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15 October 2001

The Hawaiian Endangered Bird Conservation Program Five-Year Workplan (2001 – 2005)

Prepared by:

J. Burgett[1], P. Conry[2], S. Fretz[2], T. Goltz[3], C. Henson[4], P. Henson[4], C. Kuehler[3], A. Lieberman[3], J. Nelson[4], C. Terry[2], E. VanderWerf[4], M. Zablan[4]

"If it is granted that biodiversity is at high risk, what is to be done? The solution will require cooperation among professionals long separated by academic and practical tradition"

E.O Wilson, The Diversity of Life

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[1] U.S. Fish and Wildlife Service, Hakalau Forest National Wildlife Refuge, Kona Forest Unit, P.O. Box 244, Honaunau, HI 96726

[2] State of Hawaii, Division of Forestry and Wildlife, 1151 Punchbowl Street, Room 325, Honolulu, HI 96813

[3] Zoological Society of San Diego, Hawaiian Endangered Bird Conservation Program, P.O. Box 39, Volcano HI 96785

[4] U.S. Fish and Wildlife Service, Ecological Services Division, 300 Ala Moana Boulevard, Room 3-122, Honolulu, HI 96850

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INTRODUCTION

The Hawaiian Islands are home to species of birds that are found nowhere else on the planet, exhibiting a staggering array of adaptations to life in their unique habitats. Prior to human disturbance, Hawaiian birdlife was abundant from the montane cloud forests to the rain forests by the sea in what are thought to have been the highest densities of any birds on earth. These natural treasures are integral elements of the biological and cultural heritage of the Hawaiian Islands and their people. Unfortunately, many Hawaiian bird species are highly endangered or already extinct. Of the more than 140 native breeding species and subspecies present prior to the colonization of the islands by humans, more than half have been lost to extinction. Among the remaining 71 endemic forms, 30 are federally listed as endangered, and fifteen of these are literally on the brink of extinction, numbering fewer than 500 individuals. The causes of these declines are numerous and extensive, including loss and degradation of habitat, and introduced diseases, predators and competitors. The task of preventing further declines and recovering imperiled species will require wide-ranging efforts to address and mitigate the diversity of threats faced by species in natural populations.

The Hawaiian Endangered Bird Conservation Program is a unique partnership composed of the U.S. Fish and Wildlife Service (Service), State of Hawai`i Division of Forestry and Wildlife (DOFAW), and the Zoological Society of San Diego (ZSSD), and in collaboration with many organizations statewide including the U.S. Geological Survey, Biological Resources Division (BRD), the University of Hawaii, and the `Alala, Maui and Kaua`i Partnerships. These agencies and organizations, and others, are working to recover endangered species statewide through basic research to understand the biology of particular species, mitigation and control of threats and limiting factors, and restoration and protection of managed habitat. Even with this work, however, many species remain at risk due to their small population sizes, limited ranges, and low dispersal rates. The mission of the Hawaiian Endangered Bird Conservation Partnership is to contribute to these multifacted efforts to aid the recovery of native Hawaiian ecosystems and endangered bird species and communities at the landscape-level. Our objectives are to develop and implement programs that integrate captive propagation and reintroduction technology with related work in progress by our organizations and others, including basic research and habitat management.

The technology development, planning, and implementation effort required for recovery of Hawaiian forest birds is multifaceted and complex, whether it be basic research, habitat management, education and outreach, or captive propagation and release. The task at hand is further complicated by the fact that 30 bird species or subspecies, each with unique biological attributes and needs, are currently endangered and in need of conservation action. This document outlines the proposed workplan for the Hawaiian Endangered Bird Conservation Program for the next five years (2001-2005). The purpose of this document is to provide guidance to Partnership efforts, and to provide information concerning planned partnership efforts and directions to interested parties by making the document available to the public for discussion and comment. Detailed here are specific workplans, rather than broad recovery recommendations. We emphasize that this is a working document that will be subject to frequent discussion, review, and annual revision. For comprehensive and broad recovery

recommendations, refer to the Hawaii Forest Bird Recovery Plan (U.S. Fish and Wildlife Service, *in prep*.), which examines recovery actions, both currently or not yet underway, in greater detail, including habitat management, habitat restoration, predator and competitor research and control, avian disease research and management, and research on the habitat requirements and biology of Hawaiian forest birds.

BACKGROUND

The Partnership was formalized in 1994, soon after The Peregrine Fund joined conservation efforts in Hawaii, establishing a program to breed native and endangered Hawaiian birds in captivity. At that time it was realized that an effective partnership was needed that would integrate existing strategies and programs with captive propagation efforts to aid in the recovery of endangered species. After more than six years of successful collaboration, captive breeding operations were transferred from The Peregrine Fund to the Zoological Society of San Diego, which now operates the captive breeding facilities.

The accomplishments of the Hawaiian Endangered Bird Conservation Program during the past seven years to preserve Hawai`i's endangered birds are significant. Habitat restoration and population research and management programs for endangered Hawaiian forest birds have been established or enhanced on Hawai`i, Maui Nui, O`ahu, and Kaua`i. Over 250 endemic forest birds of 12 species have hatched in captivity (seven endangered species) and a new captive propagation facility, the Keauhou Bird Conservation Center (KBCC), was constructed. During 1999-2001, 34 captive-bred Puaiohi have been released in the Alaka`i Swamp. These releases have led to the successful reestablishment of this critically endangered species. This is the first release program for an endangered passerine that has successfully incorporated a wide spectrum of conservation techniques to include the collection of wild eggs, artificial incubation and hand rearing, captive breeding, release, and subsequent breeding of the released birds in native habitat. This complete reintroduction program for the Puaiohi, from the wild to captivity and back to the wild, where breeding by reintroduced birds has been confirmed (Kuehler et al., 2000; Monahan et al., 2001), has occurred over only three years time—a remarkably successful recovery action. Equally important, the environmental education program at the KBCC reaches over 1,500 Hawaiian school children annually.

The key elements for the success of this partnership program are:

1) Species-specific information about natural populations
    - Natural history research, including habitat needs for foraging and nesting, to facilitate determination of suitability of existing habitat and aid efforts to restore marginal habitat.
    - Research to identify threats to populations, and management to eliminate those threats.
2) Habitat availability
    - Establishment of routine methods for the identification, restoration, and maintenance of sufficient suitable habitat to be used as release sites and to ensure long-term population viability of target species. Methods include the use of landscape-level remote sensing techniques, as well as ground truthing methods for the detailed documentation of vegetation structure and composition.
3) Captive propagation and release technology
    - The ability to successfully collect and artificially incubate eggs and hand-rear chicks, and maintain and breed the species in captivity (if necessary).

- The ability to collect nestlings and/or juveniles of certain species for captive propagation if the circumstances require (and all the partners agree), and if quarantine is available.
- The ability to successfully release birds that survive and reproduce in the wild.

4) Post-Release Monitoring
   - Short and long-term monitoring of released individuals and reestablished populations to provide an assessment of program success and future needs. Document dispersal and distribution, survival and reproductive success, and long-term population trends.

5) Environmental Education
   - Public awareness of conservation issues is essential to secure the long-term commitment and support needed to ensure the success of the program, and of endangered species conservation in general.

6) Support
   - Long term financial commitments to support the above elements, including personnel, equipment, and facilities.

The success of the program depends on the integration of these elements. Population research and natural history information is needed in order to identify the threats to populations and to document the habitat needs of particular species. This information must be used to secure or restore habitat that is suitable for each species with respect to both the elimination of threats to population stability and with respect to the ability of the habitat to provide sufficient food and nesting resources. The captive propagation technology provides the means to produce and reintroduce individuals into the wild to augment dwindling populations that may otherwise be lost, or reestablish populations that have become extirpated. Careful monitoring of the wild and reestablished populations provides the feedback needed to assess the success of particular projects, to identify program needs, and guide future directions. We recognize that captive breeding is not the sole answer to an extinction problem; it must be part of an overall, integrated conservation strategy including research, habitat management, and public education. Successful avian restoration programs require landscape-level programs focused on ecosystem health and protection.

Background information on the use of captive propagation and reintroduction technology for the recovery of endangered passerines may be found in Appendix 1. Additional details concerning Partnership activities and accomplishments are available in the appendices of this document, as well as Partner web sites:

State of Hawaii, Division of Forestry and Wildlife

- http://www.state.hi.us/dlnr/dofaw/
- http://www.state.hi.us/dlnr/dofaw/captiveprop/consprog.htm

U.S. Fish and Wildlife Service

- http://pacificislands.fws.gov/

The Zoological Society of San Diego (ZSSD):

- http://www.sandiegozoo.org/index.html
- http://www.sandiegozoo.org/conservation/fieldproject_hawaiian_birds.html

The Peregrine Fund:

- http://www.peregrinefund.org/
- http://www.peregrinefund.org/conserv_hawaii.html

USGS Biological Resources Division, Pacific Islands Ecosystem Research Center:

- http://biology.usgs.gov/pierc/index.htm

OVERVIEW OF PROGRAM PLANNING

The development of projects and workplans carried out by this partnership is guided through ongoing review and consultation of recommendations and policies of many individuals and organizations, including:

- U.S. Fish and Wildlife Service (Service), Division of Forestry and Wildlife (DOFAW), The Peregrine Fund (TPF), the Zoological Society of San Diego (ZSSD), U.S.G.S. Biological Resources Division - Pacific Island Ecosystems Research Center (BRD), the International Union for the Conservation of Nature (IUCN) – Captive Breeding Specialist Group Guidelines (Appendix 2.4; Foose and Ballou, 1988), American Zoological Parks and Aquariums (AZA) – Small Population Management Advisory Group, and the Secretariat for Conservation Biology (SCB) (Appendix 2.3).
- The Hawaii Forest Bird Recovery Plan (U.S. Fish and Wildlife Service, *in prep*.)
- Review of conservation and captive propagation literature (Appendices 2-6).
- Five-Year Planning Meetings and Discussions with Program Staff - Nov. 5, 1999 - 27 March 2001.
- Outside review - Five-Year Planning Meeting to review recovery priorities and program strategies with T. Pratt, B. Woodworth, D. LaPointe (BRD), Jack Jeffrey (Refuges), and Tonnie Casey (KS) - Dec. 14, 1999.

One of the key components of this planning process is to establish priorities for the use of financial and facilities resources among the species of concern. We accomplish this through review of priorities established by the Hawaii Forest Bird Recovery Plan (U.S. Fish and Wildlife, *in prep*.) as well as a number of practical considerations that may influence the effectiveness of the projects, including:

- Cause of decline in the wild and the availability of suitable recovery habitat.
- Availability and effectiveness of programmatic strategies such as habitat management, translocation, and captive breeding.

- Status of current research and habitat management efforts in the field and potential for collaboration among agencies and organizations, including private landowner partnership agreements such as Safe Harbor Agreements (SHA) and Habitat Conservation Plans (HCP).
- Avicultural and release history and difficulty.
- Cultural and educational value.

Further information concerning the planning process is provided in Appendix 2.

The information gained from the above process of review and consultation is used to develop workplans utilizing various program strategies designed to contribute to recovery efforts. Programmatic strategies are summarized as follows:

1) **Research and management**

   Research and management of wild populations with no captive propagation and reintroduction efforts may be the most effective strategy for recovery of some species. Captive propagation and reintroduction is an expensive recovery strategy that is not always necessary to restore or protect endangered species. If habitat preservation, protection and/or restoration will ensure species recovery, this is a preferable strategy.

2) **Translocation and/or Cross Fostering**

   This option requires moving wild eggs and/or birds from one field site to another. In general, cross-fostering/translocation is more cost-effective than a captive propagation program and is considered as a recovery strategy prior to implementing captive breeding. However, recovery strategies involving translocation/cross-fostering require: a) founder populations large enough to support collection of wild adults or eggs b) the availability of surrogate foster species (e.g. Chatham Island Tits were used as fosters for Robins) and c) site fidelity of translocated individuals to the new release area (Serena, 1995). For some species, although suitable habitat may be available for translocation, some or all translocated birds may return to their site of origin, especially if the site is on the same island, as in the case of the Palila (Fancy et al., 1997).

   Example Program: `Oma`o

   In 1995, an experimental program was undertaken with BRD to evaluate translocation of wild birds vs. reintroduction of captive-reared birds as potential recovery options for endangered thrushes. The results of this study with `Oma`o demonstrated similar survival rates for both groups of birds, but fidelity to the release site was higher for captive-reared birds than translocated birds (Fancy et al., 2001).

3) **Rear and release**

   A "rear and release" strategy involves the collection of wild eggs for artificial incubation/hand-rearing and immediate release of juveniles to the wild. This option requires easily located, accessible, wild nests and secure habitat for reintroduction. "Rear and release" is not always more cost-effective than captive-breeding because nest search crews, helicopter time, and the establishment and staffing of additional satellite,

"temporary" incubation facilities are expensive, especially if the program continues for several years. If the target species breeds readily in captivity, it is more cost-effective to develop a short-term "captive-breeding (immediate release)" program (~50% less cost). If nests are easily accessible and the species does not breed readily in captivity, "rear and release" is a preferable strategy if enough birds can be hand-reared to provide an acceptable release cohort.

Example Program: `Amakihi

20 viable wild eggs collected (hatchability = 85%; survivability of hand-reared chicks = 94%)

20 eggs x 85% hatchability = 17 chicks hatched

17 chicks x 94% survivability = 16 chicks hand-reared

16 birds released

(Kuehler et al., 1996)

4) **Captive-breeding (Immediate Release)**

A "captive-breeding" strategy involves the collection of wild eggs to establish a small captive flock, which encompasses some of the genetic diversity of the wild population. Juveniles are immediately released to the wild. This option requires collection of wild eggs to establish a small breeding flock with enough founders to establish some genetic diversity in captivity to produce some birds for release. Juveniles produced are immediately released to the wild. Each year a few offspring would be retained in captivity to maintain the necessary genetic/demographic stability of a captive flock designed to produce birds for immediate release. This option requires maintaining fewer captive animals than a self-sustaining population.

Example Program: Puaiohi (1996-1999)

43 viable wild and captive eggs collected (hatchability =91%; survivability of hand-reared chicks = 93%)

43 eggs x 91% hatchability = 39 chicks hatched

39 chicks x 92% survivability = 36 chicks hand-reared

14 birds released in 1999; 5 birds released in 2000

5) **Captive-breeding (Self-sustaining Population)**

This option should be considered as a "bank account" or as a hedge against future "species bankruptcy". Birds would be maintained in captivity but not reintroduced until secure habitat was available. Management of self-sustaining captive populations protects the genetic and demographic health of the species for many generations (e.g. target = 90% genetic diversity for 100 years) if further recruitment from the wild is not an option (stable population).

Example Program: Bali Mynahs

There are ~691 birds in over 100 institutions; no release program at this time. Releases failed because limiting factors were not controlled (poaching).

6) **Captive-breeding (Production for Restoration)**

This can be considered the "factory" option of captive propagation/release (hatch rate greatly exceeds mortality). After the avicultural questions have been answered, facilities built, personnel trained, and habitat for reintroduction is available, full-scale production of birds can be implemented to produce many birds for release into areas that are in need of "support". This option would only be considered for critically endangered species (extinct in the wild) that would justify the expense of many cages and maximum labor for production of as many birds as possible.

Example Program: California Condors

There are 118 captive birds; ongoing reintroduction program.

7) **Emergency Search and Rescue**

The "Search and Rescue" or last-ditch strategy should only be considered if extinction is imminent and the strategy of captive propagation has a greater probability of recovering the species than translocation or habitat management. Although we may be saving the last few eggs/individuals by removing them from their natural habitat, we are losing an opportunity to study and protect the species in the wild. There are no guarantees that captive propagation will be successful and that production will ever outstrip mortality. This strategy is high risk, but may be the only option remaining for a few species. Ideally, captive-breeding programs need to be established before species are reduced to critically low numbers if they are to have a reasonable chance of saving a species from extinction (Appendix 2).

Example Program: Micronesian Kingfishers

Twenty-nine birds were brought into captivity. For 16 years the size of the captive population has fluctuated while husbandry techniques were being developed. It currently numbers 59 birds (Bahner, pers. comm.).

8) **Technology Development Program**

A technology development program provides the development of captive propagation and release expertise. Many of the artificial incubation and hand-rearing techniques for Hawaiian forest birds have already been developed. In the future, a technology development program strategy would be chosen primarily for those species that still require development of captive-breeding or release techniques.

Example Program: `Oma`o → Puaiohi

Non-endangered `Oma`o eggs were collected from the wild to develop artificial incubation, hand rearing, and release techniques for Hawaiian thrushes - prior to the implementation of a reintroduction program for Puaiohi. Twenty-five chicks were hand-reared and released into Pu`u Wa`awa`a Wildlife Sanctuary.

29 viable wild eggs collected (hatchability =93%; survivability of hand-reared chicks = 93%)

29 eggs x 93% hatchability = 27 chicks hatched

27 chicks x 93% survivability = 25 chicks hand-reared

25 birds released

(Fancy et al., in press; Kuehler et al., 2000).

PROGRAMMATIC WORKPLAN 2001-2005

PUBLIC INVOLVEMENT

Goal: To communicate the mission, goals, and accomplishments of the program as broadly as possible to the public.

ZSSD Workplan:

1) Continue to provide public access to information through tours, open houses at the propagation facilities, publication of popular and scientific articles, and media interviews as time permits. Encourage public participation in the program.

Service/DOFAW Workplan

1) Continue development of the Partnership web page at the DLNR web site, providing access to information about projects involving partnership members, or to appropriate link sites.
2) Develop an information package with inserts from all the contributing partners in order to reach additional segments of the public. The California Condor recovery program may serve as a model for this objective.
3) Produce annual press releases providing programmatic updates to broad audiences, including daily and periodical news and information media.

ENVIRONMENTAL EDUCATION

Goal: Teach conservation values and provide information about conservation-related issues to schoolchildren as well as to the general public in Hawai`i.

Justification: *If you plan for a year, plant kalo.*

If you plan for ten years, plant koa.

If you plan for one hundred years, teach the children.

Hawaiian proverb.

During the 1998-2001 school years, the Hawaiian Endangered Bird Conservation Program hosted over 4,500 students and their teachers. This program is coordinated with the Keakealani Outdoor Education Center, other schools, and is completely funded by private donations. For many of the interested school and community groups who do not have the resources to organize field trips, we make "traveling" presentations, which include slides, posters, and live animals. In 1999, an environmental education book for Junior High School age students was published to provide an environmental education resource for teachers visiting the facility.

ZSSD Workplan:

1) Continue to solicit/acquire private and public funding for environmental education.

2) Continue collaboration with Keakealani Outdoor Education Center and other schools.

3) Expand educational seminars, public lectures, scientific and popular papers, open houses, facility tours, and educational programs.

Service/DOFAW Workplan:

1) Construct and maintain a kipuka boardwalk to showcase Hawaiian forest ecosystems providing opportunities to view forest birds in their natural habitat.

2) Continue to develop information that can be accessed from the DOFAW, Service, and ZSSD websites. Collaborate with partners to facilitate the publication of project results in scientific and popular publications.

3) Work with organizations outside of science field, such as arts and theater, which can help to disseminate information with diverse methods and reach a broader audience. Continue support for educational programs such as Ohia Productions.

4) Produce informational materials, such as coloring books, that can be disseminated to schools.

5) Develop a collection of visual images of endangered birds that can be used to promote awareness.

HABITAT MANAGEMENT AND RESTORATION

Habitat restoration and management is not a focal objective of this Partnership per se. It is, however, a key element for the success of overall recovery efforts, and is integral to the success of this Partnership. Many excellent governmental and non-governmental organizations are engaged in work to restore and protect habitat for endangered birds statewide. The Service and DOFAW are also committed to long-term efforts to restore suitable and sufficient habitat to ensure the recovery of endangered Hawaiian forest birds. To do this, our agencies maintain ongoing programs in collaboration with other agencies and organizations statewide to protect and restore endangered bird habitat. Although many excellent programs are in progress, this work is extremely expensive and labor intensive. Far more funding is needed before sufficient potected habitat is available to ensure the long-term recovery of endangered species at the landscape level. We present the following section as an overview of some of the work in progress and of some of the key programs that are in need of ongoing efforts.

Goal: To restore, manage, and protect sufficient areas of suitable habitat needed to ensure the long-term viability of Hawaiian bird species.

Justification: Loss and degradation of habitat as a result of human activities is the primary cause of species losses in Hawaii, and continues to limit numbers of many species.

Concerns and Needs: Most lowland forest habitat in Hawaii has been severely degraded or entirely replaced by alien vegetation. In addition, elevations below 4500 feet are plagued with introduced mosquitoes and diseases, to which native birds are highly susceptible. As a result, upper elevation habitats provide vital refugia for Hawaiian birds. The Hawaii Forest Bird Recovery Plan (U.S. Fish and Wildlife Service, *in prep*.) identifies habitat needed for the

recovery of endangered species. Extensive work is needed to evaluate the suitability of these habitats and to begin or continue restoration and management action. The key elements needed are fencing and removal of alien ungulates, removal of alien plants and restoration of native vegetation, and control of mammalian predators.

Service/DOFAW Workplan:

1) Continue research and development of effective means of predator control that can be used on large spatial scales statewide. Apply such methods to managed lands wherever possible. This is expected to benefit all native species.
2) Support and collaborate with the Hawaii GAP Analysis Program and BRD to document landscape-level vegetation structure and composition in relation to forest bird distribution and abundance, and critical and recovery habitat. This is expected to benefit all endangered forest bird species.
3) Continue work at Hanawi Natural Area Reserve: control alien plants, ungulates, and predators. Install and maintain fence along lower Hanawi boundary in connection with the Maui Watershed Partnership. This will benefit all Maui forest bird species, including Maui Parrotbill, Akohekohe, Poo-uli, and on-the-brink species.
4) Begin habitat restoration work at upper elevation remnant koa forest on South Haleakala to provide disjunct or fringe habitat for Maui Parrotbill and other native species.
5) Continue work at Alaka`i Wilderness Area: prevent new alien plant introductions and continue control of ungulates using public hunting. Continue small-scale predator control in connection with Puaiohi restoration. Seek funding and approval for broad scale predator control, and to establish an experimental, fenced, pig-free, 100-acre plot to test the effectiveness of aerial dispersal of diphacinone for the control of rodents. Evaluate the benefits of this work to bird species. This will benefit all Kauai forest bird species.
6) Continue and increase management of Ka`u and Kapapala Forest Reserves: support acquisition of Kahuku Ranch by NPS, and collaborate with NPS to begin removal of ungulates and weeds. This will benefit all common Big Island species as well as Akiapola`au, Hawaii Creeper, and Hawaii Akepa (and possibly Alala in the long-term).
7) O`ahu (Ko`olau and Wai`anae mountains): continue predator control in Honolulu Forest Reserve of southeastern O`ahu, and collaborative work with the U.S. Army Environmental Division and The Nature Conservancy of Hawaii, to control predators at Schofield Barracks West Range, Makua Valley Military Reservation, and Honouliuli Preserve. This will benefit Elepaio and other Oahu species.
8) Continue to support and collaborate with the Hawaii Natural Area Reserve System (NARS) partnerships to restore and manage recovery habitat statewide, including West Maui, Pu`u Maka`ala, and South Kona. These reserves support numerous species statewide.
9) Continue to support and collaborate with the Watershed Partnerships and other landowners to restore and manage recovery habitat statewide, including Ola`a-Kilauea,

Pu`u O Kukui, Ko`olau, and East Maui. These reserves support numerous species statewide.

10) Continue to support and collaborate with the U.S. Fish and Wildlife Services Refuges Division to restore and manage recovery habitat. These reserves support numerous species statewide.

CAPTIVE PROPAGATION FACILITIES

Goal: Our goal is to construct and maintain the best facilities possible to propagate Hawaiian forest birds in captivity, using the best husbandry techniques available, within budgetary constraints.

Justification: Captive propagation efforts within the Hawaiian Endangered Bird Conservation Program are designed to contribute to species recovery by providing reservoirs of genetic and demographic material that can be used periodically to reinforce, revitalize, or re-establish populations in the wild. Reinforcement of wild populations using captive propagation requires management programs that are designed to maintain genetic and demographic security.

Currently, the number of breeding enclosures for forest birds is a limiting factor for several of the program strategies proposed in this workplan. The facilities are nearly filled to capacity, limiting some of the captive-breeding options. Multi-species housing of compatible bird species may be a technique required in the future.

Due to the unpredictable weather conditions and occasional droughts in Volcano, the water storage and collection capacity at KBCC will need to be increased to handle the water requirements for the facility.

Among the potential breeding pairs of `Alala in captivity, not all are reproductively active. This may be due to: a) weather conditions b) behavioral abnormalities c) mate incompatibility or a combination of these factors. Additionally, not all adult birds breed even in healthy wild passerine populations (Newton, 1992). Four to six additional enclosures need to be constructed to meet the goal of 11 breeding pairs of Alala, and to provide the needed flocking and holding aviaries for fledgling, juvenile, and post reproductive birds. The `Alala enclosures at MBCC are rapidly deteriorating and are in great need of repair.

Service/DOFAW Workplan:

1) Acquire funding for Service-owned facilities (KBCC).
   a) Acquire funding for additional construction.
      i) Water storage tanks.
      ii) `Alala aviaries (flocking/socialization aviaries, holding cages, breeding cages, quarantine enclosures) and associated operating expenses.

      (Note: expansion of infrastructure requires a concomitant expansion in operating funds).

2) Acquire funding for DOFAW-owned facilities (MBCC).
   a) Fund construction of replacement `Alala aviaries at MBCC.
   b) Fund repairs at MBCC facility.

ZSSD Workplan:

1) Additional federal funding may not be adequate for all planned construction and additional maintenance and construction needs. Therefore, actively seek outside funding from private sources for additional maintenance and construction needs.
2) Install tanks to increase water collection and storage capacity at KBCC (if funding is available).
3) Continue repairing `Alala aviaries on Maui.
4) Design and manage construction of additional `Alala breeding aviaries. (Note: this requires additional funding).
5) Design and manage construction of quarantine enclosures at KBCC. (Note: this requires additional funding).

CAPTIVE PROPAGATION FLOCK MANAGEMENT AND RELEASE METHODS

Goal: To continue to maintain and improve upon the best captive management and release practices possible.

Justification: Responsibility for endangered avian species care and release into the wild requires continued and ongoing effort to refine and document successful flock management, propagation, and release techniques and methodologies. In addition, management to date has emphasized the collection of eggs. In the event that wild birds are injured accidentally, for example during research activities, are brought into captivity intentionally, or there is a need to reintegrate captive-reared and released birds into the captive flock, quarantine procedures are required.

ZSSD Workplan

1) Work with appropriate recovery teams, partnerships, and working groups to develop target genetic goals for all species programs.
2) Work with appropriate recovery teams, partnerships, and working groups to develop release plans that answer needs for site evaluation and preparation before captive-reared birds are released into an area, needs and requirements for releases, and post-release monitoring and reporting.
3) Work with the Veterinary Consortium and other appropriate working groups to develop mutually agreeable quarantine and pre-release disease screening procedures, as well as to address any other potential captive flock heath concerns that arise.

CAPTIVE PROPAGATION-ASSOCIATED RESEARCH OPPORTUNITIES

Goal: By mutual agreement and with Partnership coordination, work with interested outside individuals and agencies to maximize research and other information gathering opportunities consistent with the goals of the captive propagation program and forest bird recovery, within the constraints and limitations of existing funding levels, and in compliance with IACUC guidelines and policies endorsed by the AZA and the IUCN.

The review of proposals and their value to species recovery will be a Partnership responsibility supported by outside, independent review. Selection of proposals will be by mutual agreement and with Partnership coordination.

Justification: Having endangered Hawaiian forest birds in captivity offers opportunities for drawing and banking blood samples or other biological materials that may be useful for disease and genetics work, studies that may enhance captive breeding, and understanding of limiting factors in the wild.

Service/DOFAW Workplan:

1) Obtain funding for and provide assistance to ZSSD for the collection of surplus biological materials from selected birds at KBCC and MBCC.
2) Establish a sample bank(s) for storage of biological materials and coordinate deposit of these samples.
3) Accept and evaluate, in collaboration with ZSSD and qualified outside reviewers, requests from parties that wish to use these biological materials. Evaluation criteria include value of the research to captive program goals and species recovery.

ZSSD Workplan:

1) Coordinate health checks or other opportunities for the handling of birds with Service/DOFAW in a manner that surplus biological material can be taken for captive birds at KBCC and MBCC.
2) Collaborate with Service/DOFAW in the evaluation of research proposals that require the use of biological materials taken from birds at KBCC and MBCC and stored in sample bank(s).

`ALALA

Goal: Collaborate with partners to establish self-sustaining populations of wild `Alala in managed, secure habitat in Hawai`i using captive propagation and release.

Justification: This species is at the brink of extinction in the wild. The current wild population is 2 non-reproductive birds. The captive population is 35 birds (29 potentially reproductive).

Major Concerns and Needs: The major concern/need for this program is the reduction of the limiting factors in `Alala habitat to enable captive-reared birds to successfully survive and breed in the wild. It is currently not possible to produce enough birds in captivity to

overwhelm the limiting factors without adequate habitat management prior to release. At the present time, it is not clear that suitable habitat exists and additional efforts are needed to identify strategies and methods to increase the survival of released birds and restore suitable habitat. Completion of a draft or interim recovery plan for the Alala will aid partnership efforts to recover this species.

When the NRC report for the Hawaiian Crow was written, both a captive and wild breeding population existed. Reintroduction strategies assumed that there would be genetic exchange between these populations (Duckworth et al., 1992). Today all the reproductive `Alala exist in captivity. In order to safeguard the species' genetic/demographic stability we recommend that genetic diversity be maintained in captivity, and that release candidates be selected whose removal from the captive population will not jeopardize the species' long-term survival (see, e.g., Appendix 2).

Service/DOFAW Workplan:

1) Continue to monitor wild population.
2) Revise, review, and finalize recovery plan, define recovery goals for this species, or establish interim recovery and management goals.
3) Seek funding to explore alternatives and options for releases to increase the survival of reintroduced birds following recommendations of the Final Recovery Plan. Collaborate with ZSSD to develop mutually agreeable release procedures and division of partner responsibilities.
4) Select potential release sites.
    a) Finalize EA for potential `Alala release sites.
    b) Increase the involvement of stakeholders in the negotiations necessary for designing successful land management programs, such as safe harbor and partnership agreements.
    c) Inform the general public regarding proposed conservation activities through policy documents, conservation education programs, and other public relation activities.
5) Evaluate suitability of proposed release sites if accessibility can be assured.
    a) Evaluate predator population composition and density.
    b) Evaluate disease in introduced, non-native mammal population (toxoplasmosis).
    c) Evaluate mosquito/disease prevalence.
    d) Evaluate ecosystem/forest health (understory - potential food resources, invasive alien plant and bird species).
6) Continue to fund and implement habitat management programs to mitigate limiting factors.
    a) Predator control.
    b) Alien plant control.

c) Vector control.

7) Assess impact of management programs on limiting factors.

8) Continue to fund monitoring of wild `Alala.

9) Explore all avenues for funding for construction for additional `Alala aviaries (breeding/socialization/holding/flocking aviaries) and operating expenses.

10) Repair MBCC `Alala aviaries.

ZSSD Workplan:

1) Continue captive-breeding `Alala.

2) Continue to investigate strategies to increase production of `Alala.

3) Collaborate with Service/DOFAW to develop mutually agreeable release procedures and partner responsibilities in an effort to explore alternatives and options for releases that increase the survival of reintroduced birds, following recommendations of the Final Recovery Plan.

4) Explore all sources of funding for construction of needed facilities.

5) Design and construct additional breeding aviaries for `Alala when funding becomes available.

6) Continue renovation and repair of `Alala aviaries on Maui.

7) Maintain studbook

PUAIOHI

Goal: Continue current efforts to recover Puaiohi.

Justification: The Puaiohi, *Myadestes palmeri*, is a critically endangered Hawaiian solitaire endemic to the island of Kaua`i. An estimated 200-300 individuals reside in the remote Alaka`i Wilderness Preserve, of which 75% are resident to a 5-km^2 area in the Waiakoali/Mohihi and Halehaha/Halepaakai stream drainages. Historically, Puaiohi existed in greater numbers over a wider geographical region. Drastic declines are thought to be the caused by introduced mammalian predators and avian competitors, exotic diseases and disease vectors, and habitat degradation resulting from impacts of alien species. The current small population size and limited range place this species at risk due to environmental and demographic factors, and establishment of additional disjunct populations has been recommended for recovery (U.S. Fish and Wildlife Service *in prep*).

Major Concerns and Needs: The Puaiohi restoration program is a continuing Kaua`i Partnership recovery effort. The program has been successful in breeding and reintroducing 34 birds between 1999-2001 (Kuehler et al., 2000; Monahan et al., 2001). Providing that funding continues to be available at current or higher levels, captive propagation/release will continue until more cost-effective habitat management strategies have been demonstrated to sufficiently protect (and recover) the species in the wild (Appendix 2.5, U.S. Fish and Wildlife

Service *in prep.*). Because Puaiohi breed successfully in captivity; "captive-breeding and release" is more cost-effective than a "rear and release" program for this species (~50% less cost).

Also integral to Puaiohi recovery is an ongoing program of predator control and population monitoring to document demographic trends in the wild and released birds. Current funding levels do not adequately provide for this work. The Partnership is committed to securing additional funding that will control predators on a larger spatial scale and extend the demographic studies to better assess population trends for both released birds and wild birds within the core population.

Service/DOFAW/BRD Workplan:

1) Continue release program. Establish at least three disjunct sites to continue release and monitoring program.
2) Monitor released birds to determine survival and reproductive success. Determine relative impact of different limiting factors on released populations.
3) Examine the relative benefit and efficacy between the habitat based recovery approach and reintroduction. Determine what proportion of money and effort should be expended on habitat management versus reintroduction.
4) Survey and monitor the wild core population to assess status.
5) Continue habitat management for existing and released populations:
    a) Continue control of predators at release sites and evaluate effectiveness of methods.
    b) Continue ungulate control, and prevent new introductions of alien plants.
    c) Assess prevalence of introduced diseases.
6) Public Education.
    a) Increase the involvement of stakeholders in the negotiations necessary for designing successful land management programs (e.g. Robinson family, C. Brewer, KS, and hunters).
    b) Inform the general public regarding proposed predator and vector control activities through policy documents, conservation education programs, and public relation activities.

ZSSD Workplan:

1) Continue Puaiohi restoration program with Kaua`i Partnership. Continue captive breeding for release into predator-controlled habitat until monitoring studies establish that more effective habitat management strategies sufficiently protect (and recover) the wild population.
2) Maintain studbooks.

MAUI PARROTBILL

Goal: Increase population densities within existing Parrotbill populations, and establish a second self-sustaining wild population through captive propagation and release in secure/restored habitat.

Justification: This endangered honeycreeper has a low reproductive rate. The present population of an estimated 500 birds is restricted to a relatively small area of forest in East Maui, and is currently at a high risk of extinction.

Major Concerns and Needs: Limiting factors for the Maui Parrotbill may be disease, habitat degradation and food availability (Simon et al., 2000), predation, and competition from exotic species (Mountainspring, 1987). Most of the original range has been converted to exotic vegetation that the species does not inhabit. Maui Parrotbill may currently occupy all suitable habitat available (Simon et al., 1997), and protected habitat for a second population may not be currently available (T. Pratt, pers. comm.). Before an additional population can be established, potential habitat needs to be identified, evaluated, restored, and managed.

Present goals for this species are to develop captive breeding technology and establish a captive population, and to continue and increase restoration and protection of Parrotbill habitat. Habitat restoration and management is ongoing within some of the present range of the Parrotbill, but funding is limited for restoration elsewhere. Currently Haleakala National Park protects and manages habitat in the Kipahulu area, and the Service and DOFAW Partnership protects and manages habitat in the Hanawi area. Completion of the lower Hanawi-East Maui Watershed fence is needed to protect a large portion of existing habitat. Evaluation and restoration of additional habitat areas are needed both along Parrotbill range edges as well as in areas where restoration may provide habitat for a disjunct population.

Service/DOFAW Workplan:

1) Continue monitoring existing population, including special spot-mapping surveys for birds in areas not well covered by the Maui Forest Bird Survey 2001, such as the "koa patch" below FWS transect 7.
2) Continue nest-searching activities.
3) Continue or begin habitat restoration and management programs within existing Parrotbill range, including:
    a) Maintaining fencing for pigs and other ungulates in Hanawi NAR.
    b) Control of predators and evaluation of effectiveness of methods used.
    c) Alien plant control.
    d) Development and implementation of large-scale methods for the control of rodents.
    e) Collaborate with and support East Maui Watershed Partnership efforts to acquire funding to fence lower Hanawi NAR within the existing range of Maui Parrotbill.
4) Assess impact of management programs on limiting factors.

5) Seek funding and partnerships to identify, select, and restore potential habitat for a reintroduction program.
    a) Evaluate suitability and restoration potential of habitat on range edges. This may serve as a site of initial releases for a pilot project. Select sites, secure funding, and begin restoration as needed.
    b) Evaluate suitability and restoration potential of disjunct habitat to decrease the risk of extinction. Select sites, secure funding, and begin restoration.
    c) Increase the involvement of stakeholders in the negotiations necessary for designing successful land management programs such as safe harbor and partnership agreements.
    d) Inform the general public regarding proposed conservation activities through policy documents, conservation education programs, and other public relation activities.
6) Collaborate with Partners to begin a pilot release program for Maui Parrotbill in early 2003 to develop a release program. This program will be designed to monitor and evaluate release methods and success to help develop future program development.

ZSSD Workplan:

1) As genetic management requires, continue collection of eggs to develop a captive population.
2) Breed and maintain in captivity, and release when habitat to establish a second population has been selected, evaluated, restored and becomes available. Target date is late 2002-early 2003.
3) Maintain studbook.

`AKIAPOLA`AU

Goal: Collaborate with partners to recover `Akiapola`au on the Big Island through research, habitat restoration and management, captive propagation, and reintroduction.

Justification: The `Akiapola`au population is fragmented and declining. The Hawai`i forest bird surveys found four disjunct populations of `Akiapola`au totaling 1500±400. Fancy et al. (1996) analyzed more recent surveys and estimated a total population of 1163 in three disjunct populations, with most birds being found in the Hamakua forest. The species' distribution has been greatly reduced in the Kapapala/Ka`u forest, where the estimated population has declined from 533 to 44 birds. The upper elevation, relic population in mamane forest at Kanakaleionui has only 2-10 birds and is functionally extinct (Fancy, unpubl. data -pers. comm.).

Major Concerns and Needs: `Akiapola`au have not been the focus of any intensive research efforts and as a result much key information is lacking (Pratt et al. *in prep.*). Work is needed to, 1) adequately census and map population distribution and abundance on the Big Island, 2) document key demographic information, including survival, dispersal, and reproductive success, 3) document habitat needs for foraging and nesting, and 4) understand the importance

of predation in habitats where forest stature is low (U.S. Fish and Wildlife Service, *in prep*.). Recovery efforts will need to draw from this information to protect and restore suitable habitat above 1300 m elevation, and to develop a captive propagation and release program to restore this species to suitable habitat.

`Akiapola`au eggs are very difficult to locate (Banko and Williams, 1993; P. Harrity and J. Jeffrey, pers. comm.). Although TPF spent ~500 hours nest-searching in 1999 - no nests were located and of ~400 bird nests located in the Hakalau National Refuge only three were `Aki nests (Woodworth, pers. comm.). "Rear and release" is not a recommended program strategy for this species; "captive-breeding (immediate release)" is preferable. Intensive field efforts are needed to gain information about this species and help to develop methods for the identification of nests.

Partnership Goals: The Partnership is currently seeking funds to begin work to restore `Akiapola`au populations on the Big Island. As funding permits, the program strategy for `Akiapola`au seeks to obtain eggs from wild birds to begin development of captive breeding techniques, document current distribution and abundance, define suitable habitat through research on natural populations, and identify and restore suitable habitat on the Big Island using remote imaging and ground-proofing methods. At the present time, initial funding has been secured to pursue the first three of these goals. We will continue to seek funding for additional years for this work as needed.

Service/DOFAW/BRD Workplan:

1) Locate nests of wild birds for collection of eggs.
2) Document current distribution and abundance in representative areas in Hamakua, Upper Waiakea kipukas, Kulani/Keauhou, Kau/Kapapala, and south and central Kona.
3) Research habitat-use in natural populations in order to define suitable habitat and determine response to restoration.
4) Identify and restore suitable habitat, with focus on upper Keauhou Ranch, Kapapala Forest Reserve, and parcels between upper Honaunau and Manuka NAR.
5) Evaluate potential sites for restoration and reintroduction in former range, including Pu`u Wa`awa`a Wildlife Sanctuary, the Kona unit of the Hakalau National Wildlife Refuge, Mauna Loa Strip of Hawai`i Volcanoes National Park, and the upper forests of Kipahoehoe NAR.

ZSSD Responsibilities:

1) Collection of `Aki eggs to develop captive-breeding (immediate release) technology.
2) Provide `Akiapola`au for eventual release.
3) Maintain studbooks.

PALILA

Goal: Collaborate with partners to establish an additional, disjunct, self-sustaining population

of Palila (e.g. KS land - Pulehua lease, on the West Slope of Mauna Loa, and/or the North Slope of Mauna Kea).

Justification: The isolated Palila population at Pu`u La`au on the West Slope of Mauna Kea is threatened by fire, habitat degradation by grazing ungulates, predators, and limited food resources. Management efforts to recover the species by establishing new populations through translocation to the North Slope of Mauna Kea have met with equivocal success. The majority of birds return to their site of origin after translocation (Fancy et al., 1997). It is not clear whether this is due to poor quality habitat or site tenacity of translocated individuals of this species.

Recent work comparing the fate of wild translocated `Oma`o to captive-reared released `Oma`o demonstrates that captive-reared birds had greater site fidelity to the release site (Fancy et al., 2001). A "captive-breeding (immediate release)" program may provide an effective alternative recovery strategy to establish a second population in a new site.

The Pulehua lease (KS land) is an isolated site (Mauna Loa vs. Mauna Kea) within the historical distribution of this species (collection site of specimen "type"). The Service is currently funding KS for habitat restoration as part of a landowner partnership agreement (T. Casey; P. Simmons and C. Rowland, pers. comm.). Access to the North Slope site is currently limited. However, when access is achieved, support for pre-release site preparation and follow up monitoring will be available from BRD.

Major Concerns and Needs: In 1996, initial attempts to hand-rear Palila in captivity were less successful than for other species of related honeycreepers under similar conditions (50% vs. 89% survivability of chicks). A possible cause of mortality includes egg-transmitted disease (*Mycoplasma*) from the wild population during the hand-rearing process. A *Mycoplasma*-like organism was isolated from several captive and wild birds (Lauerman et al., 1996; Rideout, pers. comm.). At a Palila meeting in Hilo on November 16, 2000, attended by veterinary and avian disease experts, meeting participants agreed that *Mycoplasma* was likely not the primary cause of mortality of ten Palila nestlings at the Keauhou Bird Conservation Center in 1996, and that mortalities were more likely a result of acute bacterial infection by *Pseudomonas aeruginosa*. However, exact cause of the 1996 mortalities would likely never be determined with certainty. Because *Pseudomonas aeruginosa* is ubiquitous in the wild and is a primary threat only to young birds, there is little risk to wild birds by release of captives into the wild. Meeting participants also agreed that *Mycoplasma* is present both in captive and wild Palila and that there is little or no evidence that it is causing disease in the wild or captive populations.

Service/DOFAW/BRD Workplan:

1) Establish safe harbor agreement with KS and provide funding for continuing habitat management at the Pulehua lease site (for re-establishment of second population).
2) Evaluate habitat suitability, and implement restoration projects as needed at selected release sites.

3) Establish Palila restoration program in Kona as a 10-J. Experimental populations of listed species may be established outside the current range of the species to further species conservation. To be considered experimental, a population must be wholly separate geographically from the donor population but within the species' probable historical range (the Kona site is within historical range).

4) Continue to work to design a combined translocation/release of Palila to the North Slope of Mauna Kea and establish a Palila restoration program on Mauna Kea.

ZSSD Workplan:

1) Implement most efficacious restoration program, releasing birds on KS Land (Pulehua) and/or the North Slope of Mauna Kea when habitat is secure, to establish a second population of Palila

2) Parent-rear from first clutches until a reintroduction program is implemented. Hand-rear as needed to increase production once a reintroduction program is implemented.

3) Maintain studbook.

NENE

Goal: Collaborate with partners and others to develop self-sustaining populations of wild Nene.

Justification: The wild Nene populations must be actively managed to decrease predation and increase genetic diversity (if possible) in order to achieve recovery of this endangered species.

Major Concerns and Needs: The primary factors limiting Nene populations are currently understood to be predation by dogs and mongooses, nutrition, and inclement weather during the breeding season. The relative importance of each of these factors varies between islands and among locations within each island. The Kaua`i population is the only wild group of Nene in Hawaii that is self-sustaining. This is due to the absence of mongooses on that island—Nene in similar habitats on other islands where there are mongooses have a much lower reproductive success. Until long-term reduction or elimination of predation can be achieved, Nene will continue to require hands-on management of the populations.

Current management efforts are focused on predator control in specific breeding/release areas, reintroducing Nene to additional locations, and developing cooperative agreements with private landowners for Nene management. Because of their size, extreme mobility, and preference for young plants, the potential for negative interactions between Nene and the public is much greater than for other endangered birds in Hawaii. In order to ensure their recovery, as Nene numbers increase and the interactions with people become more frequent, it is necessary that public education be increased and that agency personnel be available to interact with the public and address negative interactions between Nene and the public.

Recent work has revealed the presence of avian malaria in some Nene. Although malaria has not been implicated as a limiting factor for Nene, efforts to minimize the potential for

transmitting unique regional strains of avian malaria between islands must be considered in developing release criteria for captive bred birds. Birds transferred between islands will either need to be screened for malaria prior to transfer or be raised in mosquito-proof facilities. Rearing Nene on the island where they will be released is likely to be the most cost effective rearing strategy and safest approach to minimizing risk of disease transfer. At the same time, it is important that the goal of increasing genetic diversity on each of the islands still be maintained if possible. Maintaining variation among captive pairs on each island, collecting and transporting eggs between islands, and transporting goslings that have been hatched in mosquito-proof enclosures are practices that can increase genetic diversity. However, these strategies can only be effective if the parentage of wild breeding pairs is known and evaluated prior to collection. Otherwise, collection of wild eggs in areas where birds have been reintroduced may increase the inbreeding coefficient in the captive flock and subsequently decrease genetic diversity.

Service/DOFAW Workplan:

1) Continue to develop and implement open-top breeding/release pens to reduce predation and increase the survival and reproductive success of wild populations. These pens are intended for the rearing and release of individuals that will leave the pens on their own accord when they become flighted.
2) Seek funding for increased public education activities and increased personnel needs. Inform the general public regarding the negative impacts on Nene and other native birds resulting from the release of domestic dogs and cats.
3) Seek funding for 2 additional breeding pens for the MBCC facility in early 2002.
4) Collaborate with National Park and other agency and NGO personnel to obtain eggs from wild birds to be captive reared, assuming that parentage of eggs to be collected is known, evaluated, and is found to be consistent with the goal of increasing genetic diversity of the captive flock. This will require careful coordination to synchronize with reproduction and laying cycles of the captive pairs. If successful, this will increase the numbers and genetic variability of birds for the reintroduction program.
5) Develop and implement the reintroduction program. Current goals are 16-20 birds per year to Molokai, 10 birds per year to West Maui, and 15 birds per year to Big Island sites.
6) Develop cooperative agreements with private landowners to restore habitat and control predators on private lands to enable birds to successfully reproduce in the wild.
7) Continue disease-screening procedures in cooperation with BRD and DOFAW for all Nene not raised under mosquito netting that will be transferred between islands. Evaluate the biosecurity risk of Nene infection and disease prevalence among captive-bred birds in conjunction with the Veterinary Consortium. Evaluate the need to continue screening.
8) Finalize Nene Restoration Plan and Nene Recovery Plan.

ZSSD Workplan:

1) Continue captive-breeding Nene using 4 breeding pairs at each facility (MBCC and KBCC)

to provide up to 20 chicks at each facility for the DOFAW release program. Increase the number of breeding pairs as facilities and personnel become available.

2) Attempt to meet reintroduction goals by maximizing clutch sizes.
3) Collaborate with DOFAW, the National Park Service, and other agencies and NGOs that obtain eggs from wild birds to be captive reared, assuming that parentage of eggs collected is known or evaluated and determined to increase genetic variability of birds for the reintroduction program.
4) Continue disease-screening procedures in cooperation with BRD and DOFAW for all Nene not raised under mosquito netting that will be transferred between islands.
5) Examine feasibility and cost effectiveness of constructing new mosquito-netted Nene pens at the KBCC and MBCC.

MILLERBIRD

The Partnership currently does not anticipate funding to develop a workplan for the restoration of the Millerbird. The following brief discussion provides some information and background relevant to this species.

Desired Goal: Implement Laysan Ecosystem Restoration Plan (Morin and Conant, 1998), and establish a second, wild population of Nihoa Millerbirds on Laysan.

Justification: The endemic Millerbird originally found on Laysan has been extinct since the island was devegetated during the early part of this century. The status of the single wild population of Nihoa Millerbirds is unclear; population estimates during the last 30 years have ranged from 31 – 731 . The species is threatened by catastrophic events including drought, hurricanes, fire, predators; and the probability for extinction is unacceptably high (Morin et al., 1997). A conservation program needs to be developed for this "biologically significant species". For example, the extinct taxon on Laysan could be replaced with the ecotype from Nihoa to: a) establish a second population for species security and b) promote the overall health of the Hawaiian ecosystem on Laysan by reestablishing Millerbirds on the island (Morin et al., 1998).

However, translocation may not be a viable option: *"Millerbirds appear to be difficult to maintain in captivity. Seven Nihoa Millerbirds were captured on Nihoa I. 31 May 1969, with intent to transport them to Honolulu; 3 of the 7 died by 5 June; remainder were then released. Two more were captured on 9 June: 1 died the same day aboard ship, and 1 died 2 days later in Honolulu (Morin et al., 1997)."*

O`AHU `ELEPAIO

Goal: Continue current efforts to restore existing populations, identify and restore additional suitable habitat, and continue the technology development program for captive propagation/release using Hawai`i `Elepaio as surrogate species in the event a restoration program for O`ahu `Elepaio is required in the future.

Justification: The O`ahu `Elepaio, once very common, has disappeared from 96% of its historic range. It is currently distributed in a series of small isolated populations (VanderWerf et al., 1997; 2001; in press; VanderWerf, 1998), and is at risk of extinction due to predators and diseases.

Major Concerns and Needs: Lack of suitable habitat due to the presence of predators and diseases is currently the most pressing concern for O`ahu Elepaio. Current Partnership efforts are therefore focused on the restoration and management of suitable habitat, and monitoring existing populations.

Service/DOFAW/BRD Workplan

1) Continue predator control and monitoring of demography, disease prevalence, and effectiveness of management efforts in existing populations in southeastern O`ahu.
2) Collaborate with The Nature Conservancy of Hawaii to continue management and monitoring of the ‘Elepaio population in Honouliuli Preserve.
3) Collaborate with the U.S. Army Environmental staff to continue predator control and monitoring of `Elepaio populations in Schofield Barracks West Range and Makua Valley Military Reservation.
4) Collaborate with University of Hawaii researchers to determine genetic structure of isolated subpopulations, develop molecular methods for the detection avian poxvirus, and identify disease-resistant individuals.
5) Complete island-wide surveys to determine the current distribution and abundance of O`ahu ‘Elepaio.
6) Identify and restore additional suitable habitat.

ZSSD Workplan: no current plans for captive breeding of this species. Continue working with Big Island subspecies to develop surrogate propagation technology.

`AKOHEKOHE

Goal: Increase population densities within existing range, and establish a second, self-sustaining wild population of `Akohekohe through translocation to suitable, restored habitat.

Justification: Historically, Akohekohe were found in the wet forests of Molokai and West Maui (Perkins, 1903). Currently, one population remains on the windward side of Haleakala between 4500’-7200’ elevation. Akohekohe nests are accessible and a “rear and release” program may be feasible. However, Akohekohe are expected to be difficult to breed and maintain in captivity. Survival of wild, translocated birds may be greater than reintroducing captive-reared birds. For this reason, a recovery strategy involving translocation of wild birds is expected to be more effective and less costly and is the first recovery strategy that will be implemented.

Major Concerns and Needs: It is unclear if habitat for a second population of `Akohekohe is currently suitable. Akohekohe may be very susceptible to introduced diseases. Prior to the

initiation of a translocation or restoration program, potential habitat for a second population needs to be evaluated, including an assessment of disease prevalence and vegetation structure. In addition, previous work translocating birds has found post-release site fidelity to be low. Work is therefore needed to explore methods to increase the probability that translocated birds will remain at the site of translocation. `I`iwi are an appropriate species and the logical choice to use as a surrogate for this work. If suitable habitat is identified and the surrogate work is successful, a restoration program involving translocation of `Akohekohe will be implemented.

If translocation is unsuccessful, then a "rear and release" strategy may be considered. However, `Akohekohe are very aggressive birds. Due to the pugnacious nature of this species, it will be advisable to test the reliability of release techniques prior to the implementation of a full-scale "rear and release" program (should translocation fail). `Akohekohe must be released at the appropriate age using the correct methods to insure survivability after independence. For example, prior to the successful reintroduction of Puaiohi, release techniques were developed with the `Oma`o. These techniques developed for frugivorous thrushes may not be appropriate for `Akohekohe. Release techniques need to be tested with young hand-reared `I`iwi (also a nectarivorous, aggressive species) prior to implementing a "rear and release" program for endangered `Akohekohe.

Service/DOFAW Workplan:

1) Continue monitoring and population studies of the existing population.
2) Compile and analyze survey and monitoring data to assess long-term population trends 1989-2001.
3) Continue habitat restoration and management program within existing range at Hanawi NAR, including:
    a) Fencing and removal of pigs, ungulates, and invasive plants.
    b) Predator control.
    c) Seek to develop and implement large-scale rodent control methods.
4) Assess impact of management programs on limiting factors.
5) If translocation fails, and suitable habitat is available, locate nests of wild birds for collection of eggs for "rear and release".
6) Seek funding and partnerships to identify, select, and restore potential habitat for a second population:
    a) Increase the involvement of stakeholders in the negotiations necessary for designing successful land management programs such as safe harbor and partnership agreements.
    b) Inform the general public regarding proposed conservation activities through policy documents, conservation education programs, and other public relation activities.
    c) Evaluate suitability of potential second site with respect to vegetation structure and composition, predators, and diseases.

d) Restore potential habitat as appropriate.

7) Conduct experimental translocation of `I`iwi – evaluate results.

8) Conduct translocation of `Akohekohe – evaluate results.

ZSSD Workplan:

1) If translocations fail, and suitable habitat is available, collect `Akohekohe eggs to develop a "rear and release" program.

2) Maintain studbook.

HAWAI`I CREEPER AND HAWAII `AKEPA

Goal: Maintain and restore habitat on the Big Island for these species, in connection with recovery efforts for `Akiapola`au.

Justification: Populations of Hawaii Creeper and `Akepa are fragmented and reduced in range. Dispersal between populations (ability to recolonize former habitat) may be limited by high philopatry (Lepson and Freed, 1997; Pratt, 1999; VanderWerf, 1998; Appendix 5).

`Akepa population dynamics are likely closely tied to habitat structure. Food availability is related to canopy density and vigor (Fretz, 2000; *in review*) and `Akepa are dependent on old-growth forests for nest sites (Freed, 2001). Each of these factors appears to be limiting populations in some areas (Hart 2000, Fretz et al., *in prep*.). Additional suitable habitat is needed to reduce the risk of extinction. These species will benefit from habitat restoration work in connection with recovery efforts for `Akiapola`au, for example in areas such as the Saddle Road kipukas, Power Line Road, Mauna Loa Strip Road, upper Keauhou Ranch, and Kapapala and Ka`u forests.

Service/DOFAW/BRD Workplan:

1) Continue annual surveys of `Akepa and Creeper populations in the Hakalau Forest National Wildlife Refuge, as well as other key areas island-wide at 5-year intervals.

2) Carry out special spot-mapping surveys in connection with `Akiapola`au surveys in areas where VCP methods are inadequate, including upper Waiakea kipukas, Kulani/Keauhou, Ka`u/Kapapala, and south and central Kona.

3) Compile and analyze survey and monitoring data to assess long-term population trends 1989-2001.

4) Continue to support a landscape level program focused on ecosystem research, habitat management and long-term monitoring of wild populations (Pratt, 1999 - Appendix 5).

ZSSD Workplan:

1) Small flocks of Akepa and Creeper are currently being held at the KBCC. Some of these have bred. Maintain the Akepa and Creeper flocks in captivity unless the facilities space is needed by higher priority species.

2) No current plans for expansion of captive breeding program (i.e. collection of additional wild eggs) and/or release of these species.

`AKIKIKI

Funding is currently not available to support Partnership efforts for Akikiki. The following discussion illustrates the need for the development of a program to support the restoration of this species.

Goal: Maintain and restore habitat on Kaua`i in connection with recovery efforts for Puaiohi, and begin technology development for captive breeding.

Justification: The `Akikiki population has been declining for the past 20 years and recent observations indicate that the population may be in jeopardy and should be federally listed (Ellis et al., 1992; D. Pratt; D. Kuhn; J. Denny; and T. Pratt, pers. comm.). Recent analysis of survey data indicates a population size of 2000-3000 individuals (J. Foster, pers. comm.), a precipitous decline in historic times (Foster et al. 2000).

Needs: The role of predators and diseases in limiting Akikiki are poorly known. Demographic studies are needed for the core population but these are expected to be costly due to the inaccessibility of the habitat and the need for helicopter access. The Alaka`i Swamp is one of the last remaining wilderness areas in the Hawaiian Islands with a high concentration of endangered species (plants and birds). Current efforts to restore Puaiohi may provide benefits for `Akikiki and other endangered species in this area by providing long-term monitoring research and management for this unique ecosystem. This work may be of greatest benefit to Akikiki if it succeeds in reducing predator abundance on large spatial scales and allows an assessment of the Akikiki population response to those efforts.

Service/DOFAW/BRD Workplan:

1) Continue surveys and monitoring at 5 year intervals
2) Compile and analyze survey and monitoring data to assess long term population trends 1989-2001
3) Seek funding for studies to determine key limiting factors and initiate large-scale efforts to control those factors.

ZSSD Workplan:

1) Collect wild `Akikiki eggs to develop artificial incubation/hand-rearing techniques, provided that budgetary and facilities space permit.

KAUA`I `AKEPA

Funding is currently not available for intensive work on Kaua`i Akepa. Habitat management and predator control work in connection with Puaiohi may benefit this species.

Goal: Continue Puaiohi recovery project and predator control work, and evaluate the benefits to Kaua`i Akepa.

Service/DOFAW Workplan:

1) Continue monitoring of the wild population.
2) Compile and analyze survey and monitoring data to assess long term population trends 1989-2001
3) Carry out experimental broad-scale predator control (upon EPA approval) and evaluate the benefits to this species.

ZSSD Workplan: no plans for the captive breeding of this species.

LAYSAN FINCH AND LAYSAN TEAL

Funding is currently not available to support Partnership efforts for these species. The following discussion is provided to illustrate some of the issues related to the conservation of these species.

Major Concerns and Needs: The wild Laysan Finch population currently numbers ~ 10,000 with no evidence of decline. Approximately 500-800 birds are scattered on several small islands at Pearl and Hermes Reef. However, bird populations on small islands such as Laysan are susceptible to catastrophic events, and translocation may be a viable recovery strategy if suitable habitat becomes available (Ellis et al., 1992).

The Laysan Teal population has the most restricted range of any duck species and the isolated, wild population is vulnerable to catastrophic events. Productivity in the wild is unpredictable and fluctuates widely (Reynolds, pers. comm.). Translocation is the preferred recovery strategy for this species. However, establishment of a small captive flock in the Hawaiian Islands to safeguard the species genetic diversity is desirable for three reasons: 1) possible catastrophic event on Laysan, 2) unpredictable reproductive performance in the wild, 3) quarantine constraints of transporting waterfowl from mainland zoos to Hawai`i (if this became necessary), and 4) limited pedigree records/hybridization information for captive Laysan Teal in mainland zoos.

Service/DOFAW Workplan:

1) Continue to monitor wild populations of Laysan Finch and Laysan Teal.

ZSSD Workplan: no current plans for captive breeding of these birds

HAWAII `ELEPAIO, `I`IWI, AND OMAO

These species are presently not thought to be at risk of extinction. However, each is likely to be an important component of Hawaiian forest ecosystems, and each continues to provide needed information for the development of captive breeding technology for other species by serving as a surrogate.

Goal: Maintain wide ranging viable populations in connection with habitat-based efforts for other species.

Facilities use and operational budgets are at or near capacity at the present time, precluding

the maintenance of captive breeding programs for species such as these whose facilities-use priorities are lower (Appendix 3, table 1). Although we are currently not engaged in reintroduction programs for these species, we recognize their importance as biologically significant species. For example, the `Oma`o is not endangered, but it is an important endemic frugivore that occupies the ecological role of seed disperser in native Hawaiian forest ecosystems. Omao and other species have declined or become extirpated from many areas of the state, potentially altering ecosystem function. Reintroduction of Omao to the leeward side of the Big Island, for example, would help reestablish this species in historical habitat, with potentially beneficial effects at ecosystem levels (Fancy et al., in press). Similarly, `I`iwi are likely important pollinators for many native plant species, and, as generalist insectivores, Elepaio may have significant effects on forest arthropod community structure, both at ecological and evolutionary time scales.

Service/DOFAW/BRD Workplan:

1) Continue surveys to monitor population dynamics.
2) Compile and analyze survey and monitoring data to assess long-term population trends 1989-2001.
3) Continue to support a landscape level program focused on ecosystem research, habitat management and long-term monitoring of wild populations (Pratt, 1999 - Appendix 5).

ZSSD Workplan:

1) Continue captive breeding of these species as needed to serve as surrogates for more endangered species.

ON THE BRINK SPECIES

Goal: Collaborate with partners and rescue species from extinction if no other viable recovery strategies are available.

Justification: The "search and rescue" or last-ditch strategy should be considered if extinction is imminent and the strategy of captive propagation/release has a greater probability of recovering the species than other recovery strategies (e.g. translocation or habitat management). Although we may be saving the last few eggs or birds by removing them from their natural habitat, we are losing an opportunity to study and protect the species in the wild. This strategy is high risk, but may be the only option remaining for a few species.

Based on our work over the last eight years developing artificial incubation and hand-rearing techniques for 12 species of Hawaiian forest birds, we believe the collection of wild eggs from "on the brink species" may be a viable "search and rescue" strategy (TPF, 1993-1999). Based on our restoration work and captive husbandry experience with `Oma`o and Puaiohi, we also believe collection of wild adult Kama`o may be a viable "search and rescue" strategy (Fancy et al., in press; Kuehler et al., 2000). However, there is insufficient data available to determine whether or not this recovery strategy would be successful.

Concerns and Needs: It is unknown whether "rescuing" eggs or birds would actually provide enough founders for genetic and demographic stability of the species, or whether sufficient numbers of birds could be captive-bred for recovery. Captive-breeding programs need to be established before species are reduced to critically low numbers if they are to have a reasonable chance of saving a species from extinction (Appendix 2).

Example Po`ouli: Recommendations for proposed conservation activities for Po`ouli are available in the public document (Final Environmental Assessment - Possible Management Actions to Save the Po`ouli). The Service and DOFAW determined that the best management strategy to conserve the Po`ouli is intensive habitat management and translocation rather than an intensive captive management strategy. This decision was based on experience with the known challenges of aviculture and also recognizing the difficulties of working with highly specialized insectivorous songbirds. It was also based on numerous discussions with experts in the field of zoology, aviculture, predator control, reforestation, and animal husbandry, and included discussions with public officials and legislators to gain a perspective on the efficacy of choosing a preferred alternative of habitat management over captive management. The stated Service position on "species rescue" by bringing into captivity the "last of the last" can only be defended for those species which have a better chance of surviving the rigors of captivity vs. the anticipated survivability in their native habitat calculating the benefits derived from habitat management and protection from predation. In the case of the Po`ouli, with habitat management still available as an option, bringing adult Po`ouli into captivity is not considered to be a "last resort" scenario. Should habitat management and translocation efforts fail, it will be necessary to reevaluate the "search and rescue" option for Po`ouli.

Service/DOFAW Workplan:

1) Continue statewide forest bird surveys.
2) Continue to support research to develop large-scale, effective predator control and toxicant registration for control of rats and mongoose.
3) Rare bird nest searching and monitoring.
4) Continue population research and management to identify and control limiting factors in the wild, if possible.
5) Continue habitat restoration and management. Develop and evaluate broad-scale predator control at Hanawi NAR, and complete EPA registration for use statewide.
6) Determine whether the "search and rescue" option is appropriate on a case-by-case basis should "on the brink species" (Kama`o, `O`u, `O`o, Nukupu`u, Maui `Akepa, Oloma`o and `Akialoa) be discovered.

ZSSD Workplan:

1) Collect "on the brink species" eggs if located (Kama`o, Po`ouli, `O`u, `O`o, Nukupu`u, Maui `Akepa, Oloma`o and `Akialoa).
2) By mutual agreement, collect birds for captive propagation if located (Kama`o and others).

3) Develop quarantine procedures and methods for care, maintenance, and captive breeding of “on the brink species” should these be discovered and it is determined that the “search and rescue” option is most appropriate.

APPENDICES

APPENDIX 1: BACKGROUND INFORMATION ON CAPTIVE PROPAGATION/REINTRODUCTION AS A RECOVERY STRATEGY FOR ENDANGERED PASSERINES

It is often incorrectly assumed that self-sustaining captive populations can be easily established for endangered species. In reality only a small percentage of all birds (9%) and mammals (19%) have bred in captivity (Conway, 1986; Rahbek, 1993). Obtaining consistent reproduction and survivorship under captive conditions has proven difficult with many species, and behavioral/nutritional "generalists" adapt better to captivity than endangered species with specialized husbandry requirements (Muller, 1976). Failure to reproduce in captivity can be due to inadequate captive environments, nutritional problems, behavioral incompatibilities and disease. Developing husbandry requirements to promote reproduction can be expensive, time-consuming, difficult, and may be impossible for some species. Often poor reproduction in captivity results in slowly declining, captive populations that take many generations to die out (Muller, 1976; Rutgers and Norris, 1977; Ralls & Ballou 1983; Danielle & Murray 1986; Frankham, 1998; Synder et al. 1996).

It has also been suggested that endangered island species may require more "effort" than related mainland species and be more susceptible to stress and disease. Island populations may have lower reproductive fitness than related mainland populations and so may be less suitable for reintroductions (Frankham, 1998).

1.1 Kirtland's Warblers

The surrogate program for Kirtland's Warblers using Nashville Warblers is an example of the problems associated with maintaining passerines in captivity. In 1986, 54 juveniles (which are considered easier to acclimate to captivity than adults) were collected: 43 birds accepted captivity, (six birds did not accept captivity and were released, five died). Thirty-nine birds were transferred to captivity; 13 birds died in the following eight months. Twenty-six birds were moved to Michigan for release. Ten birds died in the soft release program. Sixteen birds were returned to the wild - long-term survival unknown. Bocetti (1991) recommended that any technique that requires long-term captivity should be used with caution. After several years of surrogate work, captive manipulation was abandoned as a recovery strategy for Kirtland's Warbler. Instead, habitat management was implemented (and has been successful).

1.2 San Clemente Island Loggerhead Shrikes

Recovery efforts for the relatively large, hardy, insectivorous San Clemente Island Loggerhead Shrike began in the early 1990s with initial success in collection of wild eggs to develop a captive flock (Kuehler et al., 1993). Prior to recovery efforts, an extensive natural history study had been completed providing aviculturists with information on wild diet composition and natural behaviors. Maintenance of the captive Shrike population has proven to be difficult due to behavioral incompatibilities, aggression, disease and nutritional problems. Excessive aggression in this species necessitates strict behavioral management where birds must

be housed singly in the non-breeding season. Incorrect husbandry practices, nutritional problems and disease resulted in 20 captive-reared chicks dying in 1997 (Harvey and Vissman, pers. comm.). Additionally, unexplained "flightless behavior" of captive birds occurred in 1999-2000. Although established in the 1991 (through the collection of wild eggs) this captive population is not self-sustaining.

1.3 Bali Mynahs

In contrast to most endangered passerines the Bali Mynah has been successfully propagated in captivity. Nevertheless, since 1 Jan. 1995 the population has remained at about its present size; there have been 53 hatches and 66 deaths during this period. There are regional populations at zoos and breeding centers in Europe, North America, Japan, and Indonesia. European zoos report 279 birds at 36 institutions; North American zoos have 249 birds at 60 institutions; Hong Kong and Singapore report 13 birds; and four Indonesian sites report a total of over 150 birds. However, reintroduction attempts have not been successful (largely due to poaching). Fifteen birds remain in the wild (Lincoln Park Zoo, 1998).

1.4 Micronesian Kingfishers

Although not a passerine, the Micronesian Kingfisher program demonstrates that given enough time (and enough founder animals) for the development of avicultural techniques – it may be possible to propagate a difficult species in captivity. In 1983, the development of a captive-breeding program for the Micronesian kingfisher became one of the primary goals of the Guam Bird Rescue project. A total of 29 birds potential founders were brought in to captivity through a series of three imports (Bahner, 1993). Today, after 16 years the total captive population numbers 59 birds (Bahner, pers. comm.). The question remains will production of birds in captivity ever exceed mortality in sufficient numbers to support a reintroduction program.

1.5 Maui Creepers

The work with Maui Creeper nestlings by DOFAW staff in 1995 demonstrated the difficulties of working with aggressive, territorial, insectivorous Honeycreepers. Even when collected as nestlings (acclimatization is easier than for adult birds) (n = 23), 11 birds died during attempts to acclimate, breed and develop a release program. Aggression/stress was the cause of mortality and injuries, and several attempts to house birds together as pairs were unsuccessful due to incompatibility (OESPF, unpubl. necropsy records). More recently the DOFAW Maui field crew collected two Maui Creepers; one died and the second bird was released because it did not acclimate well to captivity.

1.6 Bridled White-eyes

J. Groves (MARS Coordinator) reported in 1998 that of the 30 Bridled White-eyes collected from Rota in the early 1990s, only nine birds still survive, and he was unaware of any successful reproduction (survival to maturity) in captivity.

1.7 AZA Hawaiian Bird Consortium

Currently, there are no growing captive populations of Hawaiian Honeycreepers (production

exceeding mortality) even though a consortium of North American Zoos has been working on techniques for several years. Mortality in captivity is high due to rigid dietary requirements and increased susceptibility to disease and stress (Service and State, 1999). An analysis of the long-term survival and reproduction data of the Hawaiian birds collected for North American Zoos does not support captive propagation/release as a viable option at this time. For example, overall, during the period from 1988 - 1998; 65 wild `Amakihi were collected. Nineteen of these birds currently survive and 5 chicks successfully fledged; total = 65 wild `Amakihi collected, 24 in the total population - to date. This is not a self-sustaining population nor a demonstration of a breeding flock that could support a reintroduction program (Service and State, 1999).

1.8 Fairy Wrens

Captive propagation efforts in Australia for Fairy Wrens has also been attempted as a conservation strategy. Fairy Wrens are a widespread seed-eating species in Australia. Even so, the techniques to propagate Fairy Wrens in captivity required over 30 years to develop, with significant mortality during the learning process (Schodde, 1982; Roots, 1970).

1.9 Saddleback

New Zealand's Department of Conservation biologists reported the following comments on captive propagation attempts for the insectivorous Saddleback.

"At Mount Bruce birds settled down well and have since bred, but not multiplied. Although nesting has occurred each year, the mortality of eggs and young have been high and few have survived to maturity... During the period from 1970 to 1974, nine birds were collected for captive propagation, but only one chick was produced which survived to maturity. Of all three basic methods of managing endangered wildlife -viz: preservation and, if necessary, manipulation of the natural habitat; propagation in captivity for retention or for release to the wild; or relocation where existing habitat is inadequate or threatened - only the latter has proved of value in conserving the Saddleback (Merton, 1974). Both subspecies of Saddleback have now been kept in captivity for intermittent periods over the last 50 years without anybody being able to sustain a captive population (Veitch, pers. comm.).

1.10 Chatham Island Black Robins

In 1976, New Zealand was faced with developing a recovery plan for the critically endangered Chatham Island Black Robin. Of all the recovery options proposed, captive propagation had no supporters because experience throughout the world suggested that the chances of successfully rearing a small insectivorous bird like the robin in captivity were slim (Butler and Merton, 1992).

"Long-term solutions are often politically more difficult than captive-breeding solutions, so it is tempting for managers to de-emphasize efforts for wild populations once captive populations are in place. Thus captive breeding can divert attention away from problems causing a species decline and become a technological fix that merely prolongs rather than rectifies problems. Captive breeding can become an end to itself and may undermine rather than enhance habitat preservation by reducing the urgency with which this goal is pursued. The existence of a captive population can give

a false impression that a species is safe. After all, if animals can be reintroduced later then perhaps we don't have to put such a priority on maintaining them in their natural environment. The reality, of course, is that once the animals have gone it is vastly more expensive and difficult to reintroduce them than it would have been to maintain them in the wild in the first place." Captive propagation and reintroduction can distract attention from the real issues (Bramwell, 1986; Conway, 1986; Knowles, 1986; Shepherdson, 1989; Snyder et al. 1995).

1.11 Helmeted Honeyeaters

The captive management of helmeted honeyeaters began in 1989. However, the population suffered a major setback in 1992 when the incorrect dosage of a vitamin supplement resulted in accidental mortality of most of the population in 1992. This captive population is being rebuilt by fostering helmeted honeyeaters under yellow-tufted honeyeaters (Smales, 1996).

1.12 Hihi

Hihi are held in captivity at Mt. Bruce Wildlife Centre for research into captive breeding techniques and advocacy (~ six birds). This is not a self-sustaining captive population, and captivity is not considered to be a major element of the recovery program. Hihi seem to be "high stress" birds and exhibit disease susceptibility under stress conditions. The emphasis for management is translocation to predator-free islands, accompanied by research/monitoring. Progeny have been released to the wild as part of the trial package in the last two years with variable results, 3 died (disease/stress related and 1 predation by hawk?). One male has survived and is a territory holder with a breeder female this season (Boyd, pers. comm.).

1.13 Summary of Releases

The development of release techniques for passerines is still in the infancy stage, and no one can predict all the challenges. The goal for a restoration effort involving captive propagation and release is the establishment of a self-sustaining wild population. The final measure of restoration success is the percentage of release birds that survive and breed successfully in the wild. In their review of 145 reintroduction programs of captive-bred animals, Beck et al. (1994) found only 16 cases (11%) of successfully established wild populations. Captive-bred stocks also fared poorly in the reintroduction programs reviewed by Griffith et al., (1989). These results suggest major difficulties with establishing wild populations from captive-bred stock. Additionally, a recent assessment by Wolf et al. (1996) indicated that translocated birds are less successful than mammals and an omnivorous (generalist) diet was positively correlated with translocation success.

APPENDIX 2: POLICIES, GUIDELINES, DEFINITIONS AND RECOMMENDATIONS RELATING TO RESTORATION PROGRAMS FOR HAWAIIAN FOREST BIRDS

Note: these are direct quotations.

2.1 U.S. Fish and Wildlife Service

- *Controlled propagation of threatened and endangered species*

Captive propagation/cultivation may be a useful tool to facilitate recovery of a species in the wild, but it is not a substitute for reestablishment of viable wild populations. The initiation of significant and costly captive propagation programs may be necessary, but should be considered only after all other techniques to maintain or improve a species' status in the wild have failed or are determined as likely to fail...Emphasis should be on preservation of natural habitats, population management, enforcement of protective regulations, and public education (U.S. Department of the Interior, 1990; Federal Register, 1996).

- *Incorporating ecosystem considerations in recovery*

Develop and implement recovery plans for threatened and endangered species in a manner that restores, reconstruct or rehabilitates the structure, distribution, connectivity and function upon which those listed species depend. In particular, these recovery plans shall be developed and implemented in a manner that conserves the biotic diversity (including the conservation of candidate species, other rare species that may not be listed, unique biotic communities, etc.) of the ecosystems upon which the listed species depend (Federal Register, 1994).

- *Clarifying the role of habitat in endangered species conservation*

The process of habitat protection through the designation of critical habitat is properly examined in the broad context of the importance of habitat in endangered and threatened species conservation. Virtually every study of the conservation of imperiled species considers habitat as a major component in a species' conservation and eventual recovery. The very purpose of the Act is "to provide a means whereby the ecosystems upon which endangered species depend may be conserved." The National Research Council recognized the importance of habitat in its 1995 book, Science and the Endangered Species Act: "habitat protection is a prerequisite for conservation of biological diversity and protection of endangered and threatened species." The National Research Council further noted: "the Endangered Species Act, in emphasizing habitat, reflects the current scientific understanding of the crucial role that habitat plays for species" (National Research Council, 1995; Federal Register, 1999).

- *Priority System to Guide Recovery*

The Service uses a two-tiered priority system to guide recovery, which in turn guides the allocation of recovery dollars. The first component is recovery priority, which assigns species a rank according to the degree of threat, recovery potential, taxonomic distinctness and presence of an actual or imminent conflict. The recovery priority is assigned by the lead Service Region at the time of the listing, which is reviewed yearly thereafter. The second

component is the recovery task priority, in which the recovery tasks themselves are assigned priority numbers with one of three priority levels. They are tasks necessary to prevent extinction (Priority 1), avoid significant further decline (priority 2), or other activities necessary to achieve recovery (priority 3) (Service, home-page).

- *Definition of Terms*

Reintroduction applies to areas (sites), where the species is or was known or believed to occur. All other placements are introductions (always outside of the historic range). The "experimental" designation relaxes certain restrictions imposed by Section 9 and, in some cases, Section 7 of the Act. Each member of the experimental population will be treated as a threatened species or as a species proposed for listing, depending on the circumstances.

Experimental populations of listed species may be established outside the current range of the species to further species conservation. To be considered experimental, a population must be wholly separate geographically from the donor population but within the species' probable historical range (except for unusual situations, which must be approved by the Director) (Service, 1990).

2.2 Additional U.S. Fish and Wildlife Service Communications/Documents Considered

- *Reassessment of Recovery Potential for Endangered Hawaiian Birds*

This is a memo evaluating the recovery potential for endangered Hawaiian avifauna (Engbring, 1991).

- *Potential Captive Propagation needs for Hawaiian Birds and Summary of Surrogate Bird Species*

This is a memo evaluating the potential captive propagation need for Hawaiian avifauna (Engbring, J. and K. Rosa, 1992).

2.3 Secretariat for Conservation Biology – University of Hawai`i

Guiding Concepts for Hawai`i Conservation (Secretariat for Conservation Biology, 1999).

1) Conservation Partnerships at the landscape level
2) Local Community Support
3) Outreach Stressing Positive Connections
4) Habitat Management Grounded in Science
5) Research, Training and Education
6) Planning, Inventories and Monitoring
7) Conservation in Land Policy

2.4 IUCN – The World Conservation Union

Species Survival Group, Captive Breeding Specialist Group, and Reintroduction Specialist Group

- *Guidelines for Captive Breeding*

Habitat protection is not sufficient if the expressed goal of the World Conservation Strategy, the maintenance of biotic diversity, is to be achieved. Establishment of self-sustaining captive populations and other supportive intervention will be needed to avoid the loss of many species, especially those at high risk in greatly reduced, highly fragmented, and disturbed habitat. Captive breeding programmes need to be established before species are reduced to critically low numbers, and thereafter need to be coordinated internationally according to sound biological principles, with a view to the maintaining or re-establishment of viable populations in the wild (IUCN, 1987).

- *IUCN Degree of threats*

The CAMP process is also providing an opportunity to test the applicability of the Mace-Lande categories and criteria (Mace and Lande, 1991) for assessment of threat. The Mace-Lande system is being considered as a new process for assigning IUCN Categories of Threat to species, and is still under active development. The scheme attempts to assess threat in terms of likelihood of extinction within a specified period of time. The proposed system defines three categories of threatened taxa as follows.

a) Critical: 50% probability of extinction within five years or two generations, whichever is longer.

b) Endangered: 20% probability of extinction within 20 years or 10 generations, whichever is longer

c) Vulnerable: 10% probability of extinction within 100 years

Criteria are also proposed to estimate the probability of extinction of taxa based on information about the population size (total and effective), fragmentation, trends, and stochastically for each category as well as conditions of the habitat that is more objective and rational than previous schemes have been. The criteria are based on population viability theory (Gilpin and Soule, 1986; Soule, 1987a,b; Seal et al, 1994).

In the proposed IUCN system, a species could be listed as endangered based on any of several criteria, each of which was intended to represent approximately the same rate of extinction. The decision to list a species could be based on any of the following criteria: probability of extinction, trends in abundance, population size, number of populations, and geographical extent (Mace et al., 1992).

- *Hawaiian Forest Bird CAMP Decision Key for Captive Program Recommendations*

1) Assignment to Mace-Land category of threat (Critical, Endangered, Vulnerable)

2) Taxonomic uniqueness (e.g. taxonomically unique or not)

3) Number of islands inhabited (e.g. one vs. multiple islands)

4) Population trend (declining vs. stable)

5) Availability of husbandry techniques for species (known technique or applicable/surrogate work in hand vs. technique not known or likely a difficult

species).

6) Aviculture facilities/staff (present vs. none/planned/developing)
7) Sufficient numbers of birds for the level/type of recovery proposed (sufficient numbers vs. too few)

Ongoing Captive Propagation Programs

Initiate Captive Propagation Program in Hawaii within 3 years

Initiate Captive Propagation Program in Hawaii within next 5 years

No recommendation for captive propagation at this time, pending outcome of field

surveys and/or taxonomic review

E = Captive population should be developed and managed that is sufficient to preserve 90% of the genetic diversity of a population for 100 years. Program should be developed within 3 years. This is an emergency program based on the present availability of genetically diverse founders.

N = Captive population should be developed and managed that is a nucleus 50-100 individuals organized with the aim to represent as much of the wild gene pool as possible. This program may require periodic importation of individuals from the wild population to maintain this high level of genetic diversity in a limited captive population. View this type of program as protection against potential extirpation of wild populations.

S = Captive population should be developed to be used a surrogate for other populations that may be more rare as a nucleus program and instead focuses more on development of husbandry techniques.

DIFFICULTY:

1 = Techniques are in place for capture, maintenance, and propagation of similar taxa in captivity, which ostensibly could be applied to the taxon. Least difficult.

2 = Techniques are only partially in place for capture, maintenance, and propagation of similar taxa in captivity, and many captive techniques still need refinement. Moderate difficulty.

3 = Techniques are not in place for capture, maintenance, and propagation of similar taxa in captivity, and captive techniques still need to be developed. Very difficult.(Ellis et al. 1992).

- ***IUCN Reintroduction Specialist Group - Guidelines for Re-introductions: definition of terms:***

  a) **"Re-introduction":** an attempt to establish a species in an area which was once part of its historical range, but from which it has been **extirpated** or become extinct ("re-establishment" is a synonym, but implies that the reintroduction has been successful).

  b) **"Translocation"**: deliberate and mediated movement of wild individuals to an existing population of conspecifics.

c) "**Re-enforcement/Supplementation**": addition of individuals to an existing population of conspecifics.

d) **"Conservation/Benign Introductions":** an attempt to establish a species, for the purpose of conservation, outside its recorded distribution but within an appropriate habitat and eco-geographical area.

Aims: The principal aim of any re-introduction should be to establish a viable, free-ranging population in the wild, of a species, subspecies, or race, which has become globally or locally extinct, or extirpated, in the wild. It should be re-introduced within the species' former natural habitat and range and should require minimal long-term management.

Objectives: The objectives of a re-introduction may include: to enhance the long-term survival of a species; to re-establish a keystone species (in the ecological or cultural sense) in an ecosystem; to maintain and/or restore natural biodiversity; to provide long-term economic benefits to the local and/or national economy; to promote conservation awareness, or a combination of these (IUCN, 1998).

2.5 Hawai`i Forest Bird Recovery Plan (U.S. Fish and Wildlife Service, *in prep.*)

- *Draft Forest Bird Recovery Plan Goals (meeting minutes May 2001)*

A taxon may be downlisted from endangered to threatened when all three of the following criteria, as well as any species-specific criteria listed in Table 6, apply:

1) The species occurs in at least two viable populations or a viable meta-population (as defined in number 2) that represent the ecological, morphological, behavioral, and genetic diversity of the species.

2) Quantitative surveys show either a) that the number of individuals in each isolated population or in the meta-population has been stable or increasing within 15 consecutive years, or b) demographic monitoring exhibits an average intrinsic growth rate (lambda, λ) not less than 1.0 over a period of at least 15 consecutive years; and total population size is not expected to decline by more than 20% within the next 15 consecutive years for any reason.

3) Sufficient recovery habitat is protected and managed to achieve criteria 1 and 2 above, and the major threats that were responsible for the species becoming endangered have been identified and controlled.

A taxon may be delisted when all three of the criteria above, as well as any species-specific criteria listed in Table 6, apply.

- *Criteria for Choosing Hawaiian Birds for Captive Propagation Programs*

Urgency: Urgency to act on captive propagation of species

0 - probably extinct, none detected in past 5 five years

1 - most urgent, population < 100 individuals

2 - less urgent, population 5001-1000 individuals

3 – not urgent, population > 1000 individuals

Propagation: Anticipated difficult to propagate in captivity, based on CAMP

1 – least difficult

2 – moderately difficult

3 – most difficult

Release: Anticipated difficult to release captive-reared young, based on juvenile dependency period and difficulty young experience at acquiring food

1 – least difficult – juvenile dependency .3-1 month

2 – moderately difficult – juvenile dependency 1-4 months

3 – most difficult – juvenile dependency 4-12 months

Information: Information available on breeding and feeding ecology of species

1 – Well studied species

2 – Few studies

3 – No studies; incidental observation only

Surrogate: Is there a surrogate species that has or is being studied that could be used for experimentation of captive propagation and release? The species must be non-endangered.

1 – Closely related species available

2 – A species available, but not closely related

3 – No close relative in the Islands

Site: Sites available for release to build new populations or bolster small failing ones. The "available" sites may have problems that must be dealt with first. No sites means that the bird occupies all suitable habitat currently available to it.

Y – Sites available

N – Sites not available

(Pratt, 1994)

2.6 NRC – Science and the Endangered Species Act

Evolutionary Unit

An evolutionary unit is a group of organisms that represents a segment of biological diversity that shares a common evolutionary lineage and contains the potential for a unique evolutionary future. Its uniqueness can be sought in several attributes, including morphology, behavior, physiology, and biochemistry (NRC, 1995).

2.7 American Association of Zoological Parks and Aquariums (AZA)

Guidelines for reintroduction of animals born or held in captivity – AAZPA reintroduction advisory Group

This is a policy document and reference list - Guidelines for reintroduction of animals born or held in captivity – AZA Reintroduction Advisory Group (Beck, 1992).

2.8 Australia/New Zealand

Policy for captive-breeding for translocation (re-introduction) in Australia/New Zealand

Captive-breeding for the purpose of providing animals for translocation will be undertaken only for those species where translocation of wild animals is not possible or practicable or where removal of significant numbers of animals from the wild population would have a detrimental effect on the species' survival. (Serena, 1995).

APPENDIX 3: SUMMARY OF RECOVERY STRATEGIES AND FACILITIES-USE PRIORITIES BY SPECIES

Priorities for the use of facilities take into account considerations based on taxonomic uniqueness, urgency/degree of threat, cause of decline, available knowledge of natural history, status of current research and habitat management, population size, distribution (fragmentation), practical considerations (funding, labor, facilities etc.), avicultural difficulty, release difficulty, availability/accessibility of release sites (HCP's, safe harbor and partnership agreements, etc.), value as ecosystem component, cultural value, educational value, Service, IUCN, HFBRT, recommendations and policies (Appendix 2).

Table 1. Strategies and facilities use priorities. Recovery program strategies are defined as follows: 1 = No Captive Program Necessary (other recovery strategies more appropriate); 2 = Translocation; 3 = Rear and Release; 4 = Captive-breeding (Immediate Release); 5 = Captive-breeding (Self-sustaining Population); 6 = Captive-breeding (Production for Restoration); 7 = Emergency Search and Rescue; 8 = Technology Development. Facilities-use priorities are defined as follows: 1 = Species in critical need of recovery efforts involving captive propagation techniques; 2 = Species in great need of recovery efforts involving captive propagation techniques, but with somewhat larger population numbers; 3 = Species in need of recovery efforts, but for which techniques involving captive propagation are less effective than translocation, habitat management, or habitat restoration; 4 = Species for which captive breeding development is to be used as surrogates to aid the development of techniques for other species.

Species	Captive Propagation Program Strategies	Facilities-use Priorities
On-the-Brink Species	3	1
Puaiohi	4	1
`Alala	5, 6	1
`Akiapola`au	8, 4	2
Palila	8, 4	2
Nene	4,	2
Millerbird	8, 2, 4	2
Kaua`i Creeper	8, 4	2
Maui Parrotbill	8, 4	2
O`ahu `Elepaio	1, 2, 3	3
Hawai`i `Akepa	8, 3, 4	3
Hawai`i Creeper	8, 3, 4	3
Akohekohe	8, 2, 3	3
Kaua`i `Akepa	8, 4	3
Laysan Finch	1, 2	3
Laysan Teal	2, 5	3
Hawai`i `Elepaio	8	4
`I`iwi	8	4
`Oma`o	3	4

APPENDIX 4: HAWAIIAN ENDANGERED BIRD CONSERVATION PROGRAM—CAPTIVE PROPAGATION ACTIVITIES AND MILESTONES

1993

- In collaboration with the Service, DOFAW, McCandless Ranch, KS, BRD, the ZSSD and Greenfalk Consultants, seven `Alala are hatched, hand-reared and five released to the wild.

1994

- Veterinary/Pathology consortium established including Drs. Pat Morris, Don Janssen, and Bruce Rideout (ZSSD).
- `Alala studbook initiated.
- Five `Alala reared and seven released (additional birds from DOFAW).
- Service modifies an existing agreement with TPF to design, build and operate a captive propagation facility for endangered Hawaiian Forest Birds.
- Congressional Appropriation, $1.5 million, for capital construction is received.
- Site is chosen for the development of the KBCC on 155 acres of KS land in Volcano, Hawai`i. Subsequently a 35 year license agreement is signed and the Regional Director of the Service approved the Environmental Assessment.
- Five Common `Amakihi hatched and reared; the first successful artificial incubation and hand-rearing from hatch of a Hawaiian Honeycreeper species.

1995

- Common `Amakihi, `Oma`o, I`iwi, and Hawai`i `Elepaio hatched and reared.
- Hack tower built in PWW and `Oma`o and `I`iwi released to test release techniques. `Amakihi released at KBCC to test release techniques.
- Pest control program begins at KBCC for rats, cats, mongoose, mosquitoes, and introduced plants.
- Native plant propagation program for native plants is initiated. These plants are now being used to enrich aviary environments and re-forest KBCC.
- Began food production program for maintaining Hawaiian bird species in captivity.
- Finished the A+E for the KBCC by completing the plans, the site survey, soils exploration and civil engineering.
- Facility plans were reviewed and bids submitted by six general contractors. Kawika General Contracting was selected. Construction of Phase I initiated.
- In collaboration with KS, several weeks spent working in the Alaka`i Swamp

doing reconnaissance for rare Kaua`i endemic bird species. Observations were made on six Puaiohi and one observations of a Nukupu`u.

- KBCC building site blessed according to Hawaiian tradition.

1996

- Phase I construction of KBCC is completed including: brooder/office building, forest bird barn, staff residence, `Alala aviary, storage building, civil work, water, power, A+E, and permits. Began operation of the facility on March 15, 1996.
- Assumed management of the Olinda Endangered Species Propagation Facility at the request of DOFAW, and the Service, March 1, 1996 -- renamed the Maui Bird Conservation Center (MBCC).
- Cleaned, renovated and remodeled areas in MBCC critical to the captive propagation of `Alala (incubation and brooder rooms, bird kitchens).
- Reared six `Alala, 23 `Oma`o, 11 Palila, and five Puaiohi.
- Developed a behavioral program to monitor incubation attentiveness in captive `Alala, in collaboration with the ZSSD.
- Began intern/volunteer program at KBCC.
- Added two new local members to veterinary consortium: Sterrett Grune (Big Island) and Greg Massey (Maui).
- Dr. Bruce Rideout, Director of Pathology - ZSSD is named Research Associate of TPF.
- Built a second hack tower for the release of `Oma`o at Pu`u Wa`awa`a Forest Reserve (PWW).
- Released 23 additional `Oma`o (25 total) at PWW.
- Released four `Alala in Kona.
- Hosted the semi-annual TPF Board Meeting, in Hawai`i.

1997

- Received congressional appropriation ($987,500) for capital construction (Phase II).
- Completed Phase II construction of the KBCC: four laboratories, eight fledgling aviaries, five `Alala aviaries, four Nene pens, staff residence and road improvements.
- Initiated major renovation of MBCC by repairing `Alala aviaries, painting and cleaning incubator and chick rearing rooms for forest birds, and constructing new outdoor Nene enclosures.

- Hatched and reared ten Puaiohi, four Hawai`i Creeper, two `Apapane, five `Akohekohe, one Maui Parrotbill and nine `Alala.
- Transferred two pairs of `Alala and two pairs of Nene from MBCC to KBCC for breeding. Transferred one juvenile `Alala from KBCC to MBCC.
- Released eight `Alala in Kona.
- Initiated captive population studbooks for all species housed in captivity.

1998

- Hatched and reared 23 Puaiohi , five Hawai`i Creeper, four `Alala, one `Elepaio and one `Akepa. The `Akepa is the smallest passerine successfully artificially incubated and hand-reared in captivity.
- Hatched and reared 31 Nene (15 for DOFAW release program).
- First captive-breeding of Puaiohi (parents collected as wild-eggs in 1996 and 1997).
- First reported observation of hand-reared reintroduced birds breeding in the wild
- (`Oma`o).
- Zoological Society of San Diego sponsored a two week Avian Medical Training
- Workshop at KBCC for TPF staff, February 1998.
- Added a new member to the veterinary consortium: Stephen Diana (veterinarian, TPF).
- Initiation of Environmental Education Program at KBCC.
- Congressional Appropriation, $985,000, for capital construction (Phase III) is received.

1999

- Hatched and reared five Puaiohi, two `Alala, five `Akepa, two Maui Parrotbill, and eight `Elepaio.
- Hatched and reared 13 Nene for DOFAW release program.
- Fourteen captive-reared Puaiohi were released in the Alaka`i Swamp, Kaua`i. This is the first successful endangered passerine conservation program using recovery techniques that include: collection of wild eggs, hand-rearing, captive-breeding and release; where reintroduced birds subsequently survived and bred in the wild.
- Completion of Phase III construction of a second Forest Bird Barn at KBCC.
- Completion of additional Nene enclosures at KBCC (total = 8).
- Continuation of Environmental Education Program: 1600 students participated in TPF programs in 1999. Publication of Treasures of the Rainforest.
- Continuation of renovation of facilities at MBCC: `Alala aviaries and Nene pens. The

"great room" was painted/carpeted in preparation for an environmental education program on Maui.

- Began intern/volunteer program at MBCC.

2000

- Hatched and reared three Alala.
- Hatched, reared, and released 15 Puaiohi.
- Hatched and reared 14 Palila, three from wild eggs.
- Hatched and reared three Hawaii Creeper, one from captive-laid egg. World first.
- Hatched and reared two Maui Parrotbill. World first.
- Hatched and reared seven Hawaii Akepa from wild eggs.
- Hatched and reared 49 Nene.

2001

- Hatched and reared eight Alala.
- Hatched and reared 12 Puaiohi.
- Hatched and reared four Maui Parrotbill, one from wild egg.
- Hatched and reared three Palila.
- Hatched and reared 47 Nene.

APPENDIX 5: PLANNING FOR RECOVERY OF THE HAWAI`I CREEPER, AKEPA, AND `AKIAPOLA`AU.

An informal viewpoint by Thane K. Pratt, November 1, 1999.

The Hawai`i Creeper, `Akepa, and `Akiapola`au, three endangered species of Hawaiian honeycreepers, are endemic to the Island of Hawaii. Deforestation and avian disease have extirpated the birds below elevations of about 5,000 and stranded the survivors in remnant patches of suitable forest at high elevation. It is the fragmentation of the birds' habitat and populations that causes the greatest concern for their future. Because in general small sub-populations succumb more readily than large ones, the potential extinction of all three species is indeed a case of "divide and conquer."

Planning for the recovery of these honeycreepers must involve a review of the current status of their populations and particularly of their habitat. The birds' recovery would essentially involve research, planning, and management of three co-occurring metapopulations. A first priority is to protect sites holding core populations, for instance at the Hakalau National Wildlife Refuge and at the Ola`a/Kilauea Management Area (OKMA). A second goal is to reconnect isolated forests and bird populations, as for example at Keauhou ranch, where removal of cattle has permitted forest succession that could potentially close the gap between

ecosystems isolated in the OKMA and Hawaii Volcanoes National Park (HAVO). A third goal is to reintroduce birds to managed ecosystems lacking one or more of the endangered species. Reintroductions hasten a species' recovery by creating new sub-populations, some of which can colonize habitat between far-flung existing sup-populations.

An opportunity for a collaborative project exists to try reintroductions with these three endangered honeycreepers. Over the past two decades, certain forests once inhabited by the birds have come under protection from ungulates and are now recovering. One site, the Mauna Loa Strip of HAVO, lacks all three species although it once held them. Another site, the Pu`u Wa`awa`a Wildlife Sanctuary, harbors creepers and `Akepa, but not `Akiapola`au. Research must first evaluate regenerating habitat at the new sites to determine whether the requirements of the birds will be met. Research must also determine how the birds will be maintained in captivity prior to release. A potential partnership program would involve the National Park Service and the Hawaii Department of Land and Natural Resources as the land-management agencies, the U.S.G.S. Pacific Island Ecosystems Research Center as the lead in field research, the Keauhou Bird Conservation Center to the lead research on the birds in captivity and to carry out the reintroductions, and the U.S.F.W.S to coordinate recovery efforts. By pooling efforts, conservation agencies can advance the recovery of the Hawai`i Creeper, `Akepa, and `Akiapola`au with greater chances of success than by leaving the birds' future to the survival of small, isolated populations.

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