Business Plan for

Conservation of Hawaiian Forest Birds

A 10-Year Plan to Secure Keystone Species

American Bird Conservancy

National Fish and Wildlife Foundation

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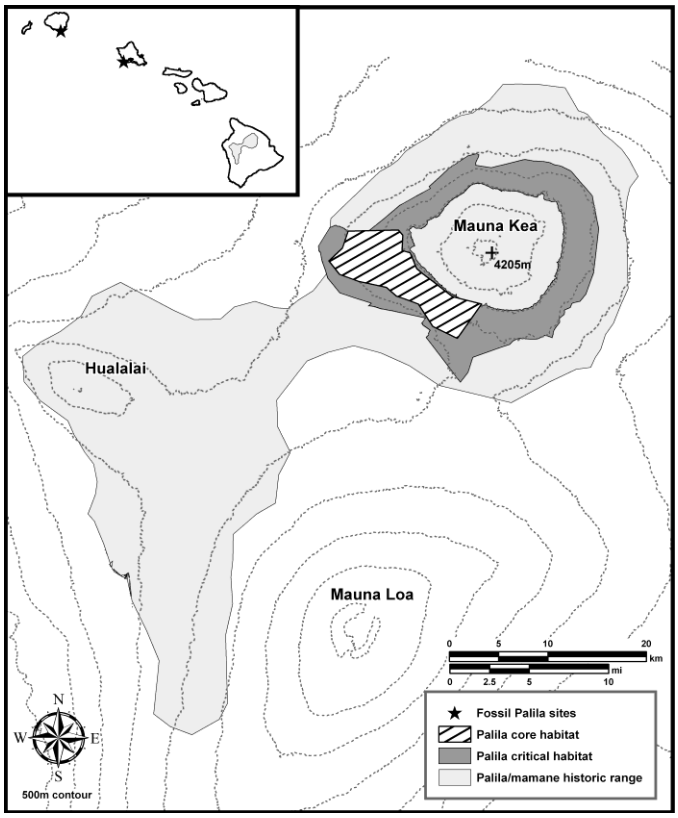
Focal Species Name: Palila (*Loxioides bailleui*)

Māmane forest of Mauna Kea.



Historic and current Palila distribution.

Anticipated Project Outcome: Cat removal would immediately increase nesting success and survivorship of incubating females. The short-term recovery of adult māmane trees from browse damage would result in greater pod production resulting in greater Palila reproductive effort. Protecting māmane trees is critical because Palila primarily use large, mature māmane trees for foraging and nesting. In the long-term, fencing and ungulate removal are essential actions to ensure the persistence of this forest and to providing high quality habitat for Palila.

Status: Listed as endangered under the U.S. Endangered Species Act, the state of Hawai`i and the IUCN. The population has declined significantly over the past 5 years from an estimated 6,633 individuals in 2003 to about 2,237 individuals in 2008.

Geographic Area: Palila were once found in lowland habitats on several islands, but historically they are only known from the Island of Hawai`i. Today, Palila are restricted to subalpine forests of Mauna Kea Volcano in an area comprising < 5% of their historic range. About 96% of the breeding population occurs in an area < 30 km^2 on Mauna Kea's western slope. During the past 30 years, the Palila's range has contracted substantially and birds are no longer recorded on the eastern slope of Mauna Kea during annual surveys. A small breeding population has been reintroduced to the northern slope of Mauna Kea, where Palila disappeared about 40 years ago.

Primary Threats: Similar to other Hawaiian honeycreepers, Palila have suffered from habitat destruction, predation by non-native mammals, and disease, but their dependence on the seeds of māmane (*Sophora chrysophylla*) trees for most of their food increases their vulnerability to environmental and

anthropogenic perturbations that decrease tree cover, seedling recruitment, and seed production. Introduced rats and Polynesian clearing of lowland dry forest likely contributed to their extirpation from Kaua`i and O`ahu. Non-native ungulates have degraded Palila habitat for the past 200 years, and browse damage continues despite control efforts by the Hawai`i Division of Forestry and Wildlife. Goats have been eradicated from Mauna Kea, but sheep remain; although numbers have been reduced sufficiently to allow māmane regeneration in some areas. Habitat restoration has been hampered by the expense and difficulty of removing animals over such a large area and by the difficulty of resolving land-use conflict. During drought, māmane seed production is reduced, resulting in lower survival and reproduction of birds, but other factors may also affect Palila demography and habitat. For example, the invasive fungus *Armillaria mellea* may be killing māmane trees, alien weeds compete for resources and increase fire risk, alien wasps parasitize caterpillars that Palila feed to their nestlings, and feral cats (*Felis catus*) depredate nests and adult birds. In addition, fire risk is high in this dry forest habitat.

Conservation Planning and Actions: Conservation planning and delisting criteria for the Palila are described in detail in the USFWS Recovery Plan for Hawaiian Forest Birds (2006). Palila recovery is unlikely without ungulate eradication from their Critical Habitat (24,357 ha). Because fencing Critical Habitat will take years to complete, aerial shooting of sheep (see below) to reduce browse pressure on māmane habitat must continue until the fence is completed. Discussions with experts are currently underway to improve the efficiency of aerial sheep control in Critical Habitat and to identify where fencing efforts should begin to minimize further ingress of sheep from adjacent lands.

The Hawaii Division of Forestry and Wildlife and its partners are engaged in a variety of efforts to benefit the Palila, including aerial sheep shoots and control of non-native predators. Mountain-wide aerial sheep shoots are conducted semi-annually, but it has recently been decided to conduct quarterly hunts to double the effort. Intensive cat trapping and control of alien plants have recently been initiated in the area of highest nesting density on the western slope. As partial mitigation for realigning a road through Palila critical habitat, cattle will be removed from areas on the western and northern slopes to allow natural regeneration of māmane, protect planted seedlings, and increase the elevational range of Palila habitat. Because māmane flowers and sets seed asynchronously across an elevational gradient, a wide belt of māmane forest increases the availability of seeds through the year. Mitigation also funded the reintroduction of Palila to Mauna Kea's northern slope, where a small population has been established by translocating wild Palila and releasing captive-reared birds. Although several pairs have bred successfully and their offspring have survived to breeding age, the population is not yet self-sustaining. Recently the USFWS provided $230,000 to install dip tanks in Palila Critical Habitat to increase the State's ability to suppress wildfires.

Increased ungulate and predator control is needed to stabilize the population and improve Critical Habitat. Additionally, fencing around Mauna Kea should be initiated to prevent immigration of ungulates from outside Critical Habitat. A fence currently encircling the Mauna Kea Forest Reserve was constructed in the 1937 and has fallen into disrepair. The cost of refurbishing this fence would exceed that of building a new fence. Enclosing Critical Habitat requires building approximately 86 km of fence, at a cost of between $5.82 and $6.61 million. FWS has allocated approximately $500,000 to this effort for the coming year. Increased aerial and ground shooting of ungulates costs $150,000 per year (an additional 6 shoots per year); this could take place while the fence is constructed. Once fencing is completed, additional funds will be required to eradicate sheep at a cost between $75 and $120 per ha. Cat trapping on the western and northern slopes costs $200,000 per year. Three full-time staff are sufficient to conduct cat trapping and fence checks and repairs. Restoration of the māmane forest and control of alien weeds is covered by existing money and personnel.

The immediate benefits to Palila of these efforts would mostly result from focused cat removal. Cats depredate approximately 11% of nests, sometimes taking the incubating or brooding female. Removing

or decreasing this threat would result in an immediate increase in the number of fledglings and adult survival. The short-term recovery of adult māmane trees from browse damage would result in greater pod production. This is important as there is a strong correlation between the mean number of pods per tree and Palila reproductive effort. Most māmane trees on Mauna Kea sprouted when ungulate thinning began in 1980. Protecting these trees and allowing them to mature is critical because Palila primarily use large, mature māmane trees for foraging and nesting. A reduction in browse pressure may increase the vigor of older trees by increasing foliage māmane pod production. In the long-term, fencing and ungulate removal are essential actions to ensure the persistence (natural regeneration replacing dying, older trees) of this forest. Because seedlings and younger trees sustain heavy browse damage in many areas, current regeneration may be insufficient to offset adult mortality.

Task	Years	Minimum Total Cost	Maximum Total Cost
Fencing	1 - 5	$5,820,000	$6,610,00
Aerial Sheep Control	1 - 5	$750,000	$750,000
Ungulate Eradication	6 - 10	$1,826,775	$2,922,840
Predator Control / Fence Repair	1 - 10	$2,000,000	$2,000,000
TOTAL		$10,396,775	$12,282,840

Planning/Research Needs: Successful implementation of this project requires developing ungulate removal strategies and methods to effectively combat invasive weeds. In addition, the longevity of the project will depends on planning the capacity exists for long-term restoration efforts and to monitor the demographic response of Palila to management activities. Research to investigate factors that limit māmane distribution, productivity, and survival should be continued and expanded.

Cultural Values: The Palila is one of the world's best monitored passerines. A 28-year survey record exists for the species as well as many years of ecological studies. With this baseline data, documenting the effects of ungulate removal on the palila and its habitat would be relatively straightforward and provide information of interest to wildlife managers worldwide. This information would benefit other Hawaiian forest birds by demonstrating the recovery of native forest and birds following the removal of introduced ungulate recovery of native forest and birds following the removal of introduced ungulates

Of all the endangered Hawaiian honeycreepers, the Palila is one of the easiest to locate and observe. Given the growing importance of bird-watching and ecotourism, this conservation effort would receive wide attention.

Potential Partners: The Hawaii Division of Forestry and Wildlife, U.S. Fish and Wildlife Service, U.S. Geologic Survey, and the Zoological Society of San Diego would be important partners in this effort.

Ancillary Species: Ungulate eradiation and control of invasive predators would benefit all native species that use māmane forests including the `Elepaio (*Chasiempis sandwichensis*), `I`iwi (*Vestiaria coccinea*), `Apapane (*Himatione sanguinea*), and Amakihi (*Hemignathus virens*). The federally endangered `Akiapola`au (*Hemignathus munroi*) was recently extirpated from māmane forests of Mauna Kea, and the recovery of the māmane forest would allow this species to be re-introduced to Mauna Kea's dry forests. Other birds will likely benefit from a large cohort of young māmane. For example, even 10-year-old māmane will benefit the `I`iwi and `Apapane that move seasonally around Mauna Kea from the lower, wetter ohia-koa forests on the eastern slope. Amakihi should also benefit to some extent, both in terms of increased nectar and arthropod prey availability. Another consideration is that the fire regime should shift to one that is less threatening as many young māmane begin to reduce the amount of alien grass and other fine fuels. By increasing māmane leaf area, cloud interception should increase, contributing to moister

soil and fuel conditions. Cloud interception by māmane accounts for about 37% of the canopy through fall during relatively dry years. As māmane sapling cover increases, ground-level winds should lighten, resulting in slower moving fires.

Figure 1. Adult male Maui Parrotbill

Focal Species Name: Maui Parrotbill (*Pseudonestor xanthophyrs*; Fig. 1)

Anticipated Project Outcome: Establishment of second population of Maui Parrotbill within 10 years on leeward east Maui to reduce extinction risk.

Status: The Maui Parrotbill is listed as endangered under the U.S. Endangered Species Act, the state of Hawai`i, and the IUCN. Population estimate is about 500 individuals. Although the population has been reported as stable for a number of years, there is evidence that the parrotbill's range is contracting.

Geographic Area: Restricted to a single population of about 50 km^2, between 1,200 – 2,350 m in east Maui (Fig. 2). The species was formerly more widespread and occurred on west Maui and Moloka`i. Fossils have been found from drier, low elevation koa (*Acacia koa***)** forests, and historic observations suggest that parrotbill may have preferred to forage on koa; now they are restricted to wet `ohia-dominated forests.

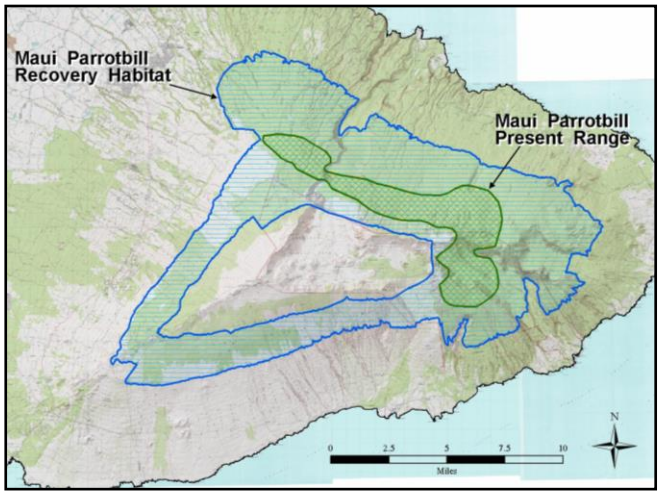


Figure 2. Range of Maui Parrotbill

Primary Threats: Similar to other Hawaiian honeycreepers, parrotbill have suffered from habitat destruction, predation by non-native mammals, and disease, but their extremely low reproductive rate and limited distribution makes them very vulnerable to extinction. Parrotbill lay a one-egg clutch and produce a maximum of one fledgling per year. Their current range is most likely an artifact of habitat destruction and disease and is likely suboptimal habitat, where frequent storms result in the loss of a high percentage of nests.

Conservation Planning and Actions: Conservation planning and delisting criteria for Maui Parrotbill are described in detail in the USFWS Recovery Plan for Hawaiian Forest Birds (2006). To secure Maui Parrotbill another population must be established. Currently, they are restricted to a single, small population that occupies sub-optimal habitat. Restoration of koa forest on leeward east Maui and establishing a second parrotbill population are essential recovery actions

A portion of their current range (Hanawi Natural Area – 2,950 ha) is fenced, ungulate free, and rat controlled, despite this, reproductive output is still low and is likely a function of extreme weather. According to the USFWS Recovery Plan for Hawaiian Forest Birds, habitat restoration and re-establishment of a population of parrotbill on the leeward side of east Maui is needed to reduce extinction risk. The restoration of native koa forest to this region is key to the establishment of a second population. This area

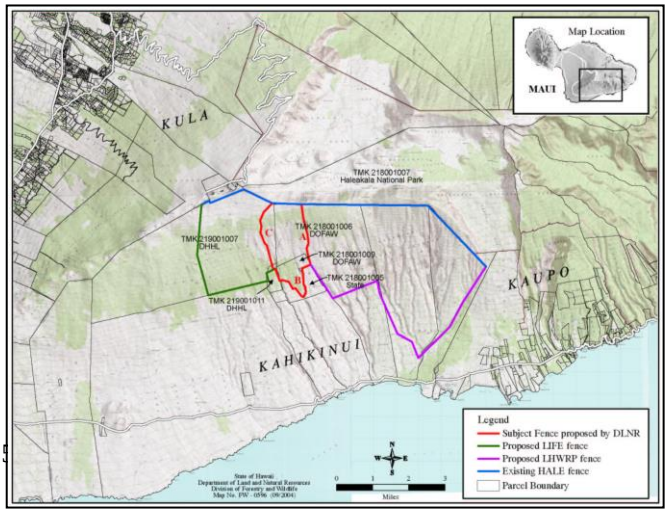


Figure 3. Proposed and actual fence lines on leeward east Maui

holds great promise for parrotbill and other honeycreepers as mosquitoes are rare even at low elevations because of the porous nature of the substrate. Unfortunately, most of the koa forest has been severely degraded by ungulates. Fencing is the first step to restoring this area, and the Hawai`i Division of Forestry and Wildlife, the Leeward Haleakala Watershed Restoration Partnership, and Living Indigenous Forest Ecosystems, a native Hawaiian group, are currently building or planning to build fences in this area. The Hawai`i Division of Forestry and Wildlife recently allocated funding for 2.5 km of fencing here. All existing or planned fences tie into the fence enclosing Haleakala National Park (Fig. 3). To date 4.9 km of fence has been built. Completing the next two segments of fencing (13 km) will secure 2,360 ha and cost between $850,000 and $1.06 million (yrs 1 - 2). Eradication of ungulates from this exclosure will cost between $120 and $150 per ha ($283,200 to $354,000; yrs 3 - 4). Planting of koa and other parrotbill food plants will follow the methods developed by the Leeward Haleakala Watershed Restoration Partnership and cost between $125 and $750 per ha (yrs 2 – 5). Once restored, this area could double the current population. Restoration costs vary by such a wide margin because some areas will require extensive efforts, while others will require minimum restoration.

Although forest in much of the area is badly degraded and will require long-term restoration efforts, the area is characterized by large gulches with protected pockets of native vegetation (Fig. 4). These refuges provide enough habitat to serve as experimental release sites for Maui Parrotbill. Toward this goal, increasing the size of the captive Maui Parrotbill flock managed by the Zoological Society of San Diego will be necessary to ensure that enough birds are available for release. Currently there are 12 birds in captivity but successful breeding has been poor. Additional birds, infrastructure, and staff are needed to increase production. Bringing additional eggs or birds into captivity and having dedicated staff will require $50,000 per annum over the next five years (yrs 1 - 5). Finally, $100,000 per annum over 8 years (yrs 3 - 10) would be needed to support the development of release protocols, pre-release reconnaissance trips, release efforts, and monitoring efforts.

Figure 4. Looking toward the ocean from the top of Kahikinui. Note mature forest in gulch.

Table 1. Specific conservation actions for the Maui Parrotbill.

Task	Years	Minimum Total Cost	Maximum Total Cost
Fencing	1 - 2	$850,000	$1,060,000
Ungulate Removal	3 - 4	$283,200	$354,000
Habitat Restoration	2 - 5	$295,000	$1,770,000
Captive Flock Management	1 - 5	$250,000	$250,000
Release Efforts	3 - 10	$800,000	$800,000
TOTAL		$2,478,200	$4,234,000

The restoration of Maui Parrotbill to leeward east Maui will take at least a decade. However, the Maui Parrotbill is one of two endangered birds with a USFWS priority rank of 1. This rank reflects the species' uniqueness (i.e., monotypic genus) and the fact that it is highly threatened with extinction but has a high potential for recovery. Unfortunately, funds allocated to this species to date have been relatively small. Between 1996 and 2004 the mean annual spending on the Maui Parrotbill was less than $100,000 per

year, far less than what is needed to re-establish a second population. For perspective, this area is only accessible by helicopter and per hour helicopter costs have increase by $250 per hour over the last 2 years and now are $1,000 per hour.

Planning/Research Needs: Research to fine-tune koa restoration methods and planning to ensure sufficient capacity for long-term restoration and monitoring are needed to maximize success of this project. Restoration planning will ensure efforts can proceed in conjunction with ungulate removal. Techniques for building the captive flock and release protocols will have to be developed.

Potential Partners: U.S. Fish and Wildlife Service, Living Indigenous Forest Ecosystems, Leeward Haleakala Watershed Restoration Partnership, the National Park Service, and the Zoological Society of San Diego would be important partners in this effort.

Ancillary Species: Fencing, ungulate eradication, and restoration of forest on leeward east Maui would benefit numerous native plants and invertebrates, and all native birds that currently occupy the area including `Apapane (*Himatione sanguinea*) and Amakihi (*Hemignathus virens*). It is unknown whether `I`iwi (*Vestiaria coccinea*) still persist on leeward east Maui, but restoration efforts would increase chances for natural recolonization by this highly-mobile species. Other species that that could be re-introduced to restored koa forest include the federally endangered `Akohekohe (*Plameria dolei*) and the Maui Creeper (*Paroreomyza montana*).

Focal Species Name: Nihoa Millerbird (*Acrocephalus familiaris kingi*; Fig. 1)

Anticipated Project Outcome: Establish second "insurance population" and double species population in 10 years.

Status: Endangered (State of Hawai`i); Endangered (U.S. Endangered Species Act); Critically Endangered (IUCN Red List)

Geographic Area: Endemic to 155-acre Nihoa Island, Hawai`i (Figs. 2 and 3). Subspecies *A. f. familiaris* formerly occurred on Laysan Island (Fig 3.), but went extinct in the early 20th century.

Primary threats: Its small population and single-island distribution make the Nihoa Millerbird extremely vulnerable to chance environmental events and demographic fluctuations and to accidental introduction of alien species and pathogens. The Laysan Millerbird and two other landbirds endemic to Laysan were lost to wholesale habitat destruction by introduced rabbits (*Oryctolagus cuniculus*), which were later eradicated. Habitat degradation and defoliation has occurred recently on Nihoa Island by irruptions of the alien grasshopper *Schistocerca nitens*.

Figure 1. The Nihoa Millerbird. Photo: Ian Jones

Figure 2. Nihoa Island. Photo: Craig Rowland

Conservation Planning and Actions: Reducing the extinction risk to the Nihoa Millerbird requires expanding its distribution and numbers through translocation to other islands and protecting the species and its habitat on Nihoa. The U.S. Fish and Wildlife Service's (USFWS) recovery plan for the three Northwestern Hawaiian Islands (NWHI) passerines (Nihoa Millerbird, Nihoa Finch [*Telespiza ultima*], and Laysan Finch [*Telespiza cantans*]) recommends general actions for the Millerbird's recovery. These include protection of the NWHI from further introductions of alien species and unauthorized entry; population monitoring ; and reintroducing millerbirds to Laysan.

Nihoa is part of the Papāhanaumokuākea Marine National Monument, and the recently published draft management plan for the Monument also recommends habitat and population monitoring, translocations to reduce extinction risk through improved distribution and increased total numbers, and alien species control and other restoration as needed to improve habitat quality. Since 1967, the Nihoa Millerbird has been monitored via standardized surveys along strip transects that sample the vegetated portion of the island. Population estimates based on these survey data document small and

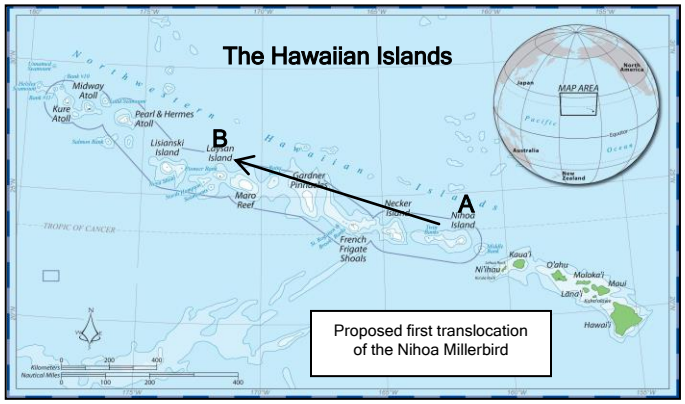


Figure 3. The Hawaiian archipelago. Nihoa Island (A) harbors the only population of the Nihoa Millerbird. Laysan Island (B), which harbored a now-extinct Millerbird, is the preferred site for a translocation from Nihoa.

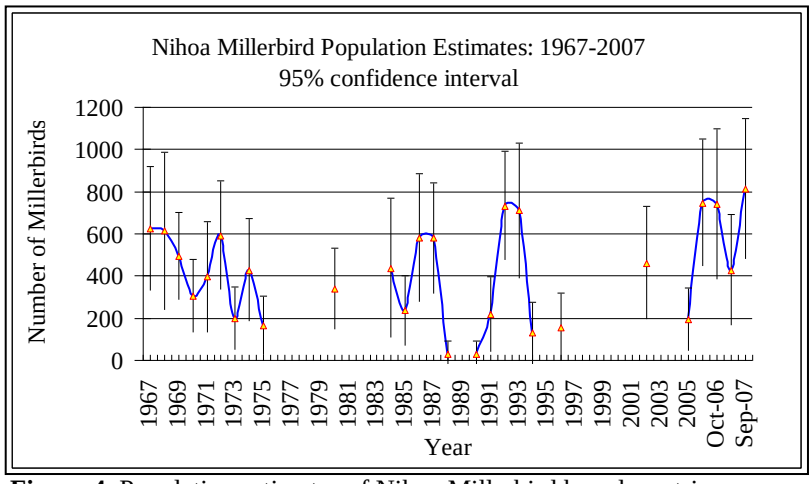


Figure 4. Population estimates of Nihoa Millerbird based on strip transect surveys.

fluctuating numbers of Millerbirds over the past four decades (Fig. 4); the most recent estimate places the population at roughly 800 birds. Because of the expense and logistical challenges of visiting Nihoa, which is accessible only by sea and lies about 170 miles northwest of Kauai, surveys were conducted opportunistically and not every year. Since 2005, however, visits have been made once or twice each year. In a 2005 assessment of potential translocation sites, Laysan Island (1,027 acres), 650 miles northwest of Nihoa, was the top-ranked site for a first translocation of the Nihoa Millerbird. Kure Atoll and Lisianski Island, also in the NWHI, were ranked second and third. In 2006 and 2007, USFWS, in collaboration with the University of New Brunswick, initiated studies to gather information necessary to plan translocation, including diet and prey-base studies (conducted concurrently on Nihoa and Laysan), collection of data on territory size and reproduction, food preference trials, and other aspects of life history and ecology.

Specific conservation actions: The immediate actions necessary for conservation of the Nihoa Millerbird are (1) establishment and monitoring of a second or "insurance" population on Laysan Island, and (2) monitoring and protection of the birds and habitat on Nihoa. Translocation to Laysan Island will serve two important conservation aims: reducing extinction risk for the Nihoa Millerbird, and restoring a missing component of Laysan's ecosystem. This translocation effort could be undertaken in the next three years; translocation to other NWHI could be undertaken in the next five to 10 years. Table 1 summarizes these actions, costs, and benefits to the Millerbird.

Table 1. Specific near-term conservation actions for the Nihoa Millerbird.

Action	Estimated Cost	Estimated Benefit
Millerbird population and demographic monitoring on Nihoa	$100,000 (3 10-day trips, 1 60-day trip)	Improved monitoring of population trend, improved likelihood of successful translocation and low impact to source population on Nihoa owing to increased knowledge of life history, demography, ecology.
Translocation to establishment of a second or "insurance" population on Laysan Island	$500,000 (2 translocations; post-release monitoring)	**Establishment of a second population on Laysan Island has the potential to at least double the current total numbers of Nihoa Millerbirds within 10 years.**

Planning/Research Needs: Our next steps toward translocation and establishment of Nihoa Millerbirds on Laysan Island include development of a detailed translocation plan that synthesizes knowledge of this species and relevant information from other passerine translocations, and some additional research. The translocation-related research described above is ongoing, and captive feeding trials with surrogate species will be initiated later this year. Some additional research is necessary to flesh out aspects of translocation such as the most effective age-class to move (adults or fledged juveniles), best practices for maintaining captive birds prior to and during transport, and the optimal time of year to capture birds for transport to Laysan.

Cultural Values Supported through Conservation of the Species: Nihoa Island was home to a small settlement of native Hawaiians between 1,000 and 300 years ago, and at least 80 cultural sites have been found on the island. Nihoa retains profound cultural significant for native Hawaiians, and special trips are organized to permit cultural practices to continue. The natural and cultural resources of Nihoa are intertwined, and conservation of Nihoa's native species and ecosystem is essential to the island's cultural integrity.

Potential Partners: USFWS (Ecological Services and National Wildlife Refuge System); NOAA (co-trustees of the National Monument with USFWS and State of Hawaii); Hawai`i Division of Forestry and Wildlife; University of New Brunswick, Honolulu Zoo, Zoological Society of San Diego.

Ancillary species: Other species benefiting from actions to conserve the Nihoa Millerbird include the Nihoa and Laysan finches, for which we also intend to establish additional populations through translocation. Translocation methods developed for the Millerbird may be adapted for the finches. The native terrestrial biota of Laysan Island, which includes the endangered Laysan Duck as well as the finch, will gain the reintroduction of a lost species and ecosystem component. This will constitute a major step in the ongoing habitat restoration on Laysan, which is of critical importance in overall restoration work throughout the Northwestern Hawaiian Islands.