

Hawaiian Endangered Bird Conservation Program



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and
State of Hawai`i

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1. ABSTRACT

At the request of the US Fish and Wildlife Service (Service) and State of Hawai'i Division of Forestry and Wildlife (DOFAW), and in cooperation with the Kamehameha Schools Bernice Pauahi Bishop Estate (KSBE), the 'Alala, Kaua'i and Maui Partnerships, and the Biological Resources Division of U.S. Geological Survey (BRD); the Zoological Society of San Diego (ZSSD) and The Peregrine Fund (TPF) - Hawaiian Endangered Bird Conservation Program had the following goals for the period between July 1, 1999 - September 30, 2000:

- 1) Continue the restoration program for the endangered Puaiohi (*Myadestes palmeri*) by breeding this species in captivity and reintroducing birds to establish a second population in the Alaka'i Swamp, Kaua'i.
- 2) Continue captive-breeding 'Alala (*Corvus hawaiiensis*) at the Maui Bird Conservation Center (MBCC) and Keauhou Bird Conservation Center (KBCC) for reintroduction to the wild.
- 3) Continue captive-breeding Nene (*Nesochen sandwicensis*) at the MBCC and KBCC to produce at least 20 goslings for DOFAW's Nene release program. Establish a captive (clipped) free-ranging flock on predator-controlled KBCC grounds. Collect wild eggs to improve the genetic diversity of the captive flock.
- 4) If found, collect wild eggs from Maui Parrotbill (*Pseudonestor xanthophrys*), Hawai'i Creeper (*Oreomystis mana*), Hawai'i 'Elepaio (*Chasiempis s. sandwichensis*), Hawai'i 'Akepa (*Loxops coccineus*), 'Akiapola'au (*Hemignathus munroi*), 'I'iwi (*Vestiaria coccinea*) and "on the brink" species to develop captive propagation techniques and restoration programs.
- 5) Establish long-term captive husbandry and breeding protocols for endemic Hawaiian passerines.
- 6) Modify five 'Alala aviaries at KBCC to facilitate: (a) isolation of disruptive males during the breeding season and (b) improve socialization and mate-choice.
- 7) Continue the environmental education program, funded by grants and private donations.
- 8) Complete Phase III construction and continue facility improvements at KBCC (second Forest Bird Barn Building, four Alala aviaries, new water tanks, and educational mural).
- 9) Continue to rehabilitate and renovate facilities at MBCC.
- 10) Develop a five-year workplan (2000-2004).

All ZSSD/TPF programmatic goals were met except for the collection of wild eggs from 'Akiapola'au, Maui Parrotbill and "on the brink species". Biologists from the U.S. Geological Survey - Biological Resources Division (BRD), (Service), DOFAW and TPF/ZSSD were unable to locate accessible nests for these species. **Of particular significance, we report the first successful captive-breeding (including parent-rearing) of three species of endangered honeycreepers this year: Maui Parrotbill, Palila (*Loxiodes bailleui*) and**

Hawai`i Creeper.

In previous years the Hawaiian Endangered Bird Conservation Program submitted two annual reports: (1) Hawai`i Division of Forestry and Wildlife (DOFAW) (July 1 - June 30) and (2) The U.S. Fish and Wildlife Service (Service) (Oct. 1 - Sept. 30). As of this year, one joint report will be submitted to both agencies on Nov. 15th. Because this annual report represents a one-time transitional report, it will also include the time period from July 1, 1999. Future reports will be submitted November 15th (reporting period for the Federal fiscal year: Oct. 1 - Sept. 30).

2. INTRODUCTION

The mission of the ZSSD/TPF - Hawaiian Endangered Bird Conservation program is to collaborate with partners to recover native Hawaiian ecosystems at the landscape level. Our goal is to establish self-sustaining populations of birds in the wild using management programs including captive propagation and reintroduction.

Changes in the natural environment of the Hawaiian islands due to increased human activity and introduced non-native plants, vertebrates and invertebrates is causing the steady decline of endemic bird populations. More than half of all the federally listed endangered species in the United States inhabit this island state, and Hawai`i is considered the extinction capitol of the world. Avian disease, habitat degradation and introduced alien species (rats, cats, mongoose etc.) are all contributing to the extinction crisis.

For many bird species in Hawai`i, habitat enhancement and protection is not occurring quickly enough to guarantee a safe haven for populations on the verge of extinction. In these critical cases, manipulation of wild birds and hands-on intervention techniques are being used as recovery management tools. Collection of wild eggs to establish captive breeding programs to produce birds for reintroduction has proven to be a valuable conservation strategy for Peregrine Falcons (*Falco peregrinus*), California Condors (*Gymnogyps californianus*), and San Clemente Island Loggerhead Shrikes (*Lanius ludovicianus mearnsi*). Populations of endangered bird species can be established in captivity without removing adult birds from the wild. Also, captive propagation of hand-reared birds is often more successful than attempting to collect and breed wild-caught birds. However, propagation of birds in captivity is labor-intensive, costly and not necessarily an effective recovery tool for all species. For some endangered bird populations translocation, and/or intensive habitat management is a preferable recovery strategy.

In 1993, at the request of the Service and DOFAW, we began a program for the restoration of endangered Hawaiian avifauna. To date, 241 endemic Hawaiian passerines have been hatched at our facilities on Maui, Kaua`i and the Big Island (hatchability = 81%; survivability = 86%)

(Lieberman and Kuehler, in press). And, the Nene captive-breeding program (established by DOFAW) is ongoing. The technology is being developed to: a) collect wild eggs for artificial incubation and hand-rearing b) propagate endemic Hawaiian birds in captivity and c) release native Hawaiian birds to the wild.

2.1 ZSSD/TPF - Hawaiian Endangered Bird Conservation Program

Program Goals:

- Develop management techniques to breed and release endangered Hawaiian birds to aid recovery of wild populations.
- Continue developing partnership restoration programs for endangered Hawaiian Island avifauna.
- Continue to acquire private funding for environmental education and programmatic activities.

2.2 Major Concerns and Program Needs:

The ZSSD/TPF - Hawaiian Endangered Bird Conservation Program is a conservation partnership with government agencies and private land-owners responsible for the environment in the Pacific Islands. In order for restoration strategies to aid the recovery of endangered species, programs designed to understand, restore and preserve native habitat require funding and implementation. Many of the limiting factors causing the decline of wild populations of bird species in the Hawaiian Islands remain unchecked. Until those limiting factors can be substantially reduced or somehow mitigated, it will not be possible to establish viable wild populations using captive propagation/reintroduction as a recovery strategy. 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. Recovery programs which utilize captive propagation/reintroduction without habitat management programs to mitigate the limiting factors in the wild cannot realistically succeed. Successful avian restoration programs require landscape level programs focused on ecosystem health and protection, as a prerequisite to reintroduction.

The Hawaiian Endangered Bird Conservation Program was established to provide birds for reintroduction to the wild for recovery of endangered species. Currently, captive-bred endangered birds, surplus to the breeding stock, are being held in captivity because acceptable habitat is unavailable for reintroduction. Unless managed habitat becomes available for reintroduction, the program will not have enough enclosure space to house all the birds produced via captive-breeding. Restoration programs cannot proceed. **Our primary programmatic concern is our inability to reintroduce birds propagated in captivity back**

to the wild - due to lack of acceptable habitat/release sites. We are currently holding birds that we are unable to release and lack sufficient enclosure space to hold the additional birds we expect will hatch next year. Given these limitations we will be changing the focus of the captive-breeding program in 2001 to parent-rearing instead of artificially incubating and hand-rearing the majority of eggs. This will decrease the potential reproductive output of the program, because we will not be inducing multiple clutches by removing eggs. We also expect hatchability and survivability under parent-rearing conditions in captivity to be lower than artificial incubation and hand-rearing. Our facility's enclosure constraints leave us no other alternative until managed habitat becomes available and birds produced in captivity can be released in a timely fashion.

Six Key Elements required for Restoration Programs involving Captive Propagation to Succeed:

- (1) **Information about the birds in the wild** - natural history research and monitoring
- (2) **Information about limiting factors and ongoing programs to reverse the trend** - habitat research and management
- (3) **Captive propagation technology** - the ability to successfully collect, maintain, artificially incubate eggs, hand-rear chicks and breed the species in captivity (if necessary)
- (4) **Release technology** - the ability to successfully release birds that survive and reproduce in the wild
- (5) **Practical considerations** - captive facilities, labor, the ability to locate eggs in the wild, long-term financial support, public/private landowner partnerships
- (6) **Acceptable release sites** - protected, accessible, suitable habitat

3. HAWAIIAN ENDANGERED BIRD CONSERVATION PROGRAM HISTORY - ACTIVITIES AND MILESTONES:

1993

- In collaboration with the Service, DOFAW, McCandless Ranch, KSBE, 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 KSBE 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 KSBE, 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 observation 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 Waawa`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 capitol 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 Hawai`i `Akepa. The `Akepa is the smallest passerine to ever be 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 capitol 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 's release program.
- Fourteen captive-reared Puaiohi were released in the Alakai Swamp, Kauai. 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 = eight).
- Continuation of Environmental Education Program: 1600 students participated in TPF programs in 1999. Publication of Treasures of the Rainforest - an introduction to the endangered forest birds of Hawai`i.
- 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

- First captive-breeding of the Palila. Two pairs produced eleven chicks; ten hand-reared and one parent-reared.
- First captive-breeding of the Hawai`i Creeper; one chick.
- First captive breeding of the Maui Parrotbill; two chicks.
- First captive-breeding for the Hawaiian Endangered Bird Conservation Program of the Common `Amakihi; one parent-reared chick.
- Hatched and reared 49 Nene; 34 birds for the DOFAW release program, additional birds retained to maintain the genetic/demographic integrity of the captive flock
- Hatched and reared fifteen Puaiohi for release on Kauai (in 2001) and to maintain the genetic/demographic integrity of the captive flock.
- Collected, hatched and reared six wild Hawai`i `Akepa.
- Collected, hatched and reared two wild Hawai`i Creeper.
- Collected, hatched and reared four wild `I`iwi.
- Collected, hatched and reared three wild Palila.
- Released five Puaiohi on Kauai with 100% survivorship for 30 days (release independence).
- Completed Phase III construction at KBCC and occupied second Forest Bird Barn.
- Established Dr. Patrick Morris (ZSSD) as Veterinary Coordinator for the Hawaiian Endangered Bird Conservation Program.

- Hosted over 1,8000 students, conservationists, professionals and interested community members at KBCC and MBCC.
- Seven Nene established as a free-ranging (clipped) semi-captive flock on fenced, predator-controlled KBCC grounds.
- Completed an education display mural at KBCC funded by private donations.
- Contractual transition from The Peregrine Fund to the Center for Reproduction of Endangered Species, Zoological Society of San Diego.

4. FACILITIES AND LAND MANAGEMENT

ZSSD/TPF Goals: 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 our current budgetary environment.

Justification: Hawaiian Endangered Bird Conservation Programs are designed to contribute to recovery efforts 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.

4.1 Keauhou Bird Conservation Center (KBCC)

ZSSD/TPF Results: Phase III construction was completed during this past fiscal year. Additional improvements include:

- **Forest Bird Building #2 (FBB#2):** This building, following the successful design of Forest Bird Building #1 (FBB#1), contains 18 aviaries for forest birds, each measuring 10' x 20' x 12-14' high. Each aviary has a cement basin and drain for discarded food, natural cinder substrate, native plantings, nesting areas, misting system (automatic), ventilation system, and a mosquito netting cover. The 18 aviaries are divided into six batteries of three aviaries each, connected by common hatches and divided from other batteries by a solid wall. Coaxial cable to each aviary allows video monitoring of nesting pairs. This building also contains a full food preparation kitchen that has the capacity to service all of the breeding stock in KBCC. This kitchen allows for the separation of food preparation activities between adult breeding birds and the neonatal chicks, whose food is prepared in the kitchen in the Brooder-Office Building. FBB#2 also has an office/video monitoring room, and a full bathroom with independent entrance. In the event of a quarantine situation, this bathroom with shower can serve as a "cleanup" area. Total forest bird aviaries = 37.
- **Four `Alala Aviaries:** These four aviaries follow the successful design of the previous six

`Alala aviaries. Each aviary measures 20'x40'x18' high, with a service vestibule that measures 10'x20'x18' high. The unique feature of these four aviaries is the dividing wall down the center of each aviary (lengthwise) that allows for the physical separation of birds. The ability to isolate birds in this fashion is extremely valuable when introducing prospective reproductive pairs, and socializing young birds. Total `Alala Aviaries = ten.

- **Five `Alala Aviaries:** Modification of five existing `Alala aviaries; construction of a dividing wall down the center of each aviary. (lengthwise) that allows for the physical separation of birds (see previous description of "divider").
- **Additional Nene Pens:** Several Nene pens were constructed to accommodate up to seven reproductive pairs as well as a release pen that will condition and acclimate birds prior to being released to the State or for "soft release" on to the 155 fenced and predator-controlled acres of KBCC. Total Nene pens = eight.
- **FBB Water Tanks:** Twin 2,500 gallon water tanks were installed to catch water from FBB#2 and deliver it to the 35,000 raw water tank located at the Brooder-Office Building. This will greatly enhance our water collection capability, bringing the roof of FBB#2 on line, as well as increase our water storage capacity with the addition of 5,000 gallons.
- **`Alala Water Tanks:** Five additional 65 gallon tanks were installed at five of the `Alala Aviaries to expand the storage capacity of these aviaries. This will allow for more frequent and longer misting bouts for the `Alala. All ten `Alala Aviaries now have a minimum of 130 gallons of stored water.
- **`Alala Aviary Expansion:** One Alala aviary was expanded by 1,200 square feet to accommodate a larger flock of `Alala for socialization of unpaired adults or for flocks of juveniles.
- **New Remote Aviaries:** Two remote aviaries were constructed to house pre-release forest birds. These two aviaries will be used for Puaiohi, Palila, etc. to maintain flocks of birds between the ages of weaning and release. These will allow a greater flight distance for muscle development as well as opportunities to develop flocking and social behaviors.
- **Video:** Video cable was installed in all 18 of the new aviaries in FBB#2 and in the four new `Alala aviaries.
- **Educational Display:** A 22' mural was painted on the interior wall of the foyer (education area) of the Brooder-Office Building. This is an educational element depicting a Hawaiian Rainforest with its endemic features as well as its limiting factors (predators, mosquitoes, invasive plants, etc). This display was funded by private donations.

- **Rock Wall:** A lava rock wall was built in front of the Brooder-Office Building. This will serve as an education "show and tell" area for visiting classrooms. The rock wall construction was funded by private donations.
- **Significant Events:** A 1,000 acre wildfire in the summer of 2000 came within .25 miles of the KBCC. Fortunately, the prevailing trade winds pushed the front towards the southwest and away from the facility. However, this potentially destructive natural event provided a test of the fire response protocols of the KBCC. Fire hoses were laid out. Back up power and fire pumps were at the ready, and the local fire companies (KMC, Kau and Puna Districts of the HFD) responded in a timely fashion. The water catchment ponds on the KBCC site were used as helicopter "dip" points for the aerial teams fighting the fire. Unfortunately, as a result of the helicopter disturbance, Puanani's clutch was pulled earlier than planned because the helicopters were flying over her aviary (causing severe nest disruption).

4.2 Maui Bird Conservation Center (MBCC)

ZSSD/TPF Results: No new construction at the MBCC. Rehabilitation and renovation of the existing structures is the focus at this facility.

- **Old Nene Building:** The twelve Nene enclosures in the Nene Building have been vacant for the past three years. They are now being converted to Forest Bird aviaries to accommodate birds produced by the program, either as eggs collected from the wild or from chicks hatched and reared at the KBCC. Each aviary is getting a new coat of paint where necessary, new mosquito netting, new plantings, and a "pass through" hatch to shift birds from one aviary to the other.
- **Forest Bird Aviaries:** Interior Forest Bird Aviaries are being cleaned out, replanted and reperched in anticipation of working with a more extensive inventory of forest birds.
- **'Alala Enclosures:** Rotting wood was removed and replaced with plastic lumber. Replaced were trusses, structural beams and load-bearing vertical supports. Rotting plywood was replaced. Rotting perches were replaced.
- **Main Buildings:** Maintenance as necessary to include roof patching, painting, plumbing repair and replacement, back-up generator rehabilitation, landscaping, etc.

Major Concerns and Needs: Recovery goals need to be defined to predict the breeding program's facility requirements for the future. Currently, the number of breeding enclosures for forest birds is a limiting factor for many of the restoration program strategies being proposed by biologists and agencies in Hawai'i. The facilities are filled to capacity. Options

include multi-species housing for compatible species and refurbishment of facilities in MBCC to expand the forest bird inventory in that facility. Multi-species housing of compatible bird species is a technique routinely used for breeding birds in zoos (worldwide).

Due to the El Nino weather conditions and subsequent drought in Volcano, the water storage and collection capacity at KBCC may still require further modifications to be increased to handle the water requirements for the facility.

All the potential breeding pairs of `Alala in captivity are not reproductively active. This may be due to: a) weather conditions b) behavioral abnormalities c) mate incompatibility or a combination of these factors. In order to provide an opportunity for young birds to learn appropriate "flocking behaviors" (behavioral socialization) and choose potential mates, aviaries needs to be constructed at KBCC that can house a social group of birds in a naturalistic enclosure. Additionally, the `Alala enclosures at MBCC are rapidly deteriorating. We are keeping them together with an ongoing repair program (and a lick and a prayer). The Hawaiian Endangered Bird Conservation Program would be more cost-effective if the programs at MBCC and KBCC were consolidated. If this is not possible, then the `Alala enclosures at MBCC should be re-built within three years - five years.

Service/DOFAW Responsibilities: Acquire funding for additional facilities.

5. 1999/2000 RESTORATION/CAPTIVE BREEDING PROGRAMS

5.1 NENE

ZSSD/TPF Goals: Continue captive-breeding Nene at MBCC and KBCC to produce a minimum of 20 goslings for DOFAW's Nene release program. Establish a captive (clipped) free-ranging flock on fenced, predator-controlled KBCC grounds. Collect wild eggs to improve the genetic diversity/demographic stability of the captive flock.

Justification: The wild Nene population occupies only a portion of its former distribution and is self-sustaining or increasing only in a portion of those occupied areas. Populations are increasing only in selected areas under intensive management or where predators do not occur. Recovery will require habitat management to control predators and the release of captive reared birds. Releases will be used to establish new populations or to increase Nene numbers in areas with good habitat and reduced Nene numbers.

ZSSD/TPF Results: In 1999/2000 eighty-nine eggs (44 viable) were laid in captivity by 13 fertile pairs and 18 eggs (15 viable) were collected from the wild. Forty-nine eggs hatched, 48 chicks survived (30 days) (Table 1). Thirty-four chicks were provided to the DOFAW reintroduction program. Additional birds were retained in captivity to improve the

genetic/demographic stability of the captive flock or are currently awaiting release.

The current inventory of Nene at KBCC and MBCC is 23.30 (Appendix I). In 1999/2000, new pairings of young Nene were established at both facilities to increase the long-term reproductive output of the population. The historical pedigree records from DOFAW (ARKS) have been compiled by K. Reininger (Nene studbook keeper) into SPARKS format to provide a historical studbook for future analysis (Reininger, pers. comm.). This analysis will be available in our annual reports when this information becomes available to us. The current genetic analysis is provided in Appendix I. Because the genetic diversity and demographic stability of the captive flock has improved and the production of chicks is exceeding the habitat available for release (Nene destined for release on Molokai in 2000 are still in holding as of the date of this report) the focus of the captive-breeding program for 2000/2001 will be parent-rearing only. We expect decreased hatchability and survivability of chicks under parent-rearing conditions (vs. artificial rearing).

Seven wing-clipped Nene are currently being managed in a 155 acre fenced enclosure, monitored and provided supplemental food and water on a daily basis. All Nene at KBCC are protected from predators: rats and mongoose - 147 bait station grid, cats - trapline, dogs - 5,000 ft. pig and cattle fence. The Nene will continue to be clipped following each molt and kept under observation for pair formation, reproductive behavior, nestling, laying and hatching of young. Juvenile Nene will be collected prior to their first flight and made available to DOFAW's reintroduction program or maintained for captive-breeding (dependant upon genetic/demographic needs of captive flock). Veterinary/Pathology information for captive Nene is provided in Tables 4 and 5.

Major Concerns and Needs: Over 2,000 captive-reared Nene have been reintroduced throughout Hawai'i, but many released populations were not self-sustaining because habitat management programs had not been implemented to decrease the limiting factors (Black et., 1997). The wild population on Kaua'i is growing, due to the abundance of grasses and absence of mongoose. Captive propagation of Nene is costly and labor-intensive. Increased recovery efforts should be directed towards protection of wild populations in managed habitat and establishment of new populations where needed. This will require continued captive-breeding and releases over the near term but this component of recovery management should be reduced at the earliest opportunity once stable populations have been established in managed habitat on all islands.

We are currently holding surplus Nene at MBCC that cannot be released because of unresolved safe harbor issues between DOFAW and private land-owners on Molokai. Our facilities at MBCC are not designed for long-term holding and the physical well-being of the Nene is being jeopardized.

Service/DOFAW Responsibilities: Define recovery and management goals and draft a Nene Restoration Plan including plans for future Nene release and relocation sites. Develop Safe

Harbor Agreements for reintroduction of Nene onto private lands and continue habitat management programs (predator control) in Nene habitat to enable birds to successfully reproduce in the wild and become reestablished into unoccupied areas. Develop management and release plans within the Nene Recovery Action Group and coordinate with the captive-breeding program to provide adequate time to produce desired number of goslings for release.

5.2 PUAIOHI

ZSSD/TPF Goals: Continue the restoration program for the endangered Puaiohi by breeding this species in captivity and reintroducing birds to establish a second population in the Alaka`i Swamp, Kaua`i.

Justification: The Puaiohi is endangered on Kaua`i (population ~ 200-300) and the establishment of additional disjunct populations has been recommended for recovery. Approximately 75% of the wild Puaiohi population occurs in a 5 km² area. As long as the population remains small and restricted to a limited area, environmental and demographic factors place this species at risk (B. Woodworth and T. Snetsinger, pers. comm.).

The Puaiohi restoration program is a continuing Kaua`i Partnership recovery effort. Captive propagation/release should continue until population monitoring studies establish that the species can be de-listed; or until more cost-effective habitat management strategies have been demonstrated to sufficiently protect (and recover) the species in the wild. Because Puaiohi breed successfully in captivity; "captive-breeding and release" is more cost-effective than a "rear and release" program for this species.

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). A long-term "field presence" focused on Puaiohi will also benefit many endangered species in this area by providing long-term monitoring research and management for this unique ecosystem.

ZSSD/TPF Results: In 1999/2000 62 eggs (18 viable) were laid in captivity by seven fertile pairs. Seventeen eggs hatched, 15 chicks survived (30 days) (Table 1). Additional birds were retained in captivity to improve the genetic/demographic stability of the captive flock. The low viability of captive-laid eggs was due to infertility caused by the high density of birds at KBCC and subsequent intra-specific aggression in the captive flock. Enclosures at MBCC are currently being renovated to provide additional housing to decrease the population size at KBCC. Five chicks were successfully released in the Alaka`i Swamp, Feb. 1, 2000 (Table 2). Long-term population monitoring and habitat management is the responsibility of the Service, DOFAW and BRD.

The current inventory of Puaiohi at KBCC and MBCC is 13.17.1. Genetic analysis is provided in Appendix II. In 1999/2000, new pairings of young Puaiohi were established at

KBCC to increase the long-term reproductive output of the population. Veterinary/Pathology information for captive Puaiohi is provided in Tables 4 and 5.

Major Concerns and Needs: Ongoing monitoring of endangered wild populations is essential. The listing and recovery goals, and "monitoring criteria" for these small isolated populations need to be defined and funded. Additionally, rats have been documented to cause mortality in Puaiohi (E. Tweed and T. Snetsinger, pers. comm.). An ongoing predator control program will be necessary to recover this species.

Service/DOFAW Responsibilities: Define recovery and management goals and draft a Puaiohi Restoration Plan including plans for future release and relocation sites. Continue habitat management efforts to control predators at release sites. Monitor the released population after the first month of release (i.e. long-term population trends).

5.3 `AKOHEKOHE

ZSSD/TPF Goals: Continue to develop captive propagation techniques. Determine requirements for breeding in captivity.

Justification: Historically, `Akohekohe were found in the wet forest of Molokai and West Maui. Currently, only one population remains on the windward side of Haleakala between 4500-7200' elevation.

ZSSD/TPF Results: In 1997, the first wild `Akohekohe eggs were hatched and hand-reared, in cooperation with BRD and DOFAW in Maui. These birds are being maintained in captivity to develop the technology for captive propagation for future release into managed habitat. These birds are extremely territorial nectivores requiring single-cage housing in captivity. There was no sustained reproductive activity observed in captive `Akohekohe during the 2000 breeding season. Due to the limited number of individuals currently housed in captivity and the behavioral problems involved with breeding these birds (mate incompatibility) a successful captive-breeding program is unlikely. The current inventory is 2.1 (Appendix III).

Major Concerns and Needs: It is unclear if habitat for a second population of `Akohekohe is currently available or suitable. Prior to the initiation of a translocation or restoration program a second population site needs to be selected, evaluated, and prepared for translocation or releases. This would include trial translocations of surrogates, needed habitat management, and coordination with adjacent landowners and notification to public. The goal should be to develop a systematic process to select/create a site that fulfills the year-round habitat requirements for `Akohekohe (adequate food resources, nesting, roosting, disease-free, predator controlled etc.). This will help ensure that birds remain in managed habitat.

After a second release site is chosen and pre-release "site preparation criteria" are met; a pilot translocation program with 'I'iwi should be undertaken by DOFAW to develop techniques. If this is successful, a restoration program involving translocation of 'Akohekohe should be implemented by DOFAW. Although 'Akohekohe nests are accessible and a "rear and release" program may be feasible, a recovery strategy involving translocation of wild birds should be the first recovery priority. Survival of wild, translocated birds may be greater than reintroducing captive-reared birds and this strategy is less costly.

The initial experience with 'Akohekohe indicates that these are very aggressive birds and may be difficult to breed in captivity and successfully release. A "rear and release" program for endangered 'Akohekohe should only be considered if translocation fails.

Service/DOFAW responsibilities: Define recovery and management goals and draft Recovery Plan section for 'Akohekohe. Conduct an experimental translocation of 'I'iwi or other appropriate surrogate and evaluate results. Continue habitat restoration and management programs to mitigate limiting factors and assess the impact of management programs on limiting factors.

5.4 MAUI PARROTBILL

ZSSD/TPF Goals: If found, collect wild eggs from Maui Parrotbill to develop captive propagation techniques and establish long-term captive husbandry and breeding requirements.

Justification: This endangered honeycreeper has a low reproductive rate (one egg clutch) and is restricted to one small patch of forest in East Maui. Immediate management of this species is a recovery priority.

ZSSD/TPF Results: One nest was located in 1997, the egg was collected and the chick hatched in captivity. This bird was confirmed as a male. DOFAW staff was unable to locate wild nests in 1998. In 1999, two eggs were collected from two different wild nests. Both eggs hatched and chicks were subsequently hand-reared and sexed as females.

In 2000, we report the first successful captive-breeding of Maui Parrotbill at KBCC. Three eggs were laid; one egg was found broken on the ground and two eggs were collected for artificial incubation and hand-rearing. Two chicks hatched and currently survive (Table 1). The captive collection inventory is 1.3.1 and the genetic analysis is provided in Appendix IV.

Major Concerns and Needs: Limiting factors for the Maui Parrotbill may be disease, habitat degradation, 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. Before an additional population can be established, potential habitat needs to be identified,

evaluated, restored and managed. Accessible nests are difficult (but not impossible) to locate

Service/DOFAW Responsibilities: Define recovery and management goals and draft a Recovery Plan section for Maui Parrotbill. Continue the habitat management efforts in Hanawi NAR and East Maui watershed areas and assess the impact of management programs on limiting factors. Conduct nest searches to locate and collect eggs for addition to the captive propagation program

5.5 HAWAI`I CREEPER, HAWAI`I `AKEPA and `AKIAPOLA`AU,

ZSSD/TPF Goals: If found, collect wild eggs from `Akiapola`au, Hawai`i Creeper and Hawai`i `Akepa to develop captive propagation techniques for restoration programs, when habitat becomes available.

Justification: The wild `Akiapola`au population is fragmented and declining. The Hawai`i forest bird surveys found four disjunct populations of `Aki totaling 1500 ± 400 . Fancy et al. analyzed more recent surveys and estimated a total population of 1163 in three disjunct populations. The species' distribution has been greatly reduced in the Ka`u district, where the estimated population has declined from 533 to 44 birds, and the relic population in mamane forest has only 2-10 birds and is functionally extinct (Fancy, unpubl. data; pers. comm.). `Aki would benefit from a captive propagation/release program given the current distribution and low reproductive rate (S. Fancy, J. Jeffrey, T. Pratt; pers. comm.).

Hawai`i `Akepa and Hawai`i Creeper populations are also fragmented and dispersal between Creeper populations (ability to recolonize former habitat) may be limited by high philopatry (Pratt, 1999; VanderWerf, 1998).

Potential habitat for reintroduction of endangered Hawaiian forest birds will become available as programs focused on habitat evaluation and management activities on the Big Island mature (e.g. Saddle Road kipukas, Power Line Road, Mauna Loa Strip Road, upper Keauhou Ranch etc.).

ZSSD/TPF Results: Hawai`i Creeper - In 1999, one pair of Hawai`i Creepers built a nest in captivity and two eggs were laid. Both eggs were infertile; possibly due to the young age of the birds (< one year of age) and/or disruptive behavior from other Creepers housed in the aviary. However, this display of reproductive activity was encouraging. The completed construction of the second Forest Bird Barn provided additional aviary space and the Hawai`i Creepers pairs were separated during the year 2000 breeding season. In 2000, we report the first successful captive-breeding of endangered Hawai`i Creepers at KBCC. Four eggs were laid in captivity; two were broken by the female, one was infertile and one egg was fertile and viable. This egg hatched and produced a surviving chick. Four wild eggs were collected; three

were viable and subsequently hatched, two chicks survived (total = 3) (Table 1). The captive inventory is 4.4 and the genetic analysis of the population is supplied in Appendix V.

Hawai'i 'Akepa - In 1998 the first wild Hawai'i 'Akepa egg was hatched, hand-reared and fledged; probably the smallest passerine (1.13 grams) ever artificially incubated and hand-reared from hatch. In 2000, 11 wild 'Akepa eggs were collected; eight eggs were viable, seven chicks hatched and six birds fledged (Table 1). The inventory is 4.5 (Appendix VI). Veterinary/Pathology information for Hawai'i Creepers and 'Akepa is summarized in Tables 4 and 5.

'Akiapola'au - Beginning on February 9, 2000 and ending on June 28, 2000 KBCC biologists spent 50 days searching for nests of 'I'iwi, Hawai'i 'Elepaio, Hawai'i Creeper, Hawai'i 'Akepa and 'Akiapola'au. Although a total of 34 nests of all these species were found; no 'Akiapola'au nests or eggs were located during the 2000 breeding season.

Major Concerns and Needs: '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 and over 400 hours nest-searching in 2000 - no nests were located. Of ~400 bird nests located in the Hakalau National Refuge by BRD, 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. However, "rear and release" may be a viable strategy for Hawai'i 'Akepa and Hawai'i Creepers because nests can be more easily located. Accessible, acceptable habitat for reintroduction must be available before full-scale restoration programs for any of these species can be initiated. We support a landscape-level conservation program focused on ecosystem health in selected areas on the Big Island for these three species ('Akiapola'au, Hawai'i Creeper and Hawai'i 'Akepa) in collaboration with community partners.

Service/DOFAW Responsibilities: Define recovery and management goals and draft Recovery Plan sections for these three species. Provide assistance with nest searching. Continue to expand habitat management and work with land-owners to prioritize sites for population re-establishment.

5.6 PALILA

ZSSD/TPF Goals: Continue development of captive propagation and release program. Conduct a pilot study to determine the role of disease as a limiting factor in Palila recovery. Assess the status of *Mycoplasma* disease in wild population and captive flock and determine its impact on releases or translocations of Palila. Release captive-reared birds into managed habitat on the North Slope of Mauna Kea or other area suitable for Palila when the habitat is evaluated to be "safe" from limiting factors.

Justification: The isolated Palila population on 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 have met with equivocal success. The majority of birds return to their site of origin after translocation (Fancy et al., 1997, Banko, pers. comm.). It is not clear whether this is due to poor quality habitat or site tenacity in this species.

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

The Pu`u Lehua lease (KSBE land) is an isolated site (Mauna Loa vs. Mauna Kea) within the historical distribution of this species (collection site of specimen "type") and may be a suitable alternative to Mauna Kea release sites. The Service is currently funding KSBE for habitat restoration as part of a land-owner partnership agreement (T. Casey; P. Simmons and C. Rowland, pers. comm.).

ZSSD/TPF Results: In 2000, we report the first successful breeding of this species in captivity (including one parent-reared chick). Twenty-seven captive eggs were laid by two producing pairs. Sixteen eggs were viable, 11 chicks hatched and were successfully hand-reared. The completed construction of the second Forest Bird Barn provided additional aviary space to allow breeding Palila pairs to be separated from each other during the year 2000 breeding season and decrease intra-specific disturbance. Additionally, because Palila are sensitive to environmental changes in their aviary, remote video-monitoring of accessible nest-sites was set up several months prior to the onset of breeding to enable breeding Palila to habituate to the presence of cameras prior to the breeding season. Video-monitoring enabled KBCC biologists to collect eggs prior to breakage by incubating females.

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 included egg-transmitted disease (*Mycoplasma*) from the wild population or infection during the hand-rearing process. A *Mycoplasma*-like organism was isolated from several captive and wild birds (Rideout, pers. comm.).

In order for recovery efforts using captive propagation techniques to proceed for this species, it was necessary to determine whether disease is a limiting factor to the successful hand-rearing of chicks in captivity. A pilot study to clarify the role of *Mycoplasma* and/or other pathogenic agents (s), was conducted by collecting four wild eggs for artificial incubation and hand-rearing in an isolated facility. Three chicks hatched and survived. Based on the results of this study (pending); recommendations will be provided to the Service and DOFAW.

Veterinary/Pathology information for Palila is summarized in Tables 4 and 5. The total captive collection inventory is 7.13.2 and the genetic analysis is provided in Appendix VII.

Major Concerns and Needs: Managed habitat on the North Slope of Mauna Kea or any other area suitable for Palila is not available for release. Palila are currently being held in captivity until "safe" habitat is available and a risk assessment regarding the role of disease in Palila recovery can be evaluated. There is insufficient enclosure space at KBCC for Palila when the birds breed again next year.

Service/DOFAW Responsibilities: Define recovery and management goals and draft a Recovery Plan section for Palila. Continue habitat management efforts on Mauna Kea and Army managed lands at Pohakaloa. Assess the impact of management programs on limiting factors and collaborate with BRD to recover Palila on north slope of Mauna Kea. Investigate potential for future safe harbor agreements with interested landowners (e.g. Pu`u Lehua lease - KSBE land).

5.7 `I`IWI, HAWAI`I `ELEPAIO AND COMMON `AMAKIHI

ZSSD/TPF Goals: Whenever possible (funding and space permitting), captive propagation and release techniques are developed and tested with closely related surrogate species prior to working with endangered species. Additionally, non-endangered Hawaiian endemic forest bird species are used in educational exhibits.

Justification: The `I`iwi, Hawai`i `Elepaio, and `Amakihi are surrogate species for endangered Hawaiian forest birds. For example the techniques developed for the Hawai`i `Elepaio will be useful for restoration of the `Oahu `Elepaio (*Chasiempis sandwichensis gayi*). Once very common, the `Oahu `Elepaio has disappeared from 90% of its historic range and only 200 - 500 `O`ahu `Elepaio remain.. Additionally the `I`iwi is a surrogate species for the `Akohekohe (see justification for `Akohekohe - 5.3).

ZSSD/TPF Results: `I`iwi - Due to their nectivorous, pugnacious nature `I`iwi and `Akohekohe are difficult species to work with in captivity. Their dietary requirements are stringent and housing birds to minimize their aggressive tendencies is challenging. In 2000 we collected ten wild `I`iwi eggs to continue working on developing satisfactory hand-rearing techniques for these obligate nectivores. All ten eggs were viable, nine chicks hatched but only four birds were successfully raised. Balancing the brooder humidity requirements and water, protein and carbohydrate components of the diet was problematic during 2000 and our hand-rearing mortality was due to renal gout and pneumonia. However, we modified the hand-rearing protocol and now have a satisfactory hand-rearing regime developed for this species (Table 1). The current captive inventory is 2.1 (Appendix VIII).

Veterinary/Pathology information is summarized in Tables 4 and 5.

`Amakihi – In 2000, we report the first successful parent-rearing of `Amakihi in our facilities. Four eggs were laid, two were broken by the parents, one was infertile and one chick hatched and was parent-reared. The current inventory is 0.2.1 (Appendix IX). These birds have been offered to the Honolulu Zoo for educational exhibitory purposes.

Hawai`i `Elepaio – In 2000, four wild `Elepaio eggs were collected. Three eggs were not viable at the time of collection. One egg was fertile, but the embryo died at pip. The captive inventory is 4.1 (Appendix X). These birds will form the nucleus of a captive-breeding flock to produce birds for reintroduction as a surrogate species to develop propagation and release techniques for the `Oahu `Elepaio. Veterinary/Pathology information is summarized in Tables 4 and 5.

5.8 ON THE BRINK SPECIES

ZSSD/TPF Goals: 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/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.

ZSSD/TPF Results: The Nukupu`u, Kama`o and Po`ouli are considered to be so rare that it is presently difficult to build a program around the remote possibility that nests may still be found

Based on our work over the last seven years developing artificial incubation and hand-rearing techniques for twelve 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. 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. However, there is insufficient data available to determine whether or not this recovery strategy would be successful. If and when nests are located, we are prepared to collect first clutch eggs and initiate a propagation program. No nests were located during the 2000 breeding season for any of these species

Concerns and Needs: It is unknown whether “rescuing” eggs/birds would actually provide

enough founders for genetic and demographic stability of the species; or, if enough 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.

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 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 DOFAW/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.

Service/DOFAW Responsibilities: Define recovery and management goals and draft Recovery Plan section for "on the brink species". Continue the statewide forest bird surveys.

5.9 `ALALA

ZSSD/TPF Goals: ` Manage the captive population to increase the production of chicks in captivity to provide birds for release.

Justification: The species is at the brink of extinction in the wild. The current wild population is two or three birds; the captive population is composed of 27 birds (21 potentially reproductive).

ZSSD/TPF Results: In 2000, eight pairs were set up for breeding and all eight pairs built nests and copulated, except for Kinohi/Niele (Figure 1). Four breeding pairs of `Alala produced 17 eggs and three chicks hatched and were successfully hand-reared (Table 3). The current inventory is 14.13 and the genetic analysis of the population is summarized in Appendix XI. Modifications to `Alala aviaries are described in Section 4.1. New pairings have been identified and mate selection is currently ongoing. All breeding pairs are

selected based on behavioral compatibility, sex, age and pedigree analysis.

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. We cannot produce enough birds in captivity to overwhelm the limiting factors and offset losses without adequate habitat management prior to release. Pre-release "site preparation criteria" need to be established, and habitat management implemented prior to reintroduction of birds.

Service/DOFAW Responsibilities: Define recovery and management goals and complete the draft Recovery Plan for this species. Obtain access to the Kona Unit of the Hakalau Refuge and continue ongoing habitat management efforts in current Alala release sites in Kona, Kona NWR and Pu`u Wa`awa`a Forest Bird Sanctuaries. Evaluate and select potential additional release sites (finalize the EA). Increase the involvement of stakeholders in the negotiations necessary for designing successful land management programs (safe harbor, partnership agreements etc.). Inform the general public regarding proposed conservation activities through policy documents, conservation education programs, public relation activities, etc. Evaluate selected release site and establish pre-release "site preparation criteria" to prepare for future reintroductions: Manage the `Io and monitor the wild `Io population to determine if `Io can be down-listed. Continue the monitoring of wild `Alala. Obtain the funding to increase the number of breeding enclosures at KBCC and renovate enclosures at MBCC. Increase the operating budget to accommodate the increase in facilities. Approve the reintroduction of a captive-bred mate for any unpaired potentially reproductive bird in the wild.

6. CAPTIVE COLLECTION INVENTORY (9/20/00)

<u>Species</u>	<u>Status</u>
Nene (<i>Branta sandvicensis</i>)	23.30
Palila (<i>Loxioides bailleui</i>)	7.13.2
Puaiohi (<i>Myadestes palmeri</i>)	13.17.1
Hawai`i Creeper (<i>Oreomystis mana</i>)	4.4
Maui Parrotbill (<i>Pseudonestor xanthophrys</i>)	1.3.1
`Akohekohe (<i>Palmeria dolei</i>)	2.1
`Alala (<i>Corvus hawaiiensis</i>)	14.13
`Akepa (<i>Loxops coccineus</i>)	4.5
Hawai`i `Elepaio (<i>Chasiempis s. sandwichensis</i>)	4.1
`I`iwi (<i>Vestiaria coccinea</i>)	2.1
Common `Amakihi (<i>Hemignathus virens wilsoni</i>)	0.2.1

Key: male.female.unknown

7. ENVIRONMENTAL EDUCATION PROGRAM

During the 1997 - 1999 school years, over 3,000 students, teachers and visitors were hosted at the KBCC. Encouraged by the very positive response from the teachers, students and parents, this program was continued for a third year during the year 2000 school year, with an additional 1,500 students, teachers and visitors touring the KBCC. The primary focus was providing this environmental education opportunity to the sixth grade classes of the State of Hawai'i's Department of Education and the conservation education program held at Keakealani Outdoor Education Center. Additional tours were given to students from several other elementary schools including the University of the Pacific, UH Manoa, and KSBE-Honolulu. Students spend two-three hours at KBCC where they are given video presentations, lectures, slides, and "hands-on" opportunities to experience some of the conservation work undertaken by TPF/ZSSD. Activities include cage building, planting native vegetation, insect collecting, bird watching, bird behavioral observations, and in general - how to "do" biology. A "mock" biology lab and a display aviary were built for the environmental education program (donated by the contractor for KBCC construction). Additionally this year an educational display mural was painted at KBCC (funded by private donations).

Initiated last year and continuing into this year was the additional educational opportunity in the form of "outreach" to the local schools, clubs, societies and special interest groups. For many of the interested school and community groups who do not have the resources to organize a field trip to the KBCC, we made "traveling" presentations, which included slides, posters, photos and live animals. These mobile presentations have been very well received. We estimate that our presentations in the last two reached over 3,000 people, in addition to the school children mentioned above. Venues have been scouts, conservation groups, bird hobbyists, Earth Day at the UH Hilo, civic groups and ecotouristic groups.

In 1999, TPF published an environmental education book for Junior High School age students entitled Treasures of the Rainforest, funded by private donations. This introduction to the avifauna of the Hawaiian Islands has been available to teachers/classes that visit KBCC (at no cost) during the academic year. Public sales of this book have been good and will be used to support future reprinting of this publications.

8. VETERINARY PATHOLOGY REPORT

Clinical veterinary consultations for the Keauhou Bird Conservation Center and the Maui Bird Conservation Center are presented in Table 4. Pathology results are presented in Table 5. All captive Hawaiian forest birds are necropsied by Dr. Bruce Rideout (Director of Pathology, Zoological Society of San Diego) or Dr. Thierry Work (BRD) and final necropsy findings are circulated to the appropriate agencies. Clinical care and pre-release screening is

conducted by our Veterinary Consortium coordinated by Dr. Pat Morris (Associate Veterinarian, Zoological Society of San Diego). Additional members include: Dr. Sterret Grune (Big Island Veterinary Care), Dr. Pat Morris Dr. Don Janssen (Director of Veterinary Services, Zoological Society of San Diego) or Dr. Greg Massey (DOFAW). All clinical care provided by Drs. Janssen, Morris and Grune and pathology support by Dr. Bruce Rideout are donations to the program. Additional information regarding veterinary/pathology activities for the Hawaiian Endangered Bird Conservation Program is available by contacting Dr. Pat Morris (Veterinary Consortium Coordinator).

9. SUMMARY

During the past seven years, The Peregrine Fund/Zoological Society of San Diego's - Hawaiian Endangered Bird Conservation Program has developed many of the artificial incubation and hand-rearing techniques required to propagate endangered Hawaiian forest birds. Twelve endemic Hawaiian passerine species have been hatched and reared in captivity and five of these species (all endangered) have now bred in captivity; `Alala, Hawai`i Creeper, Palila, Maui Parrotbill, and Puaiohi. The Keauhou Bird Conservation Center was built in Volcano, Hawai`i. Additionally, an environmental education program is being funding through public support.

In 1998, the first hand-reared birds that were reintroduced, bred in the wild (`Oma`o). And, in 1999 and 2000 a total of nineteen endangered Puaiohi were released in the Alaka`i Swamp, Kaua`i. All the release birds survived 30 days and at least eight Puaiohi chicks have successfully fledged in the wild. This is the first 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.

As the captive flocks of the endangered species grow, and the techniques for rearing and release are refined, it is hoped that many of the endangered Hawaiian birds will benefit from restoration efforts. However, captive propagation and reintroduction is only one aspect of the ecosystem management tools required in Hawai`i. Commensurate action will continue to be required on the part of land-owners (state, private and federal) to protect and enhance the native habitat.

Additional information regarding the Hawaiian Endangered Bird Conservation Program is available in our publications/presentation summary (1991-2000).

10. ACKNOWLEDGEMENTS

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Other Media:

One of the goals of the Hawai'i program this year was to explore and expand other avenues of media to include the internet. The following web sites now carry news and events of the Hawai'i Endangered Bird Conservation Program, soon to include such information as monthly reports, workplans, long-range plans and significant events.

The Peregrine Fund Website: www.peregrinefund.org

The Zoological Society of San Diego Website: www.Sandiegozoo.org

DOFAW Website: www.state.hi.us/dlnr/dofaw/

Fish and Wildlife Service, Hawai'i Website: www.r1.fws.gov/pacific/wnews/newsindex.html.

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Population Analysis (Glossary of terms and assumptions used in this report)

- MateRx Software 1999. (J. Ballou, J. Earnhardt, S. Thompson). MateRx is designed to be a genetic tool to guide population management decisions. MateRx integrates four genetic components into a single index; the Mate Suitability Index (MSI). MateRx does not address demographics, behavior or logistics for a pairing.

MSI Score Definitions:

- 1 = very beneficial
- 2 = moderately beneficial
- 3 = slightly beneficial
- 4 = slightly detrimental
- 5 = detrimental, should only be used if demographically necessary
- 6 = very detrimental, (should only be used if demographic considerations override)

preservation of genetic diversity per se)
- = so detrimental the pair should never be made

- Population Management 2000. (J. Ballou, R. Lacy and J.P. Pollak). The Population Management 2000 (PM2000) software package incorporates modeling tools for genetic and demographic analysis of pedigreed animal population (a studbook). PM2000 combines the tools available in GENES (written by Robert Lacy), DEMOG (written by Laurie Bingaman-Lackey and Jon Ballou) and CAPACITY (written by Jon Ballou).

There are many scenarios/strategies available for modeling in PM2000. Usually the wild-caught founders are not included in tallies of the genetic status (GD, GV and FGE) of the population. Instead, the measures show the genetic status of the descendant animals produced within the captive population. This is the assumption we followed in this report based on standard export files from each individual studbook. All breeding pairs are selected based on: 1) behavioral compatibility 2) past reproductive performance 3) age 4) sex and 5) genetic considerations (AZA - Small Population Management Group Guidelines).

- **Theoretical Founder Requirements for Captive Populations**

Gene Diversity	Number of Wild Founders
.50	1
.75	2
.90	5
.95	10
.98	25
.99	50

A standard goal often proposed by population biologists is the retention of 90% of the wild gene diversity in the captive population (representing the equivalent of about five wild-caught birds). The higher the level of gene diversity to be retained in captivity over a longer period, the more founders (wild-caught animals) and breeding enclosures required. Note: Small increases in gene diversity between .98 and .99 represent an increase of 25 wild-caught founders in captivity.

Founder is an individual at the top of a pedigree, assumed to be unrelated to all other founders. An individual is not yet a founder of the captive-hatched population until it has living descendants in the population.

Founder Genome Equivalents (fge) is the number of equally represented founders with no loss of alleles that would produce the same gene diversity as that observed in the living descendant population. Equivalently, the number of animals from the source population that contains

the same gene diversity as does the descendant population.

Founder Genomes Surviving is the sum of allelic retentions of the individual founders.

Gene diversity (GD) is the heterozygosity expected in a population if the population were in Hardy-Weinberg equilibrium. Gene diversity is calculated from allele frequencies, and is the heterozygosity expected in a progeny produced by random mating. It is important for the population as it defines in part the rate of genetic drift as well as the rate of genetic adaptation to a given selection pressure. Gene diversity can be viewed as the variation in the founder's representatives in the living descendant population. Gene diversity is lost when founder lines become over-represented relative to or at the expense of other founder lines.

Gene Value (GV) is the expected heterozygosity or gene diversity that would be expected in the next generation if all animals bred at random and produced a number of progeny for the next generation equal to their reproductive values.

Heterozygosity is a measure of the percent of loci that are polymorphic within an individual and is calculated as one minus an individual's inbreeding coefficient (F). Heterozygosity is important for the health and vitality of birds, by masking the effect of deleterious recessive alleles and maintaining hybrid vigor. Loss of heterozygosity occurs as a result of inbreeding, and reduces fertility, survivability, disease resistance, and reproduction in domestic and exotic captive populations.

Mean F is the probability that two alleles at a genetic locus are identical by descent from a common ancestor to both parents. The mean inbreeding coefficient of a population will be the proportional decrease in the observed heterozygosity relative to the expected heterozygosity of the founder population.

Mean kinship (MK) is the average relatedness of an animal to all animals in the living descendant population. Individuals with low mean kinships have genes that are on the average under-represented in the population and are therefore animals with high breeding priority. A drawback to using mean kinship is that full sibships have identical mean kinship values until they produce offspring. This means that full siblings would often be paired if only mean kinship was used to make pairings resulting in substantial loss of heterozygosity. Therefore, the inbreeding coefficient of potential offspring is evaluated secondarily when pairings are made.