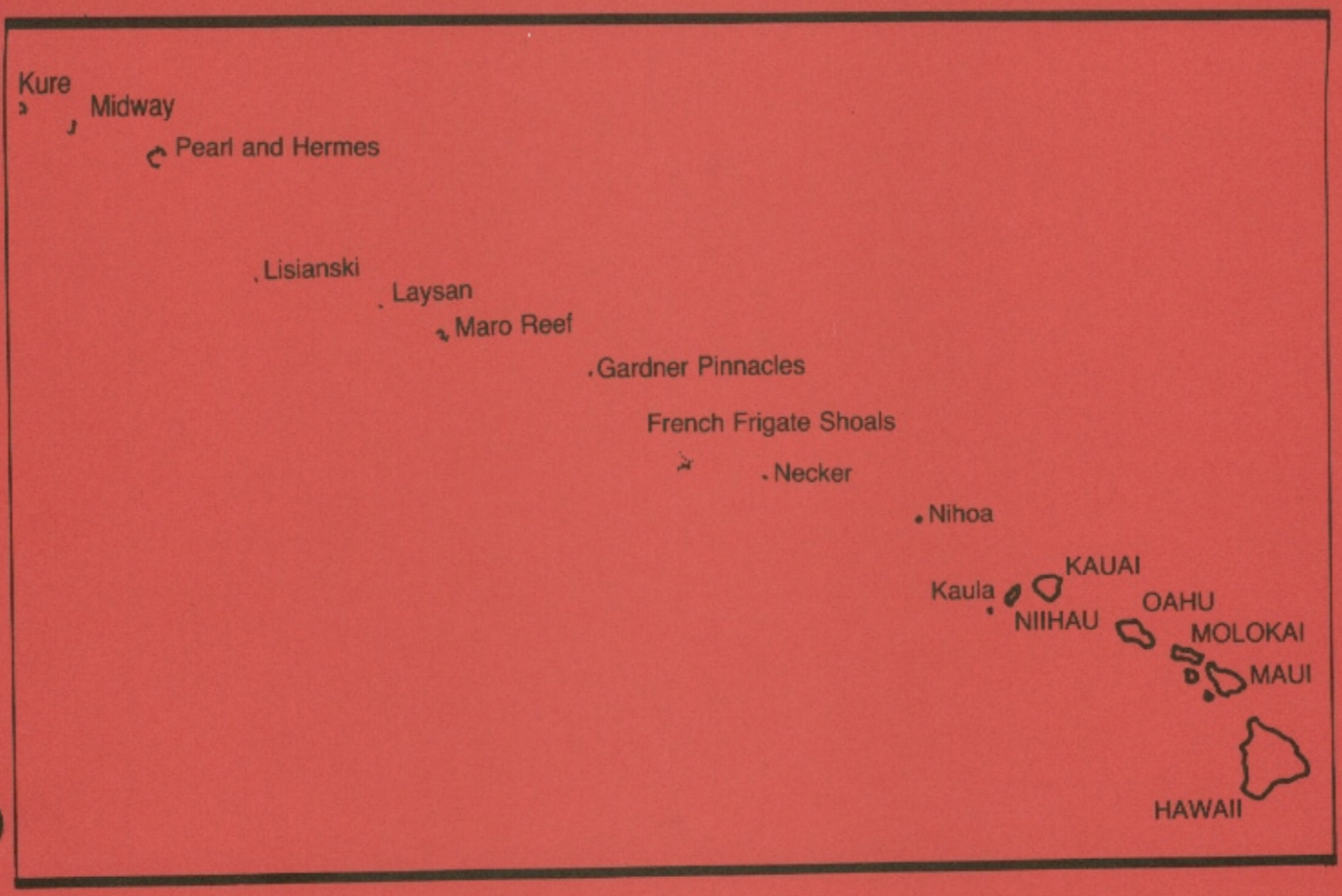

Northwestern Hawaiian Islands Passerines Recovery Plan

NORTHWESTERN HAWAIIAN ISLANDS

PASSERINE RECOVERY PLAN

Published by:

U.S. Fish and Wildlife Service

Portland, Oregon

Approved Robert E. Gilmore
Robert E. Gilmore
Associate Director-Federal Assistance

OCT · 1984
Date

THIS IS THE COMPLETED NORTHWESTERN HAWAIIAN ISLANDS PASSERINES RECOVERY PLAN. IT HAS BEEN APPROVED BY THE U.S. FISH AND WILDLIFE SERVICE. IT DOES NOT NECESSARILY REPRESENT OFFICIAL POSITIONS OF COOPERATING AGENCIES (AND IT DOES NOT NECESSARILY REPRESENT THE VIEWS OF ALL INDIVIDUALS INVOLVED IN THE PLAN FORMULATION). THIS PLAN IS SUBJECT TO MODIFICATION AS DICTATED BY NEW FINDINGS AND CHANGES IN SPECIES STATUS AND COMPLETION OF TASKS DESCRIBED IN THE PLAN. GOALS AND OBJECTIVES WILL BE ATTAINED AND FUNDS EXPENDED CONTINGENT UPON APPROPRIATIONS, PRIORITIES AND OTHER BUDGETARY CONSTRAINTS.

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PART I. INTRODUCTION

The Northwestern Hawaiian Islands (NWHI) are a chain of islands which extend about 1600 km (1000 miles) in length from Nihoa Island (about 400 km northwest of Oahu, Hawaii) northwest to Kure Atoll (Figure 1). There are many islands in this group, the oldest islands of the Hawaii volcanic chain. However their land mass only amounts to about 706 hectares (1,744 acres). These islands are the remnants of once large islands that have slowly eroded and subsided. What exist today are small land masses, or coral atolls which cover the remnants of the volcanic islands.

The NWHI are well known for their rich assemblages of seabirds which use most of the islands for nesting. Less well known are seven endemic species of primarily terrestrial birds known from these islands. Four of these species are extant and are listed as endangered by the Department of the Interior. One of these, the Laysan duck (Anas laysanensis), is treated in a separate recovery plan, completed in 1983. The other three species are songbirds (Order Passeriformes); the Laysan finch (Telespyza [= Psittirostra] cantans), the Nihoa finch (Telespyza [= Psittirostra] ultima) and the Nihoa millerbird (Acrocephalus familiaris kingi).

The remaining three terrestrial birds, the Laysan millerbird (Acrocephalus familiaris familiaris), Laysan rail (Porzana palmeri) and

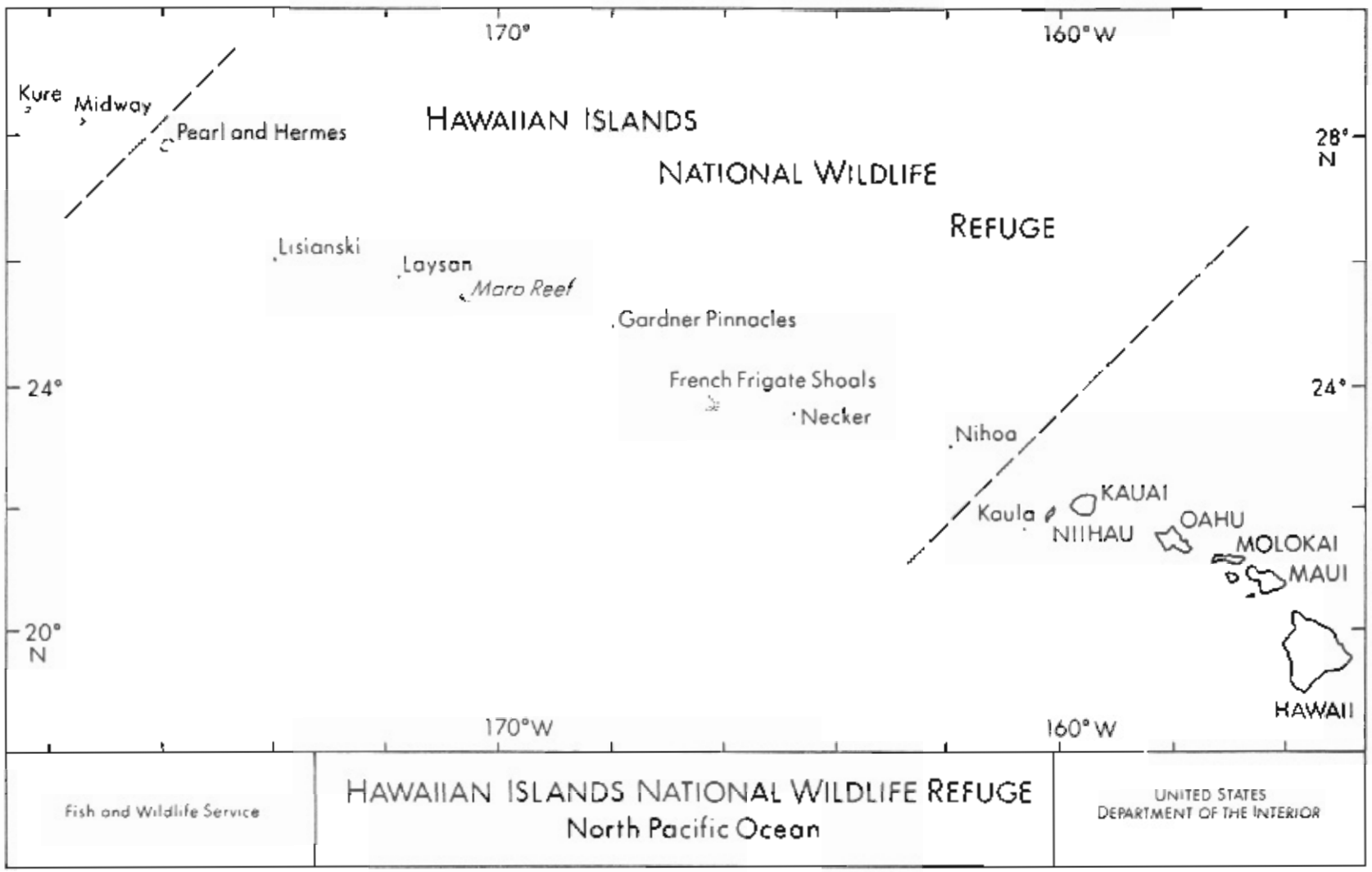
170°
160° W
Kure
Midway
Pearl and Hermes
HAWAIIAN ISLANDS
NATIONAL WILDLIFE
REFUGE
28° N
Lisianski
Laysan
Maro Reef
Gardner Pinnacles
French Frigate Shoals
Necker
24°
Nihoa
KAUAI
Kaula
NIIHAU
OAHU
MOLOKAI
MAUI
20° N
HAWAII
170° W
160° W
Fish and Wildlife Service
HAWAIIAN ISLANDS NATIONAL WILDLIFE REFUGE
North Pacific Ocean
UNITED STATES
DEPARTMENT OF THE INTERIOR

Figure 1.

Laysan honeycreeper (Himatione sanguinea freethi), all endemic to Laysan Island, became extinct by about 1923 due to destruction of vegetation by introduced rabbits (Oryctolagus cuniculus) (Ely and Clapp 1973). A transplanted population of Laysan rails at Midway Islands survived until about 1944 when rats were introduced. The extinction of these three endemics serves as a vivid warning of the serious ecological consequences when exotic organisms are introduced to island ecosystems which have evolved with only a few groups of organisms. Table 1 provides a brief review of the status and biology of all seven endemic land birds of the Northwestern Hawaiian Islands.

LAYSAN FINCH

Description/Taxonomy

The Laysan finch is endemic to Laysan Island, a 407 hectare (1,005-acre) coral sand island which is located about 1,140 km (710 miles) northwest of Oahu, Hawaii. Adult males of this species have a conspicuous, bright yellow head, throat and breast, with dark green to black streaking on the upper back blending to gray on the lower back. Females are brownish streaked all over with more black above and a faint wash of greenish-yellow, particularly on the breast. Laysan finches have a distinctive, heavy conical bill which is bluish to gray. The overall length of this species is 14.5 cm to 16 cm (6 to 6.5 inches) (Berger 1981).

The Laysan finch was first described by Wilson (1890), erroneously as from Midway Island. It was transplanted to East Island (Midway) in

TABLE 1. Status and Biology of Endemic Land Birds of the Northwestern Hawaiian Islands

	Laysan Finch 1,2,3	Nihoa Finch 2,4,5	Nihoa Millerbird 2,4,5	Laysan Duck* 1,2,3	Laysan Millerbird 1,2	Laysan Honeycreeper 1,2	Laysan Rail 1,2
First discovered	1890	1915	1923	1828	1891	1828	1828
Historical range	Laysan Is.	Nihoa Is.	Nihoa Is.	Laysan Is.	Laysan Is.	Laysan Is.	Laysan Is.
Present range	Laysan (plus several intro. populations on small islands at Pearl and Hermes Reef	Nihoa	Nihoa	Laysan (plus several captive populations)	Extinct	Extinct	Extinct
Occupied area	C. 450 acres	C. 150 acres	C. 100 acres	C. 400 acres	-	-	-
Population trend	Exceedingly common (Wilson 1890)	1,000 (1915)	100 (1923)	Not very plentiful (1891)	Plentiful (1891)	Fair number (1891)	Very plentiful (1891)
	100 (1923) (rabbits)	3,000-5,000 (1964-1973)	200-600 (1960's-1970's-1980)	2 ? (1924) (rabbits)	Abundant (1902)	1,000 (1915)	Everywhere on island 5,000 (1915)
	10,000 (1977-83)	2,000 (1980)		200 (1955)	Perhaps 1,500 (1915)	3 (1923)	2 (1923)
				400-550 (1965-1983)	Extinct ? (1918)	Extinct (1923)	Extinct (1923)

	Laysan Finch 1,2,3	Nihoa Finch 2,4,5	Nihoa Millerbird 2,4,5	Laysan Duck* 1,2,3	Laysan Millerbird 1,2	Laysan Honeycreeper 1,2	Laysan Rail 1,2
	Common; relatively stable	Fairly common; fairly stable	Low density; fairly stable	Low density; population seems to fluctuate over a normal range	Historically uncommon, now extinct	Historically rarest of all land birds, now extinct	Historically medium density
Ecological factors	-omnivorous -nest sites abund. and flexible -clutch size 3	-omnivorous -nest sites less abund. & less flexible -clutch size 3	-insectivorous -short, more variable nesting season -clutch size 2-3	-insectivorous -nest sites -apparently not limiting -clutch size 5-6	-insectivorous -clutch size 2-3	-nectarivorous -clutch size 4-5	-omnivorous -clutch size 2-3
Transplants	Midway 1891 (Midway pop. extirpated in 1944); Pearl & Hermes Reef in 1967, successful	French Frigate Shoals (1967), failed	None tried	Oahu (1894) Pearl & Hermes Reef in 1968, failed	None tried	None tried	Midway (1891 1904) successful until 1944 (rats) Lisianski (1913), failed (rabbits) Pearl & Hermes Reef (1929), failed (storm)

	Laysan Finch 1,2,3	Nihoa Finch 2,4,5	Nihoa Millerbird 2,4,5	Laysan Duck* 1,2,3	Laysan Millerbird 1,2	Laysan Honeycreeper 1,2	Laysan Rail 1,2
Captive breeding potential	Apparently possible (Throp 1970)	Apparently possible (Berger 1981)	Only birds to be held in captivity died, poor prospects	Very successful, several viable captive flocks	-	-	-
Status	Endangered, risk of extinction low relative to other endemic land birds of NWHI	Endangered, risk rated medium	Endangered, risk relatively high	Endangered, risk low to moderate (captive stock)	Extinct	Extinct	Extinct

* Treated in Separate Recovery Plan

1) Ely and Clapp 1973
2) Sincock and Kridler 1977
3) USFWS unpubl. data
4) Clapp et al. 1977
5) Conant et al. 1981

1891 (now extirpated) and Southeast Island at Pearl and Hermes Reef in 1967, where it now occupies several small islands. Recent fossil findings suggest that a closely related form was once widespread in the main Hawaiian Islands (Olson and James 1982). The taxonomic relationship of this fossil form to the Laysan finch has not yet been determined.

Laysan finches are bold birds, showing little fear of people. They were considered good cage birds by the early explorers of these islands because of their melodious song.

Population Status and Trends

When the Laysan finch was discovered in 1890 it was considered "exceedingly common" (Wilson 1890). It was found on all parts of the island. Through 1915, all observers continued to describe it as abundant everywhere (Ely and Clapp 1973). The first attempts to census the population resulted in estimates of 2,700 birds in 1911 (Dill and Bryan 1912) and 4,000 birds in 1915 by Munter (Ely and Clapp 1973). These were rough estimates based on short visits to the island. The population apparently declined sharply after the vegetation on the island virtually disappeared subsequent to the introduction of rabbits in about 1903. Estimates suggested that as few as 100 birds remained in 1923 (Ely and Clapp 1973).

The fairly rapid and complete elimination of rabbits by the members of the Tanager Expedition in 1923 undoubtedly saved the Laysan

finch from extinction. The population apparently recovered from the habitat disruption rather quickly. By 1936, there were an estimated 1,000 Laysan finches on the island and by 1950 the population consisted of an estimated 5,000 birds (Ely and Clapp 1973, Brock 1951). From the late 1950's to the mid 1970's, various trips were made to Laysan Island. Expeditions between 1957 and 1962 were conducted by personnel from the Hawaii Division of Fish and Game; those between 1963 and 1967 were conducted by personnel from the Smithsonian Pacific Ocean Biological Survey Program. More recent work has been conducted primarily by personnel of the U.S. Fish and Wildlife Service (USFWS). Population estimates generated from data gathered on these expeditions centered around 10,000 birds (Ely and Clapp 1973). The most recent counts from 1977 to 1983 (some based on only qualitative information) indicate the population has remained relatively stable at about 10,000 birds.

Some caution must be taken when interpreting the older census data. Census techniques have varied considerably over the years. Although specific technique descriptions are lacking, initial surveys were probably qualitative estimates of population size based on a short walk over the island.

In 1951, attempts to census the Laysan finch began to take on a more systematic, quantitative approach. Brock (1951) employed a simple line transect (fixed width) method. In 1966, the FWS began line transect surveys similar to the surveys done by Brock in 1951. These involved about 9 transects (100 feet wide) distributed around the

island. Counts were conducted by four men walking abreast from the beach vegetation line to the interior lagoon (Sincock and Kridler 1977). The procedure was later modified to consist of 120 randomly selected transects, each 300 feet long and one rod (16½ feet) wide. This technique was used from 1968 to 1976 (Sincock and Kridler 1977). Surveys during these particular years yielded variable population estimates (range 6,764-20,802) from year to year, but for most years the estimate was close to 10,000. An average of 12 censuses over 10 years (1966-1976) was 10,087 birds. Counts conducted in 1983, using this technique, provided a total population estimate of 11,047 (9,545-12,549 at the 95% Confidence Interval) (USFWS unpubl. data)[1]. The approximate carrying capacity of the habitat on Laysan Island for Laysan finches appears to be roughly 10,000.

Laysan finches were successfully introduced on East Island (Midway) in 1891 but had disappeared by 1944 after rats (Rattus sp.) became established in 1943 (Ely and Clapp 1973). The Fish and Wildlife Service purposefully introduced 108 Laysan finches to Southeast Island, Pearl and Hermes Reef in 1967 to establish a separate population (Sincock and Kridler 1977). The number increased fairly quickly and estimates from line transect censuses between 1968 and 1974 suggested there were about 500 birds, apparently the carrying capacity of this 12.5-hectare (31-acre) island (Sincock and Kridler 1977). In 1983, 523 Laysan finches were estimated on Southeast Island using a similar

[1]Hawaiian Islands National Wildlife Refuge, P.O. Box 50167, Honolulu, Hawaii 96850.

method (USFWS unpubl. data). Additional recent observations at Pearl and Hermes Reef indicate that this population has spread to North, Grass, Seal, and Kittery Islands (Figure 2). These populations range upward from at least 50 birds on each island and are apparently self sustaining (USFWS unpubl. data).

Habitat

Laysan Island is a coral sand island ringed on its periphery by sand dunes (Figure 3). It is about 2.9 kilometers (1.8 miles) long by 1.7 km (1.1 mile) wide totaling about 407 ha (1,005 acres). A salt-water lagoon covering about one-fifth of the island is located in the interior. The island appears to be the flattened top of an eroded volcanic peak which has subsided below sea level. The land surface has resulted from the buildup of coral, other marine invertebrates and calcareous algae on top of the basaltic volcanic peak (Ely and Clapp 1973). The island rises abruptly to 15 to 18 feet and then more gradually to an elevation of roughly 40 feet. The maximum elevation on the island is 56 feet above sea level (Stearns 1966).

Lamoureux (1963) described the vegetation of Laysan as being divided primarily into five distinct associations;

Nama association - dominated by Nama sandwichensis var. laysanicum, an herb which forms small, low-lying, rounded mounds of vegetation on the beaches and seaward slopes.

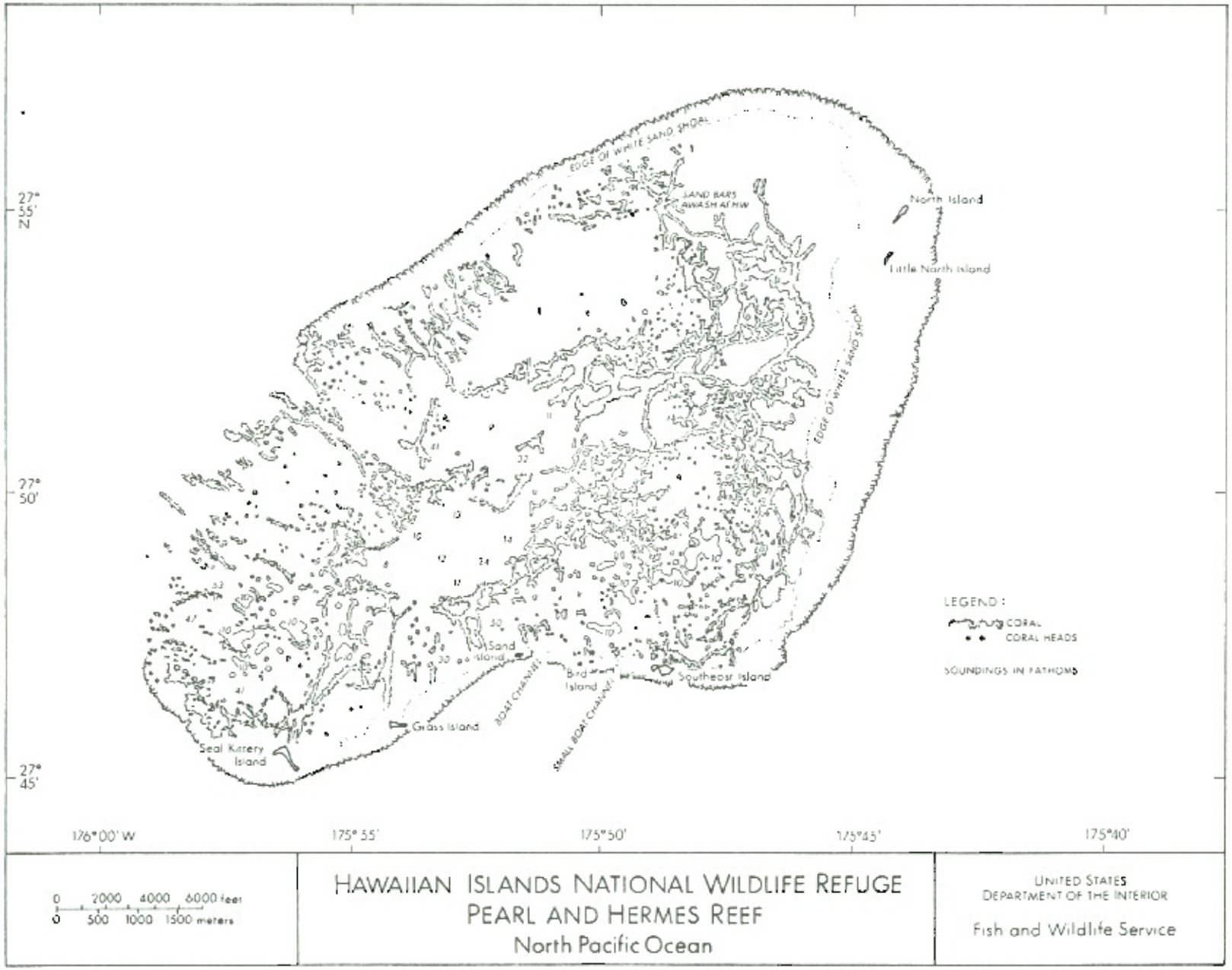
27° 55' N
27° 50'
27° 45'
176° 00' W
175° 55'
175° 50'
175° 45'
175° 40'
EDGE OF WHITE SAND SHOAL
SAND BARS AWASH AT HW
North Island
Little North Island
EDGE OF WHITE SAND SHOAL
LEGEND :
CORAL
CORAL HEADS
SOUNDINGS IN FATHOMS
Sand Island
Bird Island
Southeast Island
Grass Island
Seal Kittery Island
BOAT CHANNEL
SMALL BOAT CHANNEL
0 2000 4000 6000 feet
0 500 1000 1500 meters
HAWAIIAN ISLANDS NATIONAL WILDLIFE REFUGE
PEARL AND HERMES REEF
North Pacific Ocean
UNITED STATES
DEPARTMENT OF THE INTERIOR
Fish and Wildlife Service

Figure 2.

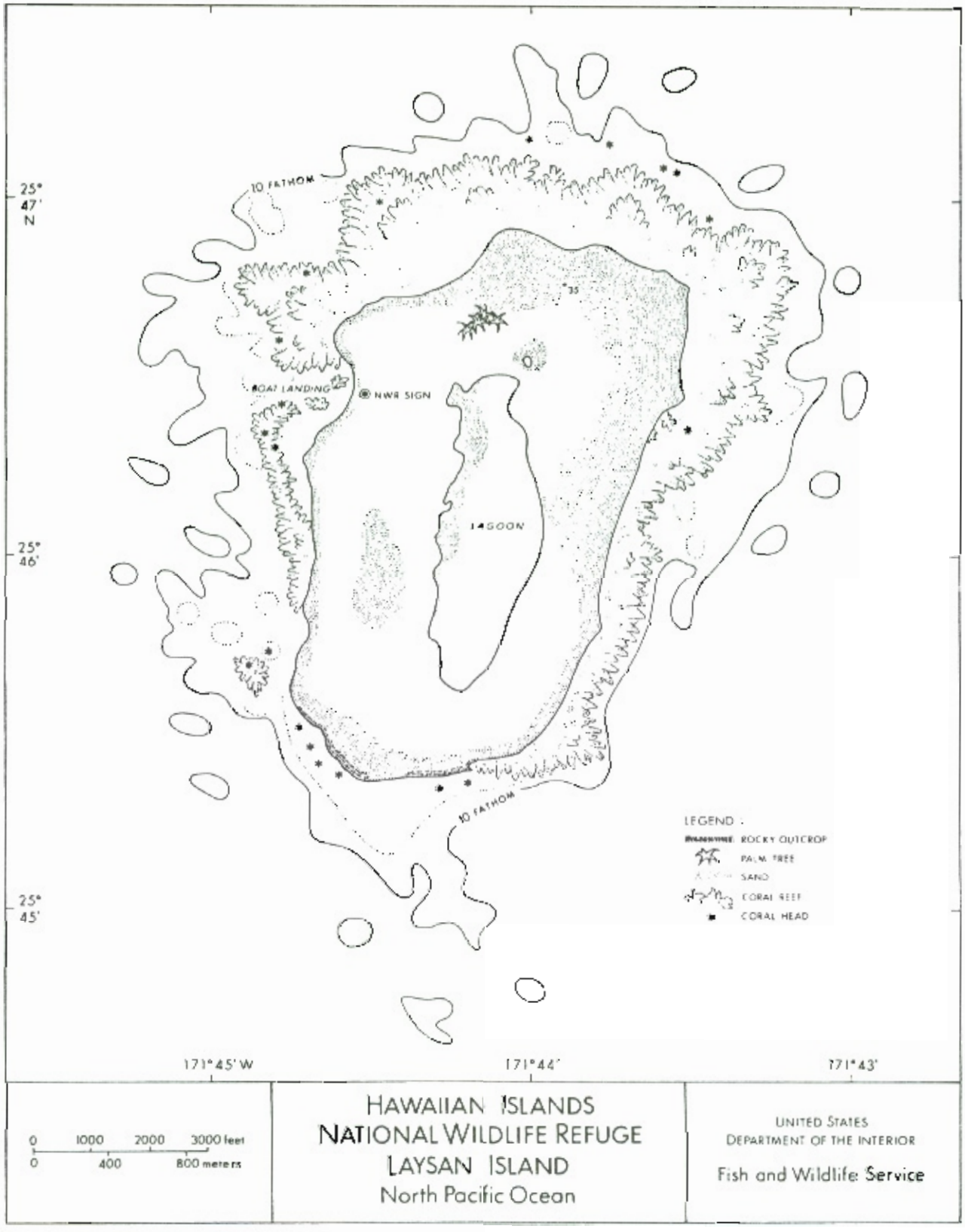
25° 47' N
25° 46'
25° 45'
10 FATHOM
BOAT LANDING
NWR SIGN
LAGOON
10 FATHOM
LEGEND :
ROCKY OUTCROP
PALM TREE
SAND
CORAL REEF
CORAL HEAD
171°45' W
171°44'
171°43'
0 1000 2000 3000 feet
0 400 800 meters
HAWAIIAN ISLANDS
NATIONAL WILDLIFE REFUGE
LAYSAN ISLAND
North Pacific Ocean
UNITED STATES
DEPARTMENT OF THE INTERIOR
Fish and Wildlife Service

Figure 3.

Scaevola association - dense shrubs to 1.5 meters, typically just inland of Nama association. This association has declined in recent years (Herbst pers. comm.). However, it appears that this vegetation is beginning a recovery and is increasing again, except for one area on the east side of the island.

Eragrostis variabilis (Bunchgrass) association - Bunchgrass dominates this association. It occupies the majority of the land area of this island.

Boerhavia - Ipomea - Tribulus association - all species in this association are low, creeping plants. They occur in a 20-to 200-meter swath of land on the lower inner slopes of the island.

Sesuvium - Cyperus - Heliotropium association - this association occurs in a 10-to 100-meter-wide band along the entire shoreline of the lagoon. The Sesuvium is a creeping plant which forms a dense mat; the Cyperus looks like a rush and stands about a meter in height.

The vegetation made a relatively rapid recovery after 1923 from the devastation caused by rabbits between 1903 and 1923. Within 25 years these associations had reestablished themselves after being almost completely destroyed (Lamoureux 1963). The vegetated area occupies about half of the island (Sincock and Kridler 1977).

A number of exotic plant species have become established on Laysan over the last 80 years, including a few coconut palm trees.

Laysan finches are found in all of the above native plant associations on the island although they appear to favor the bunchgrass association (Berger 1981). The vegetation is similar at Pearl and Hermes Reef where Laysan finches appear to select the bunchgrass association for nesting (Sincock and Kridler 1977).

Food Habits and Other Requirements

Laysan finches are known to feed on a wide variety of plant and animal material. They will take seeds, tender shoots of bushes and grasses, flowers, especially those of Tribulus (Nohu) and Eragrostis, and eggs of many species of birds (Ely and Clapp 1973). The incidence of predation on seabird eggs may be related to the presence of humans on the island who cause nesting seabirds to temporarily flush from their nests. They are also known to forage on dead seabirds for the emerging fly larvae or for other invertebrates (Wayne Gagne pers. comm.)[2].

They have been observed drinking water from the saline lagoon and from a spring (Kridler pers. comm.)[3]. Otherwise, water requirements for this species are probably met through moisture obtained from food consumption.

[2]Bernice P. Bishop Museum, P.O. Box 19000-A, Honolulu, Hawaii 96819.

[3]103 Huckleberry Crest, Sequim, Wash. 98382.

Breeding Biology

Eggs may be laid as early as February or March, but most egg-laying occurs from late April to early June (Ely and Clapp 1973). Clutch size is normally 3 eggs, but ranges from 2 to 4. Most nesting now occurs in clumps of bunchgrass, although older reports suggest these birds used other nesting sites such as holes in rocky areas and even buildings (which were formerly present on Laysan Island). However, since Eragrostis has become much more common, they apparently now use only clumps of this bunchgrass as nest sites (Ely and Clapp 1973).

The nest is a shallow cup made of dead grass blades and rootlets. The few nests (seven) that were measured by Crossin in 1960 averaged roughly 13.7 cm (5.4 inches) across and 6.9 cm (2.7 inches) high (Ely and Clapp 1973). They were usually located several centimeters above the ground, centered in a grass clump and well concealed.

Based on limited observations of a few captive birds, incubation takes about 16 days and the nestling period lasts about another 15 days (Throp 1970). The peak of nesting appears to be in mid-spring although nesting has been observed as early as February (Sincock and Kridler 1977). Most young have fledged by late July or early August. There are no data on number of young successfully fledged per nest.

NIHOA FINCH

Description/Taxonomy

The Nihoa finch is endemic to Nihoa Island, a high, rugged, volcanic remnant located about 400 km (250 miles) northwest of Oahu, Hawaii. Bryan (1917) described this species in 1917 and named it "ultima" believing that it would be the last species of bird from the Hawaiian Islands to be discovered.

This bird resembles the closely related Laysan finch in many ways. The plumages of the two species are very similar (Banks and Laybourne 1977). However, it is somewhat smaller in all dimensions, averaging 13 to 13.5 cm (5.5 to 5.65 inches) in length. Nihoa finches are also sociable and fearless birds in the presence of people, approaching observers to within a few feet. Historically, this species was restricted to Nihoa Island, although recent fossil finds (Olson and James 1982) indicate the prehistorical presence of a form similar to both the Laysan and Nihoa finch on the main Hawaiian Islands. The populations of both the Laysan and Nihoa finches were originally described as separate species. However, the Nihoa finch was subsequently considered a subspecies of the Laysan finch until recently. Banks and Laybourne (1977) provided evidence for reclassifying them to their original full species level.

Both the Laysan and Nihoa finches were formerly considered members of the subfamily Psittirostrinae in the family Drepanididae (Hawaiian honeycreepers) (Berger 1981). The taxonomy of this family has recently

been reevaluated and these species are now within the tribe Psittirostrini, subfamily Drepanidinae, in the family Fringillidae (A.O.U. 1983).

Population Status and Trends

When the Nihoa finch was first discovered in 1915, Munter estimated "1000 or more" birds on the island (Clapp et al. 1977). The few opportunities to visit this island until the early 1960's resulted in estimates between 500 and 1,200 birds. Estimates from 1964 through 1975 suggested a population of 3,000 to 5,000 birds (within a range of estimates of 1,318 to 6,686). These estimates were based on line transects and simple visual censuses (Sincock and Kridler 1977). More recently Conant et al. (1981) compared various census methods during one field season to consider the effects the observer(s) has on the behavior of the birds and the results of the census. The three techniques (fixed strip or line transects, variable strip and variable circular plot) produced somewhat different population estimates. The fixed distance strip, the technique used most often in the past, yielded a total population estimate of 1,608 (± 418 at the 95% CI). This technique appears to yield reliable data and it is probably the most practical technique for annual censuses to monitor the status of the population. The range in population estimates from different years may be due, in part, to real population fluctuation or it may just be an artifact of the various data-gathering techniques. The carrying capacity of the habitat for Nihoa finches may be fluctuating as well. This situation is not clear.

In 1967 the Fish and Wildlife Service transplanted a total of 42 Nihoa finches to French Frigate Shoals; 32 to Tern Island and 10 to East Island. Although some breeding was observed, the introduced populations have since become extirpated (USFWS unpubl. data).

Habitat

Nihoa Island is a 62-hectare (156-acre) land area which is a remnant of a volcanic cone. This island has steep slopes, rocky outcroppings, well developed valleys, and precipitous cliffs on the west, north and east edges of the island (Clapp et al. 1977). The island has notably rough topography and a maximum elevation of about 277 meters (910 feet) (Figure 4).

Low shrubs, primarily Solanum nelsoni, Chenopodium oahuense, Sida fallax in mixed or pure stands, cover the sides and much of the floors of the valleys (Clapp et al. 1977). Bunchgrasses (Eragrostis) are more common on the ridges. Four taxa of plants, including the palm tree, Pritchardia remota (found in two valleys), are endemic to Nihoa Island.

Nihoa finches are widespread over the island but they are more often seen near the rocky outcroppings. Finches have been observed to move considerable distances, sometimes flying up to halfway across the island (Conant 1983). Conant's (1983) research suggests the finches prefer an open, but vegetated habitat. Sida matches these characteristics best and Conant's (1983) data show significant

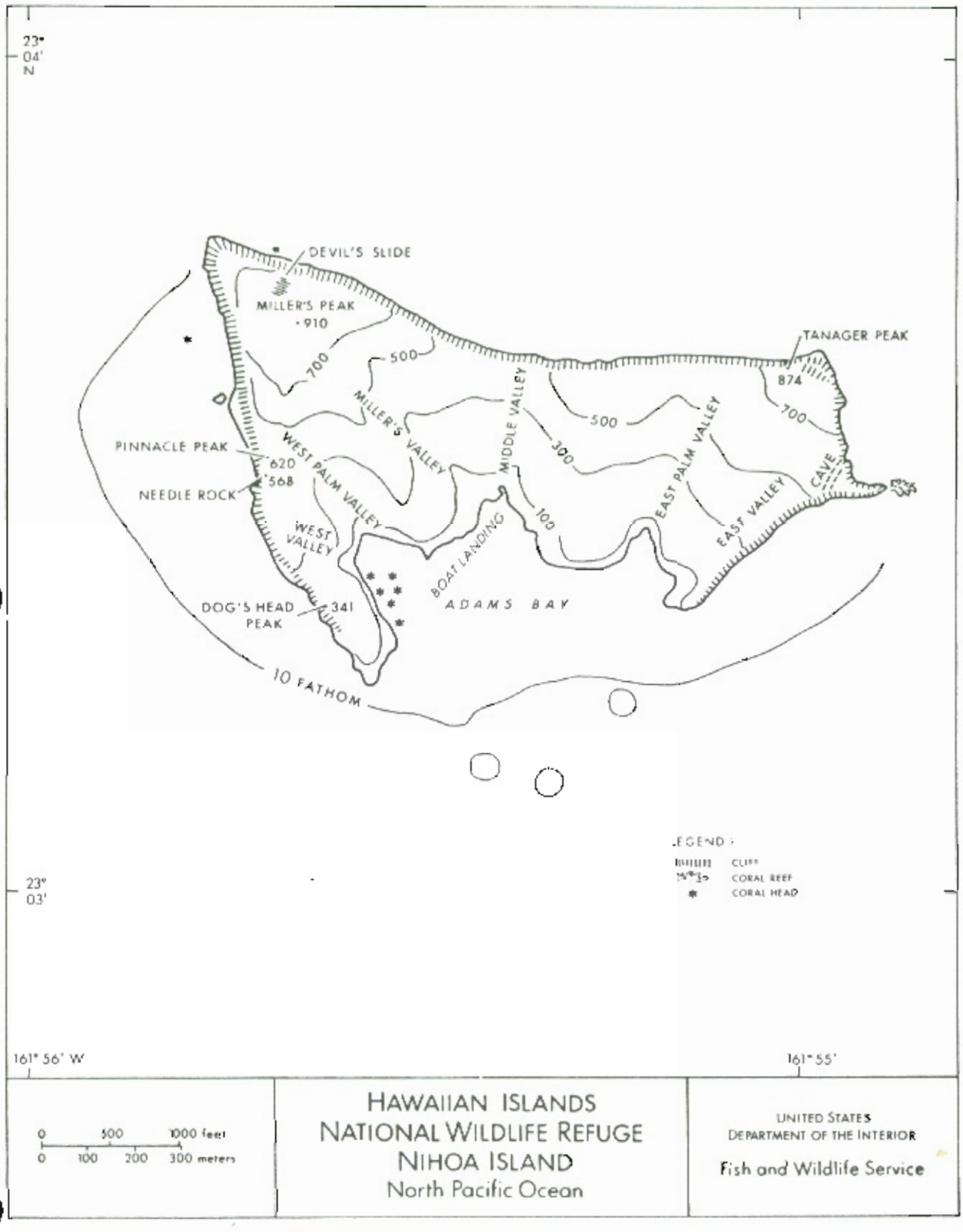
23° 04' N
DEVIL'S SLIDE
MILLER'S PEAK
910
TANAGER PEAK
874
700
500
MILLER'S VALLEY
MIDDLE VALLEY
300
500
700
PINNACLE PEAK
620
568
NEEDLE ROCK
WEST PALM VALLEY
EAST PALM VALLEY
CAVE
WEST VALLEY
100
EAST VALLEY
BOAT LANDING
ADAMS BAY
DOG'S HEAD PEAK
341
10 FATHOM
LEGEND :
CLIFF
CORAL REEF
CORAL HEAD
23° 03'
161° 56' W
161° 55'
0 500 1000 feet
0 100 200 300 meters
HAWAIIAN ISLANDS
NATIONAL WILDLIFE REFUGE
NIHOA ISLAND
North Pacific Ocean
UNITED STATES
DEPARTMENT OF THE INTERIOR
Fish and Wildlife Service

Figure 4.

positive correlation between finch sightings and Sida. The small holes in rocky outcroppings are apparently the preferred nesting sites.

Food Habits and Other Requirements

The Nihoa finch is omnivorous, eating a wide variety of plant material (seeds, flower heads, etc.), invertebrates, and bird eggs (Conant et al. 1981). Their habit of taking seabird eggs has been noted by many observers. This habit may apparently be further encouraged when people visiting the island flush seabirds off their eggs. Observers have also noted these birds congregating near the few seeps or pools of fresh water on the island.

Breeding Biology

Available data show egg laying begins in late February and lasts at least through March (Sincock and Kridler 1977). Conant (1983) estimates that egg laying may extend from early February to early July. Fledging may occur into August. All nests appear to be built in holes in cliff outcroppings at elevations of 30 to 270 meters (100 to 850 feet) (Conant 1983).

Little field data exist on incubation and nestling period. Berger (1981) found that one captive bird incubated for about 15 days before its eggs hatched. Average clutch size is 3. There are no data available on fledgling success rates or number fledging per nest.

NIHOA MILLERBIRD

Description/Taxonomy

The Nihoa millerbird was discovered on Nihoa Island in 1923 by Alexander Wetmore during the Tanager Expedition (Wetmore 1924). The related Laysan millerbird (Acrocephalus f. familiaris) was discovered in 1891 on Laysan Island by Palmer and Munro but became extinct sometime between 1915 and 1923 (Ely and Clapp 1973). The Nihoa millerbird is endemic to Nihoa Island and has never been transplanted to any other area.

The Nihoa millerbird is a member of the subfamily Sylviinae in the family Muscicapidae (thrushes, old world warblers, old world flycatchers). It is dark gray-brown above and buffy-white below, with a thin dark-colored bill. They are relatively secretive birds, usually encountered in the dense, low vegetation. They tend to run, hop or fly about in the underbrush and scarcely ever leave cover (Vanderbilt and Meyer de Schauensee 1941).

Population Status and Trends

Wetmore (1924) estimated the population size of this species to be about 100 birds when it was first discovered in 1923. This estimate was based on brief observations, and no systematic sampling was used. Although it is distributed over the entire island, it is apparently found in much lower densities than the finch. The few population appraisals of this species during the following 40 years all estimated

between 100 to 200 birds (Clapp et al. 1977). From the late 1960's to the mid 1970's the USFWS conducted line transect censuses for both finches and millerbirds. These data indicated a population of roughly 200 to 600 millerbirds.

Conant et al. (1981) used several census techniques to estimate populations of millerbirds as they did with the finches. Their estimate using the fixed strip technique was 338 birds (± 192 95% CI). This estimate is similar to the results of past censuses. The variable circular plot technique may yield more precise data but it is more difficult to use during quick visits to the island by relatively inexperienced observers. As with the Nihoa finch, the fixed strip technique yields reliable data and is considered probably the most practical technique for census purposes. The carrying capacity of the habitat used by Nihoa millerbirds appears to be a maximum of 600 birds.

Habitat

Nihoa millerbirds are more or less distributed throughout the island where they tend to stay in areas of relatively dense shrubs (*Sida* and *Chenopodium*). Conant (1983) found the presence of millerbirds to be negatively correlated with the presence of bunchgrass (*Eragrostis* sp.) habitat. They remain mostly in the cover of the *Sida* and *Chenopodium* bushes where they prefer to place their nests (Clapp et al. 1977, Conant 1983).

Although millerbirds are distributed island-wide, their relatively low density is related primarily to one factor. These birds are restricted to a diet of terrestrial arthropods which are found mostly in dense shrubby vegetation. There are about 40 hectares (100 acres) of this habitat on Nihoa Island (Conant 1983). However, the distribution and abundance of this vegetation may fluctuate over a period of years.

Movements and territory size are probably related to distribution and abundance of vegetation and terrestrial arthropods. Millerbirds are apparently quite sedentary, rarely moving more than about 20 m from a territory. Territory size is estimated to be 0.2 to 0.4 hectares (0.5 to 1.0 acres) (Conant 1983).

Food Habits and Other Requirements

Nihoa millerbirds are insectivorous, gleaning their prey primarily from foliage, but also from stems of bushes, leaf litter, and the soil surface (Conant et al. 1981). The name "millerbird" comes from this species' habit of preying on the large "miller" moths.

Breeding Biology

Little is known of the reproductive cycle of the Nihoa millerbird. The first active nest was discovered by Marshall (1964) in June 1962. Of 35 known nests, almost all have been found in *Chenopodium* or *Sida*.

The average height above the ground of these nests was 33 cm, probably because vegetation was densest at this height (Conant 1983).

Nesting chronology is unclear but this species may begin breeding anytime between January and May. Some nesting is known to occur early because nestlings have been observed in February (Conant 1983) and March (Sincock and Kridler 1977). Observations by Conant (1983) indicate that the species may have a breeding season of four to five months. It appears that millerbird nesting is linked to availability of terrestrial arthropods whose abundance is, in turn, dependent on phenological events in the plant community (Conant 1983). Thus, variation in weather could shift nesting backward or forward by several weeks from year to year.

Average clutch size is 2 eggs. There are no data on nesting or fledgling success rate.

LIMITING FACTORS

There are common factors which potentially threaten the continued existence of all three species of endemic passerine birds in the NWHI. These species have an extremely limited distribution within relatively sensitive biological systems. These conditions potentially magnify the impacts of negative influences upon the population, and the birds and their biological systems are vulnerable to even minor disruptions. The history of Laysan Island is one of the classical illustrations of this point.

Direct Effects of People

The status of Laysan and Nihoa Islands as part of the Hawaiian Islands National Wildlife Refuge and as designated Research Natural Areas serves to protect the resources of these islands from the direct effects of people. However, the remoteness of these islands makes enforcement of Refuge regulations logistically difficult. Direct effects of people through both authorized and unauthorized entry and use of these extremely sensitive islands are difficult to prevent or monitor. Indirect effects resulting from human access can also present serious problems to endemic birds including accidental introduction of exotic plants and insects attached to clothes, shoes, equipment, etc. and the potential introduction of rodents or other harmful exotics via shipwreck.

Exotic Organisms

A major concern with respect to the conservation of the three endangered birds discussed here is the threat of introduction of exotic plants and animals. Future intentional introductions are unlikely. The islands are too remote and their status as both a Refuge and a Research Natural Area dissuades intentional exotic importations. In addition, past and future educational efforts should discourage any ideas of intentional introductions of exotic organisms.

Various plants, invertebrate and vertebrate species already have been accidentally or deliberately introduced to some Northwestern

Hawaiian island ecosystems (e.g. Midway, Kure Atoll, and historically on Laysan) with significant adverse impacts on native species. Introductions of rodents, cats, exotic insects, birds and plants are major threats to bird populations on Laysan and Nihoa Islands. Rodents could possibly be introduced if individuals escape from a nearby shipwreck, from a vessel traveling near these islands or by illegal landings on the islands. These animals have demonstrated a remarkable ability to spread to unoccupied areas. If rats became established on either island they would pose a potential disaster by preying on eggs and chicks of birds, including passerines, and by destroying vegetation.

Some exotic birds such as Common mynas (Acridotheres tristis) or Japanese bush-warblers (Cettia diphone) could also create severe problems if introduced to these islands. Common mynas are known to prey on nestlings and they would certainly compete with the native species for resources. Either bird could also function as a reservoir for diseases. Such introductions are extremely unlikely but a dangerous threat, nevertheless.

The establishment of other exotic plant or animal species could create problems for the three passerine species. For example, carnivorous ants or other predacious insects, such as yellow jackets, introduced to either island could easily disrupt the fragile ecosystem which supports these birds. Such organisms could disrupt the food supply of the native passerines (particularly the millerbirds) or even directly prey on nestlings. If exotic plants become established, some

species may eventually cause major changes in the native plant communities. Such an occurrence would probably affect the native passerines.

It will be difficult to prevent the accidental introduction of new exotic organisms to these islands. The chief concern is obviously harmful exotics, such as rats, although any exotic could potentially cause harm. This problem suggests these species will always be threatened with extinction to some degree.

Avian Diseases

Avian diseases, or at least the vectors which transmit disease, apparently never or rarely occur on Laysan and Nihoa Islands, although some invertebrates (e.g. flies) already present on these islands could function as mechanical vectors of disease. The Laysan finch, and presumably the other native passerines, are apparently highly susceptible to avian diseases (van Riper et al. 1982). The possibility that the resident bird species could be exposed to avian disease presents a devastating threat. If disease (and vectors) became established there would be little to prevent it from sweeping through the populations of these birds on either of these small islands.

Natural Disasters

Natural disasters, such as a severe hurricane or a tidal wave, could destroy some portion of the population of any or all three

species. It is very unlikely that such an occurrence could eliminate an entire population, but such an event coupled with other adverse human-induced factors could present problems for one or more of these species. The relatively small populations, particularly of the Nihoa Island species, may have difficulty recovering from such events. There are no neighboring populations (with the exception of disjunct populations of Laysan finches on Pearl and Hermes Reef) which can emigrate into suddenly vacant habitat. The low numbers in the populations have always made these species relatively vulnerable to extinction.

The Laysan and Nihoa ecosystems have significantly different habitats. The Nihoa finch and Nihoa millerbird face certain unique problems. Nihoa Island is a rocky, brushy island with steep slopes and rough terrain. A significant threat to the land birds on this island is fire, either natural or man-caused. Berger (1981) gives an account of a fire on Nihoa in 1885 started by a large group of people from Hawaii who had landed on the island for a short visit. This fire apparently destroyed much of the vegetation on the island. These endemic species survived this event; however, destruction of most of the vegetation by any means poses a serious threat.

CONSERVATION MEASURES

In 1909 President Theodore Roosevelt established the Hawaiian Islands Reservation by Executive Order (E.O.) 1019. This E.O. (which did not include Midway) was issued to protect the islands from

unauthorized entry and to safeguard the native plant and animal life. Kure was later excluded from this designation and turned over to the Territory of Hawaii. In 1940, Presidential Proclamation 2416 changed the designation to the Hawaiian Islands National Wildlife Refuge under the jurisdiction of the Department of the Interior. Landing on the islands of the Refuge and entry into Refuge waters are authorized only under permit signed by the Refuge Manager. No uses are permitted within the Refuge unless they are compatible with the purposes for which the Refuge was established; however, the isolation of these islands makes enforcement of these Refuge regulations problematic.

All three passerines of the Northwestern Hawaiian Islands were listed as endangered species on March 11, 1967 (32 FR 4001) under the original Endangered Species Conservation Act of 1966. These species were included under the Endangered Species Act of 1973 (Pub. Law 93-205), which replaced previous legislation. Endangered status affords these species all the provisions of the Act.

The Laysan finch and the Nihoa finch have both been transplanted to other islands by the Fish and Wildlife Service. The purpose of these transplants was to develop a self-sustaining wild population elsewhere in the event something happened to the native populations. In 1967, 108 Laysan finches were released on Southeast Island of Pearl and Hermes Reef. This population has apparently established a breeding population on this island at or near carrying capacity and subsequently on neighboring islands of Pearl and Hermes Reef (Sincock and Kridler 1977).

Forty-two Nihoa finches were transplanted to Tern and East Islands in French Frigate Shoals in 1967 for the same purpose. The birds on East Island were never seen again; the birds on Tern Island had limited successful reproduction and remained in very low numbers for a few years. Both transplanted populations eventually failed (USFWS unpubl. data).

Scientific research has been conducted on both Laysan and Nihoa Islands for many years. More recent efforts have been directed at developing an inventory of the resources of these islands. The U.S. Fish and Wildlife Service conducted annual population surveys of Laysan finches from 1966 to 1976 and continues to monitor populations. The most recent complete census was conducted in June 1984.

The Nihoa finch and Nihoa millerbird have also been censused by USFWS personnel. Transect surveys were conducted from 1967 to 1975 and again from 1977 to 1979. More recently, Conant et al. (1981) have also conducted intensive population censuses and other ecological investigations. It is likely that the census and study of endangered species will continue on those islands in the future.

PART II. RECOVERY

Objective: The prime objective of the NWHI Passerines Recovery Plan is to perpetuate the natural populations of all three species, eliminate or mitigate human-related threats to Nihoa and Laysan Islands and some of the islets comprising Pearl and Hermes Reef, and allow the natural function of the biological systems on these islands. Because these species are naturally restricted in their distribution and abundance and are part of fragile ecosystems, they will always be threatened to some degree. In light of these special circumstances, the objectives of this plan will be to 1) put the necessary mechanisms in place that will protect these islands from exotic influences, 2) establish effective and reliable mechanisms to monitor for exotic organisms and 3) periodically assure and verify the existence of reasonably stable populations of the three passerine species. Accomplishment of these objectives will provide reasonable justification to reclassify these birds to threatened status. The following tasks outline the steps necessary to achieve these objectives.

Step-down Outline

1. Prevent unauthorized entry to Laysan and Nihoa Islands.

   11. Maintain existing Refuge restrictions.

111. Maintain active stance on permit requirements for use of Refuge.

112. Insure public awareness of Refuge restrictions.

1121. Emphasize restrictions in all published material.

1122. All other government agencies should note restrictions and assist, where appropriate, with enforcement of restrictions.

12. Maximize Refuge protection.

121. Maintain clearly marked boundaries.

122. Maintain presence in area through patrol (surface and air) to deter unauthorized entry.

2. Prevent the establishment of exotic organisms.

21. Develop procedures to minimize chances of accidental introductions.

211. Restrict vessel access to Refuge waters.

212. Develop Education/Information program for individuals planning to travel near islands.

213. Take special precautions for vessel traffic involving landing parties.

2131. Develop "safety check" of mandatory procedures for all landing parties to the islands.

2132. Administer "safety check" program required of all landing parties.

22. Continually monitor islands to detect presence of exotic species, especially rodents.

221. Develop plan and techniques to detect presence of exotics, especially rodents.

st Guard and other involved agencies to monitor vessel traffic near islands.

2212. Determine/implement feasible detection methodology for a remote island setting.

222. Implement plan from #221.

223. Keep detection plan operational.

23. Establish contingency plan to eliminate problem exotic organisms.

231. Determine need to eliminate particular extant exotic organisms.

232. Determine optimum procedures for eliminating rodents and other exotics; incorporate into a contingency plan.

233. Be prepared to implement contingency plan.

2331. Acquire and ready equipment for immediate use.

2332. Periodically check equipment; maintain in working condition.

2333. Establish/maintain appropriate interagency contacts; make arrangements for logistic support.

3. Prevent the outbreak of avian diseases.

31. Monitor for diseases in these species.

32. Prevent introduction of disease vectors.

33. Minimize effects if an avian disease problem is discovered.

331. Use available technology to attempt to eliminate/control disease problem, as needed.

332. Capture birds and maintain in disease-free environment.

4. Monitor populations of all three species and their habitats to allow for detection of changes in populations or habitat quality.

   41. Implement monitoring programs for at least annual censusing of bird populations.

   42. Develop monitoring program for habitat, focusing on plant communities and terrestrial arthropods.

5. Establish additional, disjunct populations of all three taxa to provide a buffer against catastrophic declines of natural populations.

   51. Determine the feasibility of introducing the millerbird to Laysan Island.

      511. Reevaluate the taxonomic relationship of Laysan and Nihoa millerbirds.

      512. If task 511 results in continued distinction of the two subspecies, determine if it is justified to move the Nihoa subspecies outside its historical range.

      513. Develop reintroduction plan for millerbird, if warranted.

   52. Maintain captive flocks of birds, as needed.

NARRATIVE

Prime Objective: Maintain optimum and stable populations of the Laysan finch, Nihoa finch and Nihoa millerbird and maintain their natural habitat. This shall be done through development of thorough and effective habitat protection strategies that will allow for maintenance

of the ecosystems and optimum populations of the three bird species. These strategies include 1) all feasible efforts to prevent introduction of exotic organisms, 2) a monitoring program to detect changes in distribution and abundance of exotics, and 3) a strategy specifically designed to control invasion of exotics or changes in habitat and declines in bird populations (including captive propagation/ transplantation of birds, if necessary). Populations of all three passerine species should be monitored at least annually to assess population status. When these tasks are accomplished, consideration can be given to reclassifying these species to threatened status. Many of these tasks are considered priority 1 because they are critical to minimizing the chances of exotics becoming established, the primary threat to this species.

The recovery program for these three species is somewhat different than for most endangered or threatened species. These species are indeed in danger of extinction, but not because their populations have recently declined. These species have always had relatively low population numbers and have been restricted to extremely limited natural habitats. This contributes largely to their vulnerable status. Natural catastrophies,

introduction of exotics, or disease epidemics could devastate the relatively small, island populations of these birds. There will always be some degree of threat facing these species.

All three species currently appear to have populations at or near carrying-capacity levels. The unique circumstances surrounding the status of these species require that the recovery effort not necessarily focus on increasing the populations but rather insuring, to every extent possible, that nothing threatens these fragile populations. Thus, the foundation for this recovery program will be protection of the delicate ecosystems which support these species.

Two other options exist to maintain these species. One option involves transplantation of populations to other islands with suitable habitat (e.g. Necker Island or Laysan Island for the millerbird). This has already been done with the Laysan finch (Pearl and Hermes Reef) and the Nihoa finch (French Frigate Shoals). Although the Nihoa finch transplant did not succeed, there are several islands in Pearl and Hermes Reef with self sustaining populations of Laysan finches. These populations are indeed a buffer to extinction of the Laysan finch. However,

further introductions of any species will have to adhere to USFWS policy which does not allow transplanting a species outside its historical range without particularly compelling justifications. If believed necessary, transplantations may be considered in the future but at present will be limited to consideration for transplanting the millerbird to Laysan (see item 51).

A second option involves propagation and maintenance of captive populations. This alternative will also be maintained as a means to provide a buffer against the extinction of all three species (see item 52). Selected zoos or other institutions with proper facilities could provide this function, as well as possibly provide an educational contribution to this recovery program.

The following is the narrative of the step-down outline for this recovery program.

1. Prevent unauthorized entry to Laysan and Nihoa Islands.

Laysan Island (Laysan finch) and Nihoa Island (Nihoa finch and Nihoa millerbird) are the only native habitats for the NWHI passerines. The islands of Pearl and Hermes Reef also provide habitat for the transplanted populations of Laysan finches. These islands must be protected from adverse human influences

to every extent possible. Existing authorities and regulations should be exercised and enforced.

11. Maintain existing Refuge restrictions.

These islands are currently part of the Hawaiian Islands National Wildlife Refuge (NWR), administered by the U.S. Fish and Wildlife Service (USFWS). The USFWS has strict controls over any human entry into or use of the NWHI including the authority to allow or deny entry onto the islands. USFWS needs to insure that all existing restrictions to human use of these islands are fully enforced.

111. Maintain active stance on permit requirements for use of Refuge

All parties interested in landing on these islands will continue to be required to first obtain a permit from the Refuge Manager, Hawaiian Islands National Wildlife Refuge. Only activities which do not, in any way, impact the overall stability of these populations or their habitat should be allowed. The Refuge Manager should continue to have the authority to deny or modify any proposal which may affect the islands in any way.

112. Insure public awareness of Refuge restrictions.

The existence of the Refuge and the restrictions associated with any use of the Refuge must be made known to anybody who may potentially come in contact with these islands. Every opportunity will be taken to make the public aware of the resources on these islands and the protection afforded them. Public

awareness should be focused on those most likely to come in contact with these islands (operators of fishing vessels, sailboats, freighters, etc.).

1121. Emphasize restrictions in all published material. USFWS publications and handouts, and other public information material should clearly note the special requirements on use of the Hawaiian Islands National Wildlife Refuge. All legal documents (permits, etc.) concerning any kind of use of the Refuge need to contain clear directions for preventing adverse impacts to these islands.

1122. All other government agencies should note restrictions and assist, where appropriate, with enforcement of restrictions.

The U.S. Coast Guard, National Marine Fisheries Service, Hawaii State Division of Aquatic Resources and any other concerned government agencies need to be encouraged to note the restricted use provisions associated with the Refuge wherever appropriate (e.g. maps, charts, Coast Guard Notice to Mariners, etc.). They should also inform other interested parties of the status and restrictions of the Refuge. National and international fishermen, boat and ship operators and others who may potentially contact these islands should be informed.

12. Maximize Refuge Protection.

The existing regulations must be fully enforced. Effective protection of these areas will require active USFWS participation. A presence of the USFWS needs to exist in these islands. Boundary markers, notations on maps and charts, and frequent visits will contribute to an awareness of the USFWS concern about these islands. In addition, cooperating agencies need to enforce regulations within their jurisdiction and be encouraged to assist the Refuge administration when possible.

121. Maintain clearly marked boundaries.

The Refuge status of the island needs to be clearly indicated on the islands, particularly at points where boats are likely to land. Boundaries of the Refuge should also be marked where possible (including water areas) both in the field and on navigational charts. Periodic maintenance of the signs should be conducted.

122. Maintain presence in area through patrol (surface and air) to deter unauthorized entry.

The remoteness of these islands creates logistic difficulties for enforcing regulations. The USFWS field station at Tern Island in French Frigate Shoals is manned by USFWS personnel. This crew can patrol parts of that atoll but is usually unable to reach any other island group routinely. Thus, patrol of Laysan and Nihoa Islands requires special trips from the main Hawaiian Islands by sea or air. Opportunities for

periodic patrol of these areas should be exploited. The Coast Guard, National Marine Fisheries Service (NMFS) and other agencies need to be requested to assist when possible (e.g. during foreign fishing surveillance activities or in conjunction with monk seal field research (NMFS); or in conjunction with Coast Guard logistics flights to the LORAN Station on Kure Island). Attempts should be made to patrol the islands at least two times per year. Such patrols can and should be combined with efforts to monitor populations and habitat, described in 41 and 42.

2. Prevent the establishment of exotic organisms.

Perhaps the primary threat to all three species is the potential establishment of exotic organisms on Laysan and/or Nihoa Islands. Every precaution needs to be taken to guarantee that no exotic organisms establish themselves on these islands. Particular attention needs to be directed at rodents (especially Rattus spp.) which are well known for their ability to colonize even remote and marginal habitats. If populations of these animals were allowed to become established and expand, it could result in extinction of the native passerines. Other exotic animals (e.g. insects) or plants could also cause significant adverse impacts on these native birds. These organisms should also be given adequate attention. Although the effects of their establishment may not be as damaging as rabbits were or rats could be, the chances of their introduction are far greater.

21. Develop procedures to minimize chances of accidental introductions.

The threat of intentional introductions of exotic organisms is remote; USFWS administration of Refuge regulations should minimize such actions. However, there will always be a possibility of thoughtless individuals introducing something. Special precautions need to be taken to diminish the possibility of an accidental introduction.

211. Restrict vessel access to Refuge waters.

The major potential source of exotic introductions to Laysan and Nihoa Islands is boats traveling near the islands. To minimize this risk, careful restrictions need to be imposed on boats planning to travel in the vicinity of, or especially within, the Refuge boundary. This will include provisions in all Fishery Management Plans developed by NMFS for the NWHI to address and mitigate the potential for the introduction of exotics. Additionally, this will provide for immediate notification of appropriate personnel in the event of any potentially threatening vessel activity in this area such as shipwrecks or groundings.

212. Develop education/information programs for individuals planning to travel near islands.

Fishermen, recreational boaters, military personnel and others who may travel near these islands should be alerted to the risks and problems associated with exotics becoming established on the Refuge. An

education program needs to be developed so this information is available and used by these people.

213. Take special precautions for vessel traffic involving landing parties.

Actual landings on the islands obviously present the greatest risk for introductions to the islands. Extra care needs to be taken to minimize this risk. Landings need to be minimized to reduce risks.

2131. Develop a "safety check" of mandatory procedures for all landing parties.

Accidental introductions could occur during authorized landings on these islands. Chances of introduction of any large organisms (e.g. Rattus spp.) by an authorized landing party are small but constitute a risk that can not be afforded. Introduction of small exotic organisms (e.g. mosquitos, seeds of plants, etc.) is more likely to occur unknowingly. Procedures, perhaps through a checklist of steps including vessel inspection, need to be developed to prevent any exotics from being included in the equipment or other gear of a landing party.

2132. Administer "safety check" program required of all landing parties.

The procedure recommended in 211 must be followed by all landing parties. The USFWS, through their

permit system, needs to insure that this "safety check" program is administered properly.

22. Continually monitor islands to detect presence of exotic species, especially rodents.

Despite all precautions, exotic organisms may be able to colonize Laysan or Nihoa Islands. It is possible that some exotic organism could gain access by escaping from a passing ship or a nearby shipwreck, or possibly by floating ashore from the main Hawaiian Islands, allowing colonization of these NWHI. There is also the chance that a vessel would have to make an emergency landing on one of these islands. Laysan and Nihoa Islands must be monitored periodically to detect the presence of exotics. Primary responsibility for this will be with the Hawaiian Islands NWR program.

221. Develop plan and techniques to detect presence of exotics, especially rodents.

Detecting exotic species on these islands, particularly at early and potentially controllable stages, will be difficult. The optimum, cost effective plan needs to be developed. The remoteness of these islands will make this more difficult.

2211. Develop coordination with Coast Guard and other involved agencies to monitor vessel traffic near Islands.

A plan to detect the presence of exotic organisms should start with an efficient means of being alerted to specific events which could lead

to such an introduction. This will require close coordination with the Coast Guard and any other involved agency to monitor vessel traffic near these islands and provide for the earliest possible detection of a shipwreck at Laysan or Nihoa islands.

2212. Determine feasible detection methodology for a remote island setting.

Detecting the presence of exotic organisms on these islands will be technically difficult, given their remoteness. A program needs to be developed that will monitor the population status of key species of native plant, invertebrate, and vertebrate species. This can help allow early detection of exotics and any effects they may have on the natives biota. Various approaches need to be considered, including such technologies as remote sensing, and a technically capable and logistically feasible plan developed.

222. Implement detection plan from #221.

Once a detection plan is created, it must be implemented. Necessary equipment needs to be purchased and personnel trained to carry out the plan reliably. The ability to detect exotic introductions on a continual basis would be ideal. Field checks should be made approximately semiannually.

223. Keep detection plan operational.

The conditions on these islands and their distance from equipped facilities will make operation and maintenance of the detection system difficult. Also, it has not yet been determined what kinds of equipment will be needed to adequately do the job. However, when a system is set up, periodic checks of the equipment will be necessary to keep the plan operational. Adequate stocks of supplies and equipment will also be necessary.

23. Establish contingency plans to eliminate problem exotic organisms.

In the event that exotic organisms are detected on Laysan or Nihoa Islands, such organisms may present a threat to the native passerines. If these exotic plants or animals do in fact pose a threat, prompt action must be taken to eliminate them. Consideration should be given to provide control means (e.g. drop baits for rodents) on the islands before an introduction occurs or immediately after vessel groundings to prevent establishment of exotics. Immediate controls may prevent spread of exotic organisms.

231. Determine need to eliminate particular extant exotic organism.

Laysan and Nihoa Islands already have some exotic plant species in small numbers and perhaps some exotic invertebrates. Although these do not appear to pose a problem to the Laysan finch, or Nihoa finch and Nihoa millerbird, more subtle impacts are unclear. As each

exotic species is encountered, a decision needs to be made whether or not it must be eradicated or controlled.

232. Determine optimum procedures for eliminating rodents and other exotics, incorporate into a contingency plan.

If an introduced exotic needs to be eliminated, prompt decisive action must be taken. Procedures should be developed prior to any need. There are a variety of techniques available for rodent control and for control of other exotics, and all should be explored. Experimentation could take place on Midway where many of the threatening exotics have already become established. Optimum techniques will probably differ depending on which island is invaded, what animals (or plants) are involved, and where and how many are present.

233. Be prepared to implement contingency plan.

All steps need to be taken to be able to react to an immediate problem. All equipment should be ready, reaction plans should be arranged for all parties, and emergency transportation should be ready, should action be necessary.

2331. Acquire and ready equipment for immediate use.

The equipment needed to deal with exotics will depend on the taxa involved and the control methodology employed. Additional details will be worked out (task #232). However, the necessary equipment selected for high priority eradication effort should be ready for immediate

use when the need arises. Equipment needs to be purchased and prepared for use. Staff should be trained, and funding and logistics readied for immediate action. Arrangements should be in place to provide transportation when needed.

2332. Periodically check equipment; maintain in working condition.

Need for use of equipment may not arise for several to many years. Equipment and procedures need to be checked periodically. The program must be fully ready to be put into operation at any time. As technology improves, equipment and procedures should be updated.

2333. Establish/maintain appropriate interagency contacts; make arrangements for logistic support.

Prompt and decisive action will be necessary to eliminate newly introduced exotic organisms. Any sources of assistance should be considered. Contacts need to be made to secure assistance of U.S. Coast Guard, National Marine Fisheries Service, State Department of Land and Natural Resources and other sources. All cooperators should be aware of their potential roles before an actual need is identified.

3. Prevent the outbreak of avian diseases.

Undoubtedly some avian diseases are present on Nihoa or Laysan from time to time. The seabird community or vagrant species

found on these islands are known to carry certain diseases. These either do not appear to affect the resident passerines or they have not been transmitted to them. However, these passerines are known to be susceptible to avian diseases such as pox or malaria. Precautions need to be taken to prevent spread of diseases in those populations.

31. Monitor for diseases in the passerine species.

A monitoring program should be set up for detection of disease vectors and diseases early enough so that restorative actions have an opportunity to be effective.

32. Prevent introduction of diseases/vectors.

As with efforts to prevent the introduction of exotics, precautions need to be taken to prevent the introduction of avian diseases or disease vectors that may affect the passerine populations. Although the likelihood of diseases infecting these passerine populations is small, the effects would be serious.

33. Minimize effects if an avian disease problem is discovered.

In the event an avian disease is discovered in one of the passerine populations, immediate action must be taken. At least some of the birds must be maintained as protected stock in isolation from the problem source (different geographic site). Then the disease problem must be eliminated, if possible.

331. Use available expertise to attempt to eliminate/control disease problem.

If the disease/vector can be eliminated or controlled,

immediate action is needed. If prospects for elimination or control are poor, item 332 will be essential to prevent extinction.

332. Capture birds and maintain in disease-free environment. If a disease problem appears to be a threat to the entire population, birds should be captured and transported to a disease-free location with adequate facilities to maintain the birds. See item 52.

4. Monitor populations of all three species and their habitats to allow for early detection of changes in populations or habitat quality.

With all the safeguards (outlined above) set in place, the recovery program for these species will be in full operation. An additional segment of the recovery program will involve monitoring these delicate ecosystems routinely. This will allow discovery of any changes in habitat or the bird population which may not be detectable through other phases of the program (i.e. detection of rodents and other exotic organisms). If significant declines or other problems are discovered, Refuge staff will begin necessary corrective actions. Monitoring efforts can and should be combined with efforts to patrol the islands, described in 122.

41. Implement monitoring programs for at least annual censusing of bird populations.

Simple census of the bird populations will allow for detection of significant declines. To balance between logistic constraints and the need to detect population changes in a

timely manner, a census should be conducted at least annually for all three taxa. The fixed distance strip techniques (line transect), used most often by previous expeditions, should be employed. It is relatively simple, can be completed in a short time, and will yield reliable data that are comparable with past census results.

42. Develop monitoring program for habitat, focusing on plant communities and terrestrial arthropods.

Detection of changes in the habitat (including the population status of native plants and invertebrates) will be an important supplement to monitoring for exotic organisms (23). Detrimental changes in the habitat could result from a number of influences, including the presence of exotic organisms which are not immediately detectable. Continual monitoring of vegetation and invertebrates will bring these problems to the attention of the Refuge staff and serve to protect the other resources of the islands.

5. Establish additional, disjunct populations of all three taxa to provide a buffer against catastrophic declines of natural populations.

The thrust of this recovery program lies with efforts to protect and maintain the ecosystems upon which these endangered species depend. Protection of native habitat to maintain these species is the most reasonable and effective means to conserve these species. However, because of the nature of these species' limited populations and habitat, there is a possibility that any of the populations could be extirpated by some adverse factor.

Additional populations would provide a significant buffer against such an event. The Laysan finch has additional populations at Pearl and Hermes Reef that serve this purpose. These populations appear to be thriving; thus Laysan finches will not be considered further here. Provisions should be made for the millerbird and the Nihoa finch.

51. Determine the feasibility of introducing the millerbird to Laysan Island.

Laysan Island evolved with a millerbird as a component of its fauna. It is expected that Laysan could accommodate (biologically) the Nihoa millerbird which is presently considered a close relative of the now extinct Laysan millerbird.

Moving the Nihoa subspecies to Laysan should first address several questions necessary to justify such action.

511. Reevaluate the taxonomic relationship of Laysan and Nihoa millerbirds.

The two recognized subspecies of Northwestern Hawaiian Island millerbirds are quite similar. The taxonomic distinctions are relatively minor and have not been carefully reviewed in many years. It would be worthwhile to reevaluate their taxonomic relationship.

512. If task 511 results in continued distinction of the two subspecies, determine if it is justified to move the Nihoa subspecies outside its historical range.

This task is linked to 511. If the Nihoa millerbird remains a distinct subspecies after additional taxonomic

review, the option still exists to move it to Laysan to fill the vacant niche of the Laysan millerbird. It is anticipated that the Nihoa form may readily adapt despite the differences in habitat, and a second population would serve as an important buffer against extinction. This proposal should be considered.

513. Develop introduction plan for the millerbird, if warranted.

If it is determined through either 511 or 512 that millerbirds will be moved to Laysan, reliable procedures need to be used/developed. Millerbirds are delicate animals and transportation from Nihoa to Laysan is logistically difficult.

52. Maintain captive flocks of birds, as needed.

Another alternative for providing additional populations is maintenance of captive flocks. There are, however, several obvious drawbacks or limitations to this alternative (expense, genetic drift in captive populations, etc.). The only species where such a need is potentially perceived is the Nihoa finch. The Laysan finch (Pearl and Hermes Reef populations) should be adequately covered elsewhere. The Nihoa millerbird is delicate and difficult to handle in captivity and may be covered adequately by the above tasks (51). This does not necessarily preclude establishment of captive populations of any of these birds if it is consistent with the rest of this recovery plan and would benefit the species (e.g.

educational). However only the Nihoa finch should receive any recovery program effort for captive population work.

LITERATURE CITED

American Ornithologists Union. 1983. Check-list of North American Birds. Sixth ed. Allen Press, Lawrence, Kansas. 877 pp.

Banks, R. C. and R. C. Laybourne. 1977. Plumage sequence and taxonomy of Laysan and Nihoa finches. Condor 79:343-348.

Berger, A. J. 1981. Hawaiian birdlife, 2nd Edition. The University Press of Hawaii, Honolulu. 270 pp.

Brock, V. E. 1951. Laysan Island bird census. Elepaio 12:17-18.

Bryan, W. A. 1917. Description of Telespiza ultima from Nihoa Island. Auk 34:70-72.

Clapp, R. B., E. Kridler, and R. R. Fleet. 1977. The natural history of Nihoa Island, Northwestern Hawaiian Islands. Atoll Res. Bull. 207:147 pp.

Conant, S. 1983. Ecological requirements of the Nihoa millerbird and the Nihoa finch, including an analysis of management options for the millerbird. Unpubl. Rept. U.S. Fish and Wildlife Service, Honolulu, Hawaii. 47 pp.

Conant, S., M. S. Collins, and C. J. Ralph. 1981. Effects of observers using different methods upon the total population estimates of two resident island birds. Studies in Avian Biology No. 6:377-381.

Dill, H. R., and W. A. Bryan. 1912. Report of an expedition to Laysan Island in 1911. U. S. Dept. Agric. Biol. Surv. Bull. 42:30 pp.

Ely, C. A., and R. B. Clapp. 1973. The natural history of Laysan Island, Northwestern Hawaiian Islands. Atoll Res. Bull. 171:361 pp.

Lamoureux, C. 1963. The flora and vegetation of Laysan Island. Atoll Res. Bull. 97:1-14.

Marshall, D. B. 1964. Treasure islands--of wildlife. Audubon Mag. 66(May-June):160-165.

Olson, S. L., and H. F. James. 1982. Prodromus of the fossil avifauna of the Hawaiian Islands. Smithson. Contr. Zool. 365. 59 pp.

Sincock, J. L., and E. Kridler. 1977. The extinct and endangered endemic bird of the Northwestern Hawaiian Islands. Unpublished MS. 111 pp.

Stearns, H. T. 1966. Geology of the State of Hawaii. Pacific Books, Palo Alto, California. 266 pp.

Throp, J. 1970. The Laysan finch bill in the Honolulu Zoo. Elepaio 31:31-34.

Vanderbilt, George and R. Meyer de Schauensee. 1941. Zoological results of the Vanderbilt Nihoa expedition. 1. Summary of zoological explorations and the birds of Nihoa. Notulae Naturae 85:1-14.

van Riper III, C., S. G. van Riper, M. L. Goff, and M. Laird. 1982. The impact of malaria on birds in Hawaii Volcanoes National Park. Tech. Rept. 47, Cooperative National Park Resources Studies Unit, University of Hawaii, Honolulu.

Wetmore, Alexander. 1924. A warbler from Nihoa. Condor 26:117-118.

Wilson, S. B. 1890. On a new finch from Midway Island, North Pacific. Ibis 1890:170-196.

PART III. IMPLEMENTATION SCHEDULE

Table I, which follows, is a summary of scheduled actions and costs for the Northwestern Hawaiian Islands passerines recovery program. It is a guide to meet the objectives of the Northwestern Hawaiian Islands Passerines Recovery Plan, as elaborated upon in Part II, Action Narrative Section. This table indicates the priority in scheduling tasks to meet the objectives, which agencies are responsible to perform these tasks, a timetable for accomplishing these tasks, and lastly, the estimated costs to perform them. Implementing Part III is the action of the recovery plan; that when accomplished, will satisfy the prime objective. Initiation of these actions is subject to the availability of funds.

GENERAL CATEGORIES FOR IMPLEMENTATION SCHEDULES

Information Gathering - I or R (Research)

1. Population status
2. Habitat status
3. Habitat requirements
4. Management techniques
5. Taxonomic studies
6. Demographic studies
7. Propagation
8. Migration
9. Predation
10. Competition
11. Disease
12. Environmental contaminant
13. Reintroduction
14. Other information

Management - M

1. Propagation
2. Reintroduction
3. Habitat maintenance and manipulation
4. Predator and competitor control
5. Depredation control
6. Disease control
7. Other management

Acquisition - A

1. Lease
2. Easement
3. Management agreement
4. Exchange
5. Withdrawal
6. Fee title
7. Other

Other - O

1. Information and education
2. Law enforcement
3. Regulations
4. Administration

Task Priority

Priority 1 - An action that must be taken to prevent extinction or to prevent the species from declining irreversibly.

Priority 2 - An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.

Priority 3 - All other actions necessary to provide for full recovery of the species.

PART III IMPLEMENTATION SCHEDULE

GENERAL CATEGORY	PLAN TASK	TASK #	PRIORITY #	TASK DURATION	RESPONSIBLE AGENCY FWS REGION	FWS PROGRAM	OTHER	FISCAL YEAR COSTS (EST.) FY 1	FY 2	FY 3	COMMENTS/NOTES
O 3	Maintain refuge restrictions	111	1	Continual	1	RWR					*Included in Refuge Operations
O 1	Emphasize restrictions in published materials	1121	1	Continual	1	RWR SE					Administrative costs projected to be minimal
O 1	Encourage other agencies to note restrictions	1122	1	Continual	1	SE	DLNR USCG				Administrative costs projected to be minimal
O 2	Maintain clearly marked boundaries	121	1	Continual	1	RWR					*Included in Refuge Operations
O 2	Patrol Islands	122	1	Continual	1	RWR	USCG				*Included in Refuge Operations
O 3	Restrict vessel access	211	1	Continual	1	RWR					*Included in Refuge Operations
O 3	Develop educational program for mariners	212	1	Continual	1	RWR					*Included in Refuge Operations
O 3	Special precautions	213	1	Continual	1	RWR					*Included in Refuge Operations

PART III IMPLEMENTATION SCHEDULE

GENERAL CATEGORY	PLAN TASK	TASK #	PRIORITY #	TASK DURATION	RESPONSIBLE AGENCY FWS REGION	FWS PROGRAM	OTHER	FISCAL YEAR COSTS (EST.) FY 1	FY 2	FY 3	COMMENTS/NOTES
O 4	Coordinate with Coast Guard/other agencies to monitor vessel traffic near islands	2211	1	Continual	1	RWR	USCG				*Included in Refuge Operations
R 4	Develop detection methodology	2212	1	2	8 1	RES RWR		25,000 5,000	25,000 5,000		
M 4	Implement exotic organism monitoring plan	222	1	Continual	1	RWR		Unknown	Unknown	Unknown	Standby funding needs to be available in an emergency
M 4	Keep detection plan operational	223	1	Continual	1	RWR		Unknown	Unknown	Unknown	
I 9	Determine need to control extant exotics	231	1	1	1	RWR		Unknown	-	-	
R 9	Determine procedures for eliminating rodents, other exotics; incorporate into contingency plan	232	1	3	8 1	RES RWR		25,000 15,000	20,000 10,000	15,000 5,000	The remoteness of the islands makes this task especially difficult
M 7	Acquire equipment for exotics control contingency plan	2331	1	1	1	RWR			20,000		

PART III IMPLEMENTATION SCHEDULE

GENERAL CATEGORY	PLAN TASK	TASK #	PRIORITY #	TASK DURATION	RESPONSIBLE AGENCY FWS REGION	FWS PROGRAM	OTHER	FISCAL YEAR COSTS (EST.) FY 1	FY 2	FY 3	COMMENTS/NOTES
M 7	Periodically check equipment	2332	1	Continual	1	RWR					*Included in Refuge Operations
M 7	Make arrangements for logistic support	2333	1	Continual	1	RWR					*Included in Refuge Operations
M 6	Monitor for diseases	31	1	Continual	1	RWR					*Included in Refuge Operations
M 6	Prevent introduction of disease vectors	32	1	Continual	1	RWR					*Included in Refuge Operations
M 6	Use available technology to control/eliminate disease, as needed	331	1	As needed	1	RWR		Unknown	Unknown	Unknown	Standby funding needs to be available in an emergency
M 1	Capture birds, maintain in disease free environment, as needed	332	1	As needed	1 8	RWR RES		Unknown	Unknown	Unknown	Standby funding needs to be available in an emergency
L 1	Monitor bird populations biannually	41	2	Continual	1	RWR SE					*Included in Refuge Operations

PART III IMPLEMENTATION SCHEDULE

GENERAL CATEGORY	PLAN TASK	TASK #	PRIORITY #	TASK DURATION	RESPONSIBLE AGENCY FWS REGION	FWS PROGRAM	OTHER	FISCAL YEAR COSTS (EST.) FY 1	FY 2	FY 3	COMMENTS/NOTES
I 2	Monitor habitat annually	42	2	Continual	1	RWR SE		10,000	5,000	Unknown	*Included in Refuge Operations
R 5	Reevaluate taxonomy of millerbird	511	3	1	8	RES	DLNR Other institutions				
I 13	Determine if it is justified to move millerbird to Laysan	512	3	1	8 1	RES SE					
M 2	Reintroduce millerbird	513	3	1	8 1	RES SE					
M 1	Maintain captive flocks, as needed	52	3	Unknown	8 1	RES SE	DLNR				May be implemented immediately by cooperating zoological institutions

*These items would come under annual operation and maintenance responsibilities of Hawaiian Islands National Wildlife Refuge. To adequately carry out these tasks, additional O & M funding for the Refuge will be required. Approximately $50,000 to $75,000 is an estimate for adequately handling the additional responsibilities the Refuge will have with the implementation of the plan.

Key to Abbreviations:
RES - Fish and Wildlife Service, Research Division
RWR - Fish and Wildlife Service, Refuges and Wildlife Resources Division
SE - Fish and Wildlife Service, Endangered Species Division
DLNR - Hawaii Department of Land and Natural Resources
USCG - United States Coast Guard

PART IV. APPENDIX

APPENDIX A

ESSENTIAL HABITAT FOR THE LAYSAN FINCH,
NIHOA FINCH, AND NIHOA MILLERBIRD

Essential habitat for the three Northwestern Hawaiian Islands passerines is as follows:

Laysan finch - All land area to the mean lower low water line on Laysan Island [approximately 407 ha. (1,005 acres)]. All land area on all islands (nine) of Pearl and Hermes Reef to the mean lower low water line [approximately 34 ha. (84 acres)]. (See Figure 2 and Figure 3.)

Nihoa finch and Nihoa millerbird - All land to the mean lower low water line on Nihoa Island [approximately 62 ha. (153 acres)]. (See Figure 4.)

APPENDIX B

AGENCIES OR ORGANIZATIONS CONTACTED DURING AGENCY REVIEW

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and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

*Commander, 14th Coast Guard District
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