978 the staff included a refuge manager and a part-time maintenance worker, but during that year a YACC program was added and a temporary biological technician was employed. A part-time refuge clerk and another part-time maintenance worker were added to the staff in 1979 and carried through 1980.

	<u>Permanent</u>		<u>Temporary</u>	<u>YACC</u>
	<u>Full-Time</u>	<u>Part-Time</u>		
CY 1978	1	1	1	8
CY 1979	1	2	1	6
CY 1980	1	2	1	4

3. Safety

No accidents were reported for the refuge staff during the period. Three minor YACC injuries occurred despite the weekly safety lectures to youth program participants.

F. HABITAT MANAGEMENT

1. General

The vegetation at Kilauea Point was mostly introduced shrubs and other noxious weeds at the beginning of the period. To restore native plants in the area a joint YACC/YCC project was initiated to construct a green house, grow a stock of native plants from seeds, remove exotic plants and plant and maintain native plants. The project is continuing at the close of the reporting period, but results to date have been very good. Nine species of native plants have been re-established and the Point is beginning to look like a natural coastal seabird habitat for the first time in over 50 years.



KPW-3 - Naupaka and eight other native plant species were propagated and reestablished at Kilauea Point. RJS

10. Pest Control

Introduced mammals have decimated most ground nesting birds in Hawaii. To improve the nesting habitat for shearwaters, the refuge must be protected from feral dogs and cats. Live trapping was continually conducted during the period. At least 15 cats and 3 dogs were captured and given to the Humane Society. In 1979 a dog-proof fence was constructed at the base of the peninsula of Kilauea Point. It has proven effective in excluding dogs, but cats must still be trapped inside the fence. Three species of rats have been accidentally released in Hawaii. At Kilauea Point rats frequently chew through screens and come into the residences and offices. A continuing snap trapping program is in force. The effects of cat predation on seabird populations is not known, but it is believed to be minimal at Kilauea Point.

The severity of the wedge-tailed shearwater egg predation by the common myna became more apparent during a shearwater nesting study at Kilauea Point in 1978. About 21% of the eggs monitored were pecked open allegedly by the common mynas. In early July, 1978, several myna control techniques, e.g. shooting, live trapping, and scaring with shell crackers, were tested. Shell crackers used daily reduced the average number of mynas from 12 to 1 or 2 birds seen per visit. Chicken eggs injected with ammonia were used as a taste deterrent in 1979-1980 with good success. In early May, chicken eggs were injected with ammonia, sealed with clear paraffin and placed near burrow openings scattered throughout the colony.

G. WILDLIFE

2. Endangered and/or Threatened Species

Newell's Manx Shearwater - The cross-fostering of Newell's Manx shearwaters conducted at Kilauea Point is discussed in Section D. 5a. In addition to this study, refuge personnel participated in a cooperative salvage, banding and release program with the State Division Fish and Game. Many young shearwaters, after leaving their burrow nests in the central mountains, would become disoriented by bright lights along the coastal roadways as they headed to sea. These shearwaters would fly into powerlines and buildings and end up on the ground, unable to regain flight. Local citizens would take these downed birds to holding areas to await pickup by State or Federal biologists. The refuge staff assisted with these pickups and banded the birds before releasing them at Kilauea Point. The following table indicates the great success of the Newell's Manx shearwater retrieval program:

<u>Year</u>	<u># of Shearwaters Retrieved and then Released</u>
1978	867
1979	1,377
1980	1,358
1981	1,123



KPW-4 - A typical Newell's shearwater aid station where citizens brought downed fledglings to be banded and released by refuge personnel. RJS

Hawaiian Monk Seal - An adult female monk seal hauled out in the cove just east of the Kilauea Point peninsula in March and April, 1978. This was the first record of a seal hauling out on a main Hawaiian Island in recent times. The seal was first seen hauled out on March 26 and periodically returned to this rocky beach for 6-12 hours, 3-4 days a week, for several weeks. No other sightings of seals were made in 1979-1980.



KPW-5 - An adult female Hawaiian monk seal hauled out at Kilauea Point cove in April, 1978. IT

Green Sea Turtle - Four to six threatened green sea turtles are regularly seen in the waters surrounding Kilauea Point. None were observed hauled out on the rock ledges, as they do on the uninhabited islands further west of Kauai.

5. Shorebirds, Gulls, Terns and Allied Species

Wedge-tailed shearwaters are the most numerous bird species at Kilauea Point. Approximately 4,000 shearwaters inhabit the site from mid-March to November. During a nest survey in September, 1978, 1,671 nesting burrows were located at Kilauea Point. About 54% of these burrows were considered to be active.

The red-footed booby colony of 800-900 birds nests primarily on the eastern edge of the refuge. The colony location was gradually moving further east and off the refuge as the trees and other vegetation which supported the nests began to dieback. This dieback appears to be associated with the heavy bird use and accumulation of bird feces.

An estimated nesting population of 12-16 white-tailed tropicbirds and 12-20 red-tailed tropicbirds is also found at the Point. Another common seabird, seen over this site, is the great frigatebird, with high summer counts of 40-200 birds. There were uncommon sightings of sooty tern, Newell's Manx shearwater, brown booby, black noddy, Laysan albatross and black-footed albatross. A Bulwer's petrel was found dead near a guy wire at the Point in June, 1978. See Section D. 5b-e for other accounts of these birds.

9. Marine Mammals

Hawaiian Monk Seal - (see Section G. 2)

Humpback whales are sometimes seen from the Point as they migrate to and from their winter calving area between the main islands.

Spinner dolphins are often seen in the quiet water in the lee (west-side) of the Point.

11. Fisheries Resources

The clear ocean waters surrounding the Point contain a wide assortment of reef and shore fishes typical of remote coastal areas in the main island group. No qualitative or quantitative studies have been made to further assess this resource.

16. Marking and Banding

Young wedge-tailed shearwaters were banded at Kilauea Point just prior to fledging. Most were double-banded using an incoloy band on the right tarsus and a monel band on the left tarsus to study the differential wear patterns of these burrowing seabirds. The following table summarizes this banding effort:

Wedge-tailed Shearwater Fledglings Banded at Kilauea Point

<u>Year</u>	<u>Single Banded</u>	<u>Double Banded</u>
1978	-	362
1979	297	400
1980	219	281

Refuge personnel also assisted with the banding and release of Newell's Manx shearwaters during the 1978-1980 period (see Section G. 2).

H. PUBLIC USE

1. General

During the period 1978 to 1980 visitors to Hawaii increased at a rate of about 20% per year. A similar increase was recorded at Kilauea Point. The total visitation at Kilauea Point during 1978-1980 is given below:

Kilauea Point Visitors

<u>Year</u>	<u># of Visitors</u>
1978	116,258
1979	137,505
1980	140,857

The hours open to public visitation were noon to 4:00 p.m., Sunday through Friday, throughout the 1978-1980 period (holidays included).

2. Outdoor Classrooms - Students

Kilauea Point is a popular outdoor classroom site to illustrate seabird ecology, marine biology, botany and oceanography. The historic lighthouse, built in 1910, is also a point of interest.

A large regional YMCA camp, located 10 miles west of Kilauea Point, conducted 18 field trips a year to Kilauea Point (25-30 students/visit). Approximately 10-12 local school groups also visited the Point each year. Groups from three universities on the mainland utilized the Point each year during special extended field trips.

3. Outdoor Classrooms - Teachers

Each year two YMCA counselors were instructed by refuge personnel on how best to use the Kilauea Point area for their numerous field trips.

6. Interpretive Exhibits/Demonstrations

During the 1978-1979 period a display with photographs and a narrative description of the biology of the major seabirds at Kilauea Point was maintained on the office door, but it was not adequate to meet the increasing public demand for additional information.

Promotion Products, Inc. in Portland, Oregon was contracted (\$64,000) in September, 1979, to design, fabricate and install an interpretive display at Kilauea Point and at the Hanalei NWR overlook. Eleven exterior interpretive panels (3'x5') were installed in September, 1980, at strategic locations around Kilauea Point.



KPW-6 - One of eleven exterior interpretive panels along a cliff-side path at Kilauea Point, installed in September, 1980. BGB

The visitor parking area was moved further inland away from the immediate lighthouse area to create a 20-minute walking tour of the scenic peninsula. The refuge office was also moved from the small building adjacent to the lighthouse to Quarters #3 next to the new visitor parking area. The old office area (15'x20') was converted to an exhibit room containing three interpretive panels and a large mural explaining the remote island ecology of the Hawaiian Islands NWR extending 200-800 miles west of Kilauea Point. Service personnel worked together with Promotion Products, Inc. to produce an attractive and informative exhibit at the Point. The positive visitor response to this effort was tremendous.

9. Fishing

Local citizens from Kilauea have been fishing at Kilauea Point for many years. This fishing access was continued after the service acquired the use of Kilauea Point in 1972. However, fishermen are required to request permission from the resident refuge manager and must also notify the manager when they depart the area. Only 4 or 5 fishermen visited the site each month during the 1978-1980 period. The steep cliff-side trail, used by these experienced fishermen, does not lend itself to an expanded fishing access program.



KPW-7 - A large mural, depicting the dense seabird colonies in the remote Hawaiian Islands NWR, is part of a new seabird exhibit room at Kilauea Point. RJS

11. Wildlife Observation

In addition to the numerous general public visitors to the Point, several special interest groups conducted regular excursions to this site. The Sierra Club and the Audubon Society brought 4-6 groups a year on special birding trips. A few other small private birding tours also visited the Point.

17. Law Enforcement

Several "bird-shooting" incidents were investigated during 1978-1980 at Crater Hill, an area adjacent to the eastern boundary of Kilauea Point. The cattle egret and red-footed booby colonies in this area were usually the intended targets. No arrests or citations were made. The county police force cooperated in this enforcement effort.

18. Youth Programs

Eight-week non-residential YCC camps were held at Kilauea Point each summer during the 1978-1980 period. Fifteen enrollees and three YCC staff members worked on various habitat improvement projects at Hanalei NWR but spent most of their time at Kilauea Point. Major projects completed by this work force included: removal of exotic trees and

brush (4 acres), cultivating native plants from seeds and cuttings and later planting them in the cleared areas, installation of a drip irrigation system in the landscaped areas, painting and rehabilitating the three residences and exhibit building, assisting with shearwater studies, repairing the access roadway and assisting with interpretation programs for visitors. Environmental education programs for these camps focused on seabirds, marine biology and the endangered Hawaiian water birds.

A YACC program was initiated in 1978 and it continued through 1980. The 3-7 enrollees and one crew leader spent most of their time at Hanalei NWR. Major projects which they accomplished at Kilauea Point included: installation of a new visitor protection fence around the north end of the peninsula, construction of a greenhouse/storage building (15'x15'), assist with exotic brush removal, native plant cultivation and transplanting, installation of drip irrigation systems and supplementary watering of other landscaped areas, construction of the new parking area, remodeling the old office into an exhibit room and construction of a predator-proof fence along the southern boundary of the peninsula.

19. Cooperating Associations

Initial discussions of the feasibility of a cooperative association at Kilauea Point were begun in the fall of 1980. The vacant room adjacent to the exhibit room and next to the lighthouse was designated as a good location for this sales operation. The Association would fund the sales of natural history books, slides, maps and other environmental education material. Association sponsored seminars and tours were also proposed.

I. EQUIPMENT AND FACILITIES

1. New Construction

A predator exclosure fence was installed in early 1979 along the southern boundary of the Kilauea Point peninsula. Welded wire (4" mesh) with a green plastic covering was used to reduce rust. The 6'-high fence was buried 6" deep and back filled with gravel to prevent predators from digging under it.

A greenhouse/storage building (15'x15') was constructed in 1979 approximately 150' east of Quarters #1. The eastern half of the building was used as a greenhouse, for the cultivation of native plants, which were later used to landscape the Point.

Interpretive exhibit - (see Section H. 6) - The 4"x4" wooden frames holding the outdoor interpretive panels began to split and crack within a month after their installation. Promotion Products, Inc. was held responsible for this rapid deterioration. Negotiations were begun in December, 1980, to decide how best to curtail the rate of weathering and mitigation for this oversight.

2. Rehabilitation

The garage adjacent to Quarters #3 was remodeled to accommodate the YCC program need for office and classroom space. Quarters #3 was remodeled in 1980 to become the refuge office (with a guest room). A new roof was installed on Quarters #3 in December, 1980.

3. Major Maintenance

Grounds maintenance tasks for the visitor areas at Kilauea Point continued to grow during the 1978-1980 period. Watering the newly planted native shrubs and grass areas and mowing the increased lawn areas was very time consuming. Enrollees in the youth programs were a great help in these tasks.

Major repairs to the electrical and water lines serving Kilauea Point were repaired several times each year during the 1978-1980 period. The main water line is above the ground surface at many places along the entrance road. Vehicles which pull off the road sometimes damage this exposed pipe. The heavy ocean salt-spray at the Point causes accelerated corrosion of all metal parts including pipes, electrical wires, nails and other hardware, screens, plumbing fixtures, metal furniture parts, appliances and anything of any value!

5. Communications Systems

A single side-band radio was installed in Quarters #3 in 1979 to communicate with the Tern Island staff, Hawaiian Islands NWR. Daily communications with Tern Island were made throughout 1979-1980.

6. Energy Conservation

A solar water heater was constructed by refuge personnel in 1978 for Quarters #3. This energy saving device worked well throughout 1979-1980.